Richard Fraenkel
Niamey 13.12.84

PASTORAL DEVELOPMENT
IN
CENTRAL NIGER

République du Niger
Ministère du Développement
Rural

Service de l'Elevage

United States Agency
for International
Development

(USAID)

PASTORAL DEVELOPMENT IN CENTRAL NIGER:

REPORT OF THE NIGER RANGE AND LIVESTOCK PROJECT

Edited by Jeremy Swift

Niamey, Niger

1984

Acknowledgements: Special thanks are due to Dr Ari Ibrahim, Minister of Rural Development, Dr Mazu, Director of the Livestock Service, Dr Rhissa, responsible for Pastoral Zone Development in the Livestock Service, and the Prefets, Sous-Prefets, and administrative and technical service officers of the Agadez, Tahoua and Maradi Departments, for their help with the Niger Range and Livestock Project.

During the 1980 82 period when research described in this report was carried out, the exchange rate varied between US $1 = 300-350 CFA francs.

Jeremy Swift is a Research Fellow at the Institute of Development Studies, University of Sussex, supported by the International Livestock Centre for Africa and the UK Overseas Development Administration.

PASTORAL DEVELOPMENT IN CENTRAL NIGER

Table of Contents

Chapter	Page
SUMMARY	i
1. INTRODUCTION	1
2. NATURAL RESOURCES	
1. Rainfall (M. Starr, J.J.Swift)	3
2. Landscape and geography (M. Starr)	13
3. Water (J. Knight, M. Starr)	21
3. ANIMAL PRODUCTION	
1. Animal numbers and distribution (M. Starr, J.J. Swift)	35
2. Animal production (T. Wilson, K. Wagenaar, S. Louis)	69
3. Animal disease (A. Sollod)	145
4. Grazing and animal-plant relationships (B. Wylie, R. Senock, L. Snyder, B. Roettgen, B. Porter)	163
5. Seasonal changes in nutritive values of rangelands (S. Louis, A. Dankintafo, B. Boukary, N. Goumeye)	214
4. PASTORAL PRODUCTION SYSTEMS	
1. People and production systems (J.J. Swift, M. Starr)	225
2. The WoDaaBe (A. Maliki, C. White, L. Loutan, J.J. Swift)	255
3. The Twareg (M. Winter)	531
4. Farmers and agropastoralists (J. Curry, M. Starr)	621
5. LIVESTOCK MARKETING (M. Makinen, E. Ariza-Nino)	671
6. INSTITUTIONAL FRAMEWORK: GOVERNMENT POLICIES AND SERVICES (M. Starr)	683
7. EXPERIMENTAL DEVELOPMENT INTERVENTIONS	
1. Pilot herder associations (J.J. Swift, A. Maliki)	703
2. Range management and animal production (B. Wylie, R. Senock, L. Snyder, B. Roettgen, B. Porter)	757
3. Veterinary auxiliaries (L. Loutan)	763
4. Human health (L. Loutan)	783
8. PASTORAL DEVELOPMENT STRATEGY OBJECTIVES (J.J. Swift)	807
REFERENCES	

SUMMARY

Chapter 1 introduces the report. The Niger Range and Livestock Project (NRL) was the result of concern arising from the drought of the early 1970s about the future of the pastoral economy and environment. An approach based on research and pilot interventions, leading to more sustained developed actions, was adopted. Raising the living standards of herders was adopted as the major goal.

Chapter 2 (pages 3 to 34) summarily describes the natural resources of the project area. It lies between the 350 and 100 mm isohyets; rainfall is highly variable from year to year, with standard deviations which vary from over 25 percent of the annual mean in the south of the zone, to over 40 percent in the north. Temporal distribution of rains during the rainy season is more important for vegetation production than total annual rainfall. Rainfall at the start and end of the season is especially risky. The record since 1900 suggests that wet and dry periods of variable length are common and that, following a wet 1950s, a dry period has been very widespread since the early 1960s; the possibility that local land-use practices in the Sahel have influenced climatic feedback mechanisms cannot be rejected. The future Sahelian climate is likely to be at least as variable, and perhaps more so, than recent decades.

Project area vegetation is typically Sahelian; density of plant cover generally decreases from south to north according to rainfall, soil fertility and type, and microtopography. Despite low rainfall, cultivation is increasing in the project area. The project surveyed and mapped water points in the area, including ponds, springs, boreholes, cement wells, traditional deep wells, shallow wells (which have to be redug each year), and artesian wells. Since 1970, there has been an increase in the number of high or moderate capacity permanent water points and they have extended into areas previously poorly endowed with water; there has been an increase in artesian

wells in the extreme north of the area as a result of geological exploration; south of the Tiggidit cliff there has been a significant increase in the number of traditional wells; there has been a decrease in the number of functionning boreholes, especially south and east of Agadez; there has been no growth in the number of permanent pastoral water points in the shallow well-dominated western quarter of the project zone. Project research suggests that, although the project area as a whole is reasonably well endowed with water, there are many places where a shortage of water in the dry season is a serious constraint on production and the use of available pasture.

Chapter 3 (pages 35 to 224) deals with animal production. Government statistics and three aerial surveys made by the project show that there are high livestock densitites in the south of the country, and low densities but high livestock per person ratios in the pastoral zone. However, Niger's livestock population has undergone significant changes in its distribution in the past 15 years. At the time of the drought of the early 1970s, in addition to substantial animal deaths, there was also a significant shift in ownership of animals, as impoverished herders sold animals to farmers and urban people in the south. As a result, the portion of the national herd in the pastoral zone, which was most severely struck by the drought, has reconstituted at a slower rate than elsewhere in the country, and is still much smaller than it was before the drought. In contrast, the portion of the national herd in the farming zone reconstituted much more rapidly as a result of these shifts. The evidence suggests that an increasingly large part of the pastoral zone herd belongs to absentee oweners, non-pastoralists who invest in livestock and hire herders to take care of them. There has thus been both a geographic redistribution of animals from north to south and also a redistribution of ownership within the pastoral zone herd itself.

The project's aerial survey estimated the area to contain between 289,000 and 377,000 cattle, between 780,000 and 1.1 million sheep and goats, and between 70,000 and 156,000 camels, depending on the season; the Livestock Service's own figures based on ground counts were found to be generally

accurate for dry season populations. The project mapped the dry and wet season distribution of all animal species in relation to environmental conditions.[1]

Research was conducted on animal production technical parameters in project area herds. Camel herds contained 59.6 percent females, and breeding females (those over 5 years) were 33.9 percent of the total herd. Camel births peak markedly in the rainy season. Age at first parturition was 4.96 years; mean calving interval 26.21 months; annual reproduction rate 40-45 percent; calf mortality 20.9 percent; marketed offtake 6-8 percent a year. Goat and sheep flock parameters were similar to those under pastoral management mainly for milk production in other arid regions. Donkey herds contained just over 70 percent of females, with breeding females making up 51.5 percent of the total herd; some males are sold; age at first parturition was estimated at 3.5 years; estimated foaling interval 27-30 months; and estimated annual reproduction rate 40-45 percent.

WoDaaBe cattle herds surveyed contained 73 percent females, with reproductive cows making up 40.5 percent of the herd. Larger herds contained fewer milking cows as a result of early weaning of calves and increased reproduction rate. The herds surveyed contained 12 percent of animals loaned between WoDaaBe according to the traditional haBBanae system, and 17.5 percent of animals entrusted to WoDaaBe by non-WoDaaBe as jokkere, under which the herdsman received only the milk of the lactating cows as payment for herding labor. Cattle calving is strongly seasonal, with 60 percent of births occuring in the three month period of the transition and early rains. Average age at first calving was 4.5 years; mean calving interval was 18.7 months, although there were two distinct peaks, at about 12 and 24 months, resulting from the strong seasonality of calving. Annual reproduction rate is 60 70 percent; cows in the herds had a mean of 2.11 calves each, and average age at culling of females was 7.7 years. Mortality rates were very high, with male calf mortality of 41 percent and female of 32 percent; most calf

---

1. These maps and others are contained in the Pastoral Atlas of Central Niger (Swift et al. 1984) which accompanies this report.

mortality occurs in the dry season and the transition to the rains. Total offtake was 7.8 percent, with 5.3 percent sales; most sales of both male and females were when they were very young, in the 1-2 year age class. Percent offtake declined with increasing herd size.

The project made a epidemiological survey of patterns of animal disease and their economic incidence in the area. Animal disease is a clear constraint to livestock production. Diseases of greatest economic importance present in the zone include anaplasmosis, vitamin A deficiency, blackleg and malignant edema, bovine plueropneumonia, brucellosis, enterotoxemia, foot and mouth, nodular worm disease, sheep pneumonias, PPR, rinderpest, salmonellosis and sheeppox.

Chapter 3.4 (pages 163 to 213) describes project research on plant-animal relationships. Heavy grazing during the plant growth period stimulates plant production, although grazing too early is detrimental. Grazing in the rainy season creates a soil moisture reserve available for plant growth, which prolongs the plant growing period for about two months beyond the end of the rains, while the soil in ungrazed pastures is dry two weeks after the end of the rains. Heavy grazing produces a larger soil moisture reserve than light grazing, and light grazing more than no grazing at all. The soil moisture reserve is used by perennial grasses, shrubs and trees in the dry season, and these provide protein and vitamin A to animals at critical moments. Heavy grazing during the rains leads to lower percent dry matter in plants and thus to higher digestible crude protein and nitrogen in the vegetation at the end of the rains.

There is often not enough biomass in the project zone for fires to spread; when they do, they remove plants and litter, and expose the soil to wind and water erosion. However there is some evidence for faster and greater regrowth of both annual and perennial pastures following a fire; the new growth is also more easily available to animals because the fire removes rank old growth.

Vegetation quality is more important than quantity, even in rainy season grazing. Heifers gained weight slower on pastures with more than 400-500 kg/ha of vegetation than with less. This is due to the high quality of the

early phenological stages in the rainy season; for this reason light grazing on short new pastures in the rainy season is ideal, and this is what WoDaaBe and other herders in fact do.

Plant litter is an important dry season animal feed. Absence of litter and the rotting that sets in with the first rains causes serious animal nutrition problems in the transition period between the dry season and the full rains. Heifers on a deferred grazing system which have put on weight throughtout the early dry season in April and May, lost on average 16 kg each in June as a result of this. All experimental animals also lost weight during the transition period between the cold and hot seasons in March and April.

A deferred grazing system, in which pastures were used in rotation, had significantly better heifer growth rates throughout the dry season than light grazing without rotation at the same overal stocking rates. Deferred grazing at the end of the dry season could imporve animal body weights before the critical dry to rainy season transition.

Chapter 3.5 (pages 214 to 223) summarizes project research into the nutritive value of grasses, shrubs and trees in the project area in different seasons. In most common grass species, digestible protein and vitamin A is negligible in the dry season; Pennisetum pedicellatum and Panicum turgidum are exceptions, at least until mid-December. During the rainy season, protein content of these grasses was adequate although vitamin A is always low. Of the major elements calcium, magnesium and potassium are adequate, while sodium, phosphorus and the calcium/phosphorus ratio are inadequate in the dry season. Non-graminaceous herbages and ligneous species on the other hand are generally good dry season sources of protein digestible energy, vitamin A, and major elements including phosphorus, although sodium content is generally low.

Chapter 4 describes project socioeconomic research on the pastoral production systems of the area. Chapter 4.1 (pages 225 to 253) summarizes information on the size and distribution of the pastoral and agropastoral population of the area from Niger government records and from the project's own air surveys. The main inhabitants are Twareg and WoDaaBe nomadic herders; pastoral FulBe and Tamasheq-speaking agropastoralists are a second major

group; sedentary Hawsa farmers cultivate especially in the extreme south of the zone; and there is a small Arabic-speaking herding population in the northwest. The air surveys, administrative census and ground surveys suggest a dry season population of around 219,000 people, including 111,000 Twareg and Arab herders, 43,000 WoDaaBe/FulBe herders, and 65,000 Twareg agropastoralists; this does not include the Hawsa farming and urban/large village population. The Pastoral Atlas gives maps of the distribution of these populations in different seasons.

An attempt was made to classify the pastoral and agropastoral populations into production systems: an estimated 59 percent of the zone's 219,000 people are pure pastoralists, 11 percent practise pastoralism associated with rainfed agriculture, and 30 percent are true agropastoralists.

Chapter 4.2 (pages 255 to 529) outlines the results of project research on the WoDaaBe, one of the major pastoral groups of the project area. The WoDaaBe are skilled herders and have a detailed knowledge and technology of herding, some of which is described. The WoDaaBe year revolves around the pasture and water needs of their animals. Camps move every few days in the rains so herders can vary the type of grass the cattle graze, and about once a month for the rest of the year. Cattle are watered several times a day during the rains, daily in the early cold season, and every two days for the rest of the dry season. The transition period between the hot season and the raina is a time of especial hardship for people and animals; animals lose weight fast, and high mortality occurs, especially if the rains are delayed.

WoDaaBe society is organized in lineages, subdivided into segments - the main administratively recognized unit - which are subdivided in turn into migratory groups, which have some resource-management and decision-making significance; the migratory group has a consensual leader, a rainy season pasture scout, a common dry season pasture area to which it habitually returns, and also consults together about rainy season camp movements. Within migratory groups, extended families and nuclear households are the main groups cooperating in economic activities. The basic production unit is an autonomous household herding its own animals, which may in some season join up with households of close kin in a camp, but which nevertheless in most circumstances continues to operate independently for both production and consumption.

Children are given animals in childhood by their parents and members of their extended family group, which has a responsibility to equip its members with sufficient animal capital for independent production; when a new production unit is formed, in theory after the birth of a couple's first child but sometimes delayed by lack of sufficient animals, they live from the herd built up from these animals. The loan of cows between individuals, haBBanae, whereby the borrower keeps three calves and returns the cow to the lender, are a flexible mechanism for animal redistribution to those in need, which also builds and maintains social relations. Recently, WoDaaBe have also started looking after jokkere, entrusted cattle from non-WoDaaBe proprietors; for this they received the milk of the lactating animals. However the presence of jokkere animals in the herd is a sign of poverty, with adverse consequences for herd management, and tends also to exclude the herder from the network of haBBanae loans.

The project did intensiive resesrch on household production parameters, especially budgets and labor use. Data were collected twice weekly from a sample of 14 production units, each containing an average of 8.9 people and herding 23 cattle (25 if jokkere animals are included). Mean household cash expenditures in the survey year were 545,000 CFA. Food accounted for 36 percent of this. Sample households had available from their own herds about 2.4 liters of milk per person during the rains, but this declines to zero at the end of the dry season. Cereals were a mjaor expenditure: the average household bought 831 kg of cereals, and also obtained 122 kg of cereals by barter, especially for milk and butter. When the absence of household members on migrant labor is taken into account, households had 120 kg of cereals/ person/year. Tea and sugar is another major expenditure, as are animal production inputs, especially salt and feed supplements. A major expenditure item is animals - especially cattle and camels - responsible for 41 percent of total cash expenditures.

Sale of animals - mainly cattle - is the source of 90 percent of cash incomes, with the remainder coming mainly from salaries earned by migrant laborers. WoDaaBe households also have important incomes and expenditures in kind. WoDaaBe try to sell male cattle at a profit-maximizing age of 4-5

years, but are forced by poverty to sell younger males and reproductive females. In the sample households, 32 percent of animal sales were of males aged less than 3 years, and 26 percent were females of reproductive age; this pattern is especially true of the poorer households. Other characteristics of poverty in the sample were larger household size, fewer animals, lower cash incomes, lower cereal inflows, and recourse to migrant labor and taking on jokkere animals to make ends meet.

Detailed studies of work hours performed by WoDaaBe men, women and children at all productive tasks over a 19 month period revealed high labor inputs to the herding economy. Adult men worked on average 2,800 hours/year, adult women 2,900 hours/year, and young boys and girls 1,579 and 972 hours/year respectively, totals which are well above those worked in most Sahelian pastoral and agricultural economies. For men, watering and pasturing animals are the most demanding tasks. Men's total labor is highest in the transition season between the hot season and the rains, lowest (although still high - about 5 man hours/day on average) in the late rains, and rises steadily through the dry season. Adult women milk cattle and do some other animal work, but their main activities are domestic: pounding, cooking and fetching camp water. Their seasonal peak is in the dry season. Children of both sexes make an important labor contribution from 6 or 7 years onwards, and boys aged 6-14 especially worked long hours at animal pasturing and watering.

The labor data show that in the WoDaaBe economy there is a high labor cost in simple maintenance activities for the herd through the year; unlike farmers and their fields, herders cannot leave their herd for a few weeks to do other jobs. There is no slack season, and even in the late rains, men are working several hours a day tending their animals. The WoDaaBe manage their herds much more intensively than other Sahelian pastoralists, which results in exceptionally long labor hours. Production is organized in very small autonomous units, in which the important economies of scale possible in some herding operations are not captured. The WoDaaBe also spend considerable amounts of time travelling in search of the information necessary for successful herd management.

Watering labor is a constraint on production, and time spent watering is substituted for time spent pasturing. Technology to improve water lift would relieve this constraint.

Measures to reduce dry season migrant labor would also make available more labor at a time when its marginal return is high. The high labor inputs by WoDaaBe children will make programs of formal education for children difficult.

The project surveyed the nutritional and health status of the WoDaaBe. Children under 5 years show an increase in acute malnutrition in the dry season, and a decrease in the rains, with 7 to 17 per cent of these children falling below 80 per cent of weight for height over the year as a whole. In the late dry season they lost weight, and the most critical moment was at the start of the rains. Dry season stresses include heat, food shortages, lack of water, less attention from parents and a high rate of diarrhoea. Adult men and women also lost weight - 5 per cent and 4.5 per cent respectively - in the dry season; although women lose less weight than men, they recuperate less rapidly in the rains.

The WoDaaBe have a relatively well-developed system of identifying and treating illness, including a traditional form of vaccination against smallpox. Fevers - mainly malaria - were the major rainy season illness, respiratory diseases in the cold season, and bone-joint pains and diarrhoea in the hot season.

WoDaaBe have a mental model of an entirely livestock-based economy, in which all their needs are met either directly from their herds or indirectly from the sale or exchange of animals and their products. As a result of sales and deaths of animals in the 1973 drought, less than 10 per cent of WoDaaBe are now able to do this. Groups differ in the response they made to these circumstances: an estimated 50 per cent in the project area took on jokkere animals, 65 percent left on migrant labor, especially to Nigeria, and some groups did both. Both jokkere and migrant labor have deleterious consequences for the quality of WoDaaBe herd management and thus for pastoral production.

Household research enables a theoretical poverty threshold of 3 TLU/person, or about 4 cattle/person, to be identified: a small number of households above this threshold are able to subsist without either migrant labor or jokkere, while those below it show characteristics of extreme poverty. The generally low level of household herd size obliges herders to sell increasingly young male and female cattle, depriving herding households, which have carried the high mortality risk of the first year, of the benefits of rapid increase in value over the next few years of their life. Because these animals are worth less, households have to sell more of them, accentuating the downward spiral of herd decapitalization. WoDaaBe households respond to these pressures by migrant labor (which reduces dry season household cereal requirement, and thus the need to sell animals) and by taking on jokkere animals. Neither is a viable long term solution.

The cumulative effect is a progressive replacement in the WoDaaBe economy of animals owned by herders by animals owned by outsiders, an increase in the average age of sale of males, a reduction in the overall productivity of the livestock present in the pastoral zone, and a downward spiral of economic viability of pastoral households. This leads to destructive social processes triggered by large scale seasonal absences, a further undermining of the WoDaaBe society's own self-help and insurance mechanisms, a progressive reduction in the ability of the economy to guarantee the minimum herd capital for new household formation, and an increased vulnerability to drought on the part of households operating with diminished and below subsistence herds of their own and entrusted animals they cannot sell.

Chapter 4.3 (pages 531 to 619) describes the main features of the Twareg pastoral economy and society in the project area, and the main recent changes of importance to development planning. Twareg society is analyzed through the operations of three systems: the status system, according to which all Twareg

belong to one of a series of hierarchically arranged status groups, with a fundamental distinction between "free" and "ex-slave" status, with members of the latter making up the majority of the Twareg population; the tawshit or kinship system, organizing real or putative descent groups, which define the constituent groups within a status category; and the ettebel, or traditional political authority system, which organizes the descent groups into traditional political groupings headed by members of the highest status groups.

The organization and techniques of Twareg pastoral production are described, as well as the extensive non-pastoral activities they undertake: opportunistic cultivation and more sustained agropastoralism, collection of wild grains and other plants, seasonal migrant labor and more sustained emigration into urban centers within Niger, trade in salt and other commodities, artisan production, and most recently, participation in the bureaucracy. Pastoral production is based on raising several species, with commercial emphasis on cattle and sheep, and an important subsistence contribution from camels and goats. Since the turn of the century, the Twareg of the project zone have become increasingly and more directly dependent on pastoralism as an economic activity; this has been accompanied by greater participation in exchange and increased emphasis on cattle and sheep.

Pastoral production is disproportionally controlled by the wealthy, higher status groups; low status Twareg have especially participated in the non-pastoral economic sectors. This is mainly the result of the control, by high status groups, of the main means of pastoral production. The reproduction of traditional Twareg society is strongly influenced by the need to replace the existing class and status structure, and to this end, a combination of status endogamy and mechanisms of livestock transfer, whether between or within generations, serve to retain livestock within the upper classes and withold them from the lower classes. Thus the system functions at one level to reproduce the class and status structure, and at another to ensure that the propertied classes, through transmitted wealth, reproduce themselves along the lines of kinship. Unlike the WoDaaBe, imbalances between

the numbers of people and the numbers of animals in the system are resolved by exporting low status, poor people to other economic systems, and by concentrating the remaining livestock into the hands of the higher status groups.

Chapter 4.4 (621 to 669) describes project research on the agropastoral economy of the area. The development of farming on a significant scale in the pastoral zone is relatively recent and is the result of natural population growth, the sedentarization of poor herders into farming, and the expansion north into the zone by farmers from the south as land became scarcer there. The main agricultural systems are classified as occasional farming and systematic farming by people whose main activity is herding, and true agropastoralism.

A sample studied in the south of the area showed some of the characteristics of the agropastoral production system: millet and sorghum were the main crops planted; mean area cultivated per household was 3.7 ha; there was light manuring of the fields by neighboring pastoral groups; the villagers had relatively important holdings of cattle, sheep and goats. Crop yields were low (194-221 kg/ha over three years of observation) and very variable between households. Household production of cereals in the survey years on average provided only 3-4 months of total cereal needs, and only one household produced enough to last until the next harvest.

Chapter 5 (pages 671 to 681) describes the results of a livestock market study undertaken by the project. There have been considerable changes in the last 10 years, due mainly to the growth in demand for meat from Nigeria, changes in road transport, an increase in animal traction to the south of the project zone, and changes in markets through which animals pass. Nigeria is the main consumer of animals from the project zone. Urban population growth at 7 per cent has been sustained and seems likely to continue, although a recent decline in oil revenues and other economic problems may be felt eventually in meat demand. The improved road systems in Nigeria and Niger has

made trucking of animals much easier and has now replaced long distance trekking. The increase in livestock traders resulting from increased demand and better communications has increased competition and pushed up prices to herders.

Chapter 6 (pages 683 to 702) describes the organization and mandate of the main government services concerned by pastoral zone development, and some main government policy areas which are relevant. The Five Year Plan (1979-1983), although now over, contained important policy discussions and statements, especially concerning the priority given in national planning to food self-sufficiency, to the growth in economic self-reliance, and to a new framework for participatory development, the Development Society, in which pre-cooperative and cooperative groups are to play an important role. Pastoral zone land tenure poses important problems, arising especially out of the lack of a legally - recognized claim by herders to the pastures they use. Livestock export policy has been to restrict exports of certain categories of animals in order to encourage herd reconstitution, but it is likely that, even if effectively implemented, such a policy would be counterproductive; it is questionable whether continued export restrictions are necessary, useful or effective.

Chapter 7 (pages 703 to 806) describes the pilot interventions undertaken by the project to test new development ideas arising from national policy and project research. Ten pilot herder associations were created as a new institutional framework through which development actions could be channelled; the lack of such a framework has been a major constraint on pastoral development hitherto. In line with government policy, and following project research and extensive discussions with herders, the project set up the associations as small units, starting from the actual groups of families in which herders cooperate in daily life; the associations number no less than 15 and no more than 30 families (100 to 200 people), chosen on the basis of kinship and shared resource management. The associations have several officers, each with a particular role or program. An important program

implemented by the end of the project involved revolving credit funds, used for dry season cereal stocks, for female animals for herd reconstitution, and for male animals for growing out; credit funds are designed to be repaid with enough interest to cover full administrative and financial charges.

The project trained 20 herder paravets in order to extend animal health coverage to a much greater area then can be covered by a small number of fixed veterinary posts. The paravets were trained to recognize the main livestock diseases, common parasitic infections, and to give appropriate treatments to a limited number of common disease problems; they are unpaid and work within their association.

Project research identified the lack of human medical care as an important development constraint in the area. Herders are too far from the few dispensaries most of the time to use them. The project trained 9 human health auxiliaries with a curriculum covering the principles of nutrition and disease, disease transmission, recognition and treatment of common complaints, drug doses, the identification of tuberculosis and the main epidemic diseases, and the recording of consultations.

Follow-up supervision of the paramedics and paravets showed that they were performing a useful service, and that their work was valued by herders. They are most effective within a herder association framework, as part of the range of activities of the association. Supervision and resupply with drugs creates serious problems, not yet fully resolved.

Chapter 8 (pages 807 to 830) sets out, in the light of government policies for rural development and for the pastoral zone, and of the project's own research conclusions and pilot programs, a statement of proposed development strategy objectives for the herding economy. Primary objectives are to improve self-reliance in the pastoral economy, to improve self-managed development by pastoral zone inhabitants and to increase the contribution of the pastoral sector to the national economy; the intermediary objectives,

through which the primary objectives can be achieved, are to raise the productivity of herding, manage the range and manage water.

Improved self-reliance in the pastoral economy can be achieved by improved pastoral zone food production and distribution , by assuring herders' food security in case of drought, and by measures to make possible increased, better distributed incomes in the pastoral zone. Better self-managed development by pastoral zone inhabitants can be achieved by improving herders' ability to organize so as to take in hand their own development, improve human health, education and training, and by a better ability to manage natural resources. The ability of the rural economy to finance its own development must also be enhanced, through a reorganization of financial flows to serve national objectives better.

The contribution of the pastoral zone to the national economy can be increased through an improved supply of animals for fattening, traction, urban consumption and export, and by increasing government revenues from the livestock sector.

CHAPTER 1 INTRODUCTION

The Niger Range and Livestock (NRL) project was designed in the immediate aftermath of the Sahelian drought of the early 1970s at time of widespread concern in Niger and the international community more generally that drought and "desertification" threatened an important part of the very livelihood of the state. For a country with only a narrow southern strip of farming land, in which livestock-raising contributes around 20 percent of Gross Domestic Product and probably more to foreign exchange earnings, the fear of a simultaneous collapse both of the livestock economy and of the pastures which support it, forced planners to rethink their traditional priorities in this field.

It was recognised by both the Niger and US governments that despite an important previous research effort, especially the work by French research institutes synthesised in a 1972 study entitled "Modernization of the Pastoral Zone"[1], there was still considerable uncertainty about the problems of pastoral development, how to define it and how best to achieve it. Experience with livestock projects elsewhere in Africa was at best disconcerting, with more failures than successes.

The project drafted by the two governments as a result of these concerns was in many ways innovatory. Most importantly, its emphasis was squarely on improving the "income and well-being of the traditional herders in the pastoral zone" rather than on increasing livestock exports or urban consumption, the more usual goal of livestock projects.[2] To achieve this, it was agreed that the project should focus on studies which would guide careful and appropriate actions (rather than a program of immediate but potentially negative or partial interventions), on evolving a broad framework for conservation-oriented action in the pastoral zone as a whole (rather than

1. SEDES (1978).
2. NRL Project Paper

limited interventions in favored or well-known localities, and on working directly with small producers in a collaborative and exploratory manner (rather than on simple extensions of known techniques and of government control and direction of the zone).

The goal of raising the living standard of the population of the pastoral zone in a ecologically conservative manner was seen to be a long-term process. To achieve that goal, it was decided to proceed by phases, the first of which was to respond to the gaps in knowledge about pastoral development, and which would therefore consist mainly of studies and pilot interventions. These studies and small-scale interventions were meant to "(1) provide information on the existing livestock production systems, (2) measure the impact of various productivity-increasing interventions, and (3) establish the technical and social feasibility of preserving the Sahelian rangeland." [1] If the first phase went well, a second phase project would implement a long-term action program based on these findings. The Project Grant Agreement was signed on 26 September 1977, although because of long delays in recruiting personnel, operations on the ground did not start until two years later.

This report summarises the main conclusions of NRL project research, and describes and evaluates the experimental development interventions which were undertaken. In most cases the results reported here are necessarily abbreviated from much longer, more fully documented technical reports, which are available at the project library in Tahoua.

The intention of the NRL project was to prepare for a longer-term development program. The design in early 1983 of its successor, the Integrated Livestock Project (ILP), was based on the results and experience of NRL, and took place with the participation of the full NRL team. ILP itself is explicitely seen as the start of a long-term process of pastoral development which may take a generation or more. In that perspective this report is the first of a series of building blocks designed to help attain the long-term objective, first specified in the NRL project paper, of increasing the income and well-being of the herders of Niger's pastoral zone.

---

1. NRL Project Grant Agreement, Article 2.

CHAPTER 2 NATURAL RESOURCES

2.1 RAINFALL

A principal environmental factor affecting pastoral production in the Sahel is the low and extremly variable annual precipitation. The project area lies largely between the 350 and 100 mm isohyets, as can be seen in figure 2.1.1. It is thus above the official northern limit of agriculture, which roughly corresponds with the 350 mm isohyet.

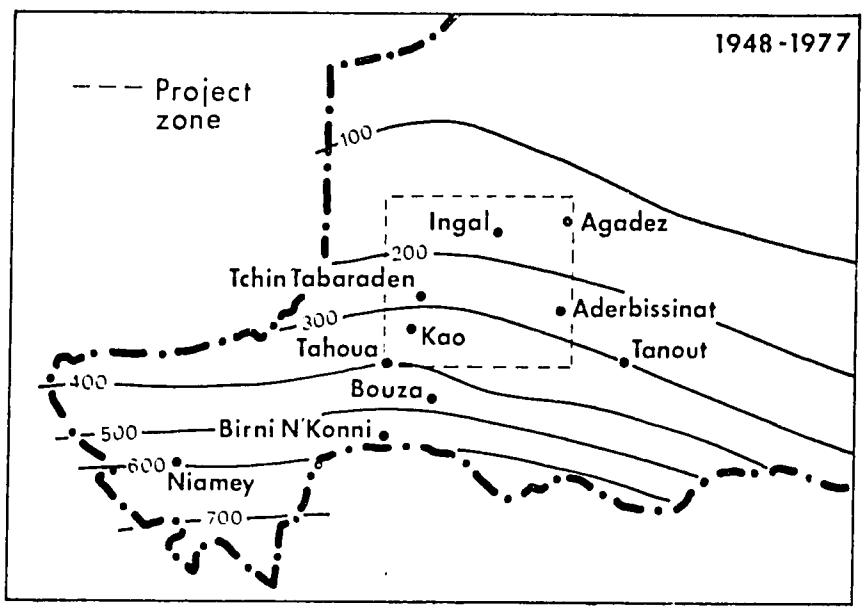


Figure 2.1.1 Rainfall (mm) in the pastoral zone of Niger

Rainfall variability

The annual vegetation production upon which pastoral herds depend is determined in part by the amount and timing of rainfall received each year.[1] In the project zone, the rainy season generally lasts from 3 to 4 months between June and September; during this period, a region may receive between 25 and 40 showers, of which roughly one-quarter deposit over 10 mm of rain. Consistent with the overall pattern of precipitation in West Africa, the average amount and number of days of rain per year tend to decrease from south to north within the project zone. However, rainfall in the Sahel, particularly in pastoral regions, is highly variable, which makes accurate prediction of trends virtually impossible and subjects herders to a high level of risk. This variability is of three types:

(1) Interannual variation. The total amount of rainfall received in a given place varies greatly from year to year, with standard deviations from the mean in the order of 30 percent or more. In general, variation is greater in the pastoral zone than it is in wetter areas further south. Table 2.1.1. shows average annual rainfall for varying series of years at several stations in and around the project zone. Standard deviations from mean figures are under 30 percent in areas with over 350 mm of rainfall per year and from 30 to 50 percent in the pastoral zone. Figure 2.1.2 shows how this variability affects the project zone, figure 2.1.3 shows the high variability in the annual rainfall totals of the last 60 years at Tahoua and Agadez, and table 2.1.2 shows the distribution of the Tahoua and Agadez annual rainfall into size classes.

---

1. Recent research in the pastoral zone of Mali has shown that in Sahelian areas receiving more than about 300 mm of rain annually, soil fertility, especially in nitrogen and phosphorus, is the limiting factor on plant growth; however, in areas receiving less than 300 mm, which includes almost all the project zone, soil water, not fertility, is the limiting growth factor (Penning de Vries and Djitèye 1982, Breman and de Wit 1983).

Table 2.1.1 Variation in total annual rainfall for selected stations in and around the NRL zone

Station	Number of years of data	Average annual precipitation (mm) ± standard deviation in %	
Agadez	52	155.6	± 38
Ingal	17	198.4	± 47
Tchin Tabaraden	12	218.2	± 34
Tanout	39	268.4	± 40
Kao	19	308.5	± 28
Tahoua	51	401.7	± 25
Bouza	21	443.7	± 27
Birni N'Konni	49	552.3	± 26

Source: Service Météorologique

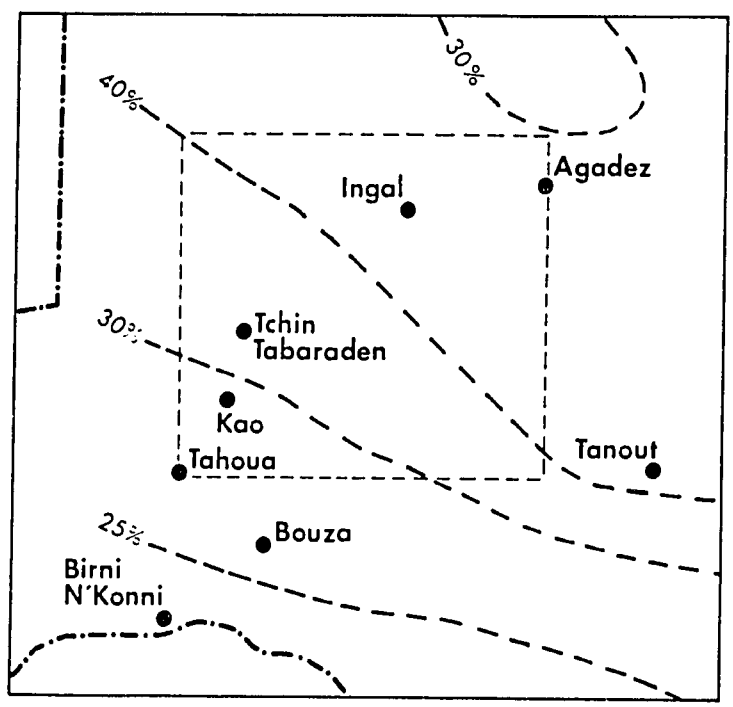


Figure 2.1.2 Variability of annual rainfall in project zone

(2) Spacing of storms and showers across the year. During any given year, the number of days of rain, the amount of rain involved in each storm or shower, and the temporal distribution of days of precipitation play a major role in determining the extent of seasonal pasture growth. Monthly rainfall figures for Tanout in the past 40 years, presented in table 2.1.3 give an idea

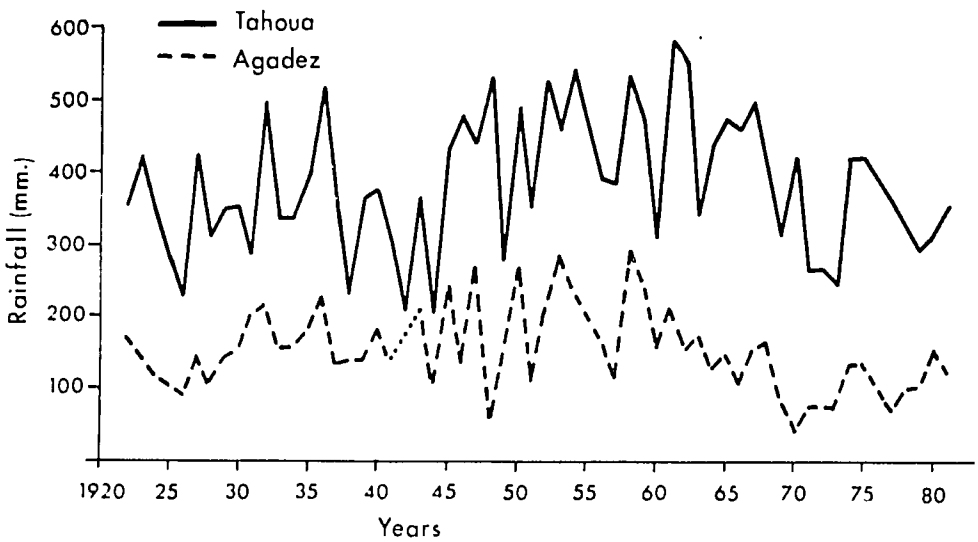


Figure 2.1.3 Long-term annual rainfall at Tahoua and Agadez

of the extreme variation in these factors. In general, the rains begin in May and June, increase in frequency and volume till August, then diminish and eventually cease in October. However, the lowest standard deviation for the mean monthly figures - in August, the height of the rainy season - is still almost 50 percent of the mean. The highest degrees of variability are found at the beginning and end of the rainy season; the former is particularly important because moderately heavy early rains followed by regular showers are necessary for the grass to germinate and proceed uninterrupted through the growth cycle. Indeed, the temporal distribution of storms and showers across the rainy season appears to be more important for pasture growth than total annual rainfall or the number of days of rain. Data collected at Aderbissinat

on rainfall and vegetation production in 1981 and 1982, shown in table 2.1.4, illustrate this point.

Table 2.1.2 Annual rainfall distribution for Agadez and Tahoua, 1920-1981

	Percent of years in given rainfall range (mm)					
	<100	100-200	200-300	300-400	400-500	>500
Agadez	22	57	22	-	-	-
Tahoua	-	-	17	37	34	12

Table 2.1.3 Monthly rainfall totals at Tanout, 1939-1982

Month	Mean	Standard deviation		SD as % of mean
May	6.2	±	9.9	160
June	26	±	35	135
July	81	±	49	60
August	111	±	54	48
September	36	±	35	95
October	2	±	4.5	219
(Annual total	268.4	±	106.9	40)

Source: Service Météorologique.

Table 2.1.4 Precipitation and forage production at Aderbissinat, 1981-2

	1981	1982
Total precipitation (mm)	153.3	150.4
Days of rain	14	11
Forage production (kg of dry matter per ha)	500	725

Source: Wylie et al (1983)

As can be seen in table 2.1.4, total rainfall was virtually the same in the two years (150 mm) but forage production was over 45 percent greater in the latter year in spite of the fact that there were fewer days of rain. In 1981, 72 percent of total annual precipitation fell in two showers, one of 90 mm; the high percentage of runoff and soil erosion associated with such storms meant that available water could not be efficiently used by the plants. In contrast, in 1982 six well-distributed, moderate rains in August prompted good vegetation production of 725 kg/ha, despite two unsuccessful germinations in July. These questions are discussed at greater length in chapter 3.4.

(3) Spatial variations. Bernus (1981: 20-21) quotes a Twareg proverb which captures the nature of this: "The rain usually falls on one horn of the cow but not the other." Storms can be so highly concentrated that there are often significant and irregular differences in rainfall at two points very close to one another. A good example of this is precipitation levels at two stations in Niamey, one at the airport and the other in the town itself, only 5 km away; between 1943 and 1952, their annual rainfall totals differed by an average of 70 mm, with a range from 12 to almost 200 mm.

Long-term trends

In addition to short-term variability in pastoral zone rainfall, there appear also to be longer-term trends, with series of years both considerably wetter and drier than the long-term mean. Figure 2.1.3 suggests that at Tahoua and Agadez in the project zone a relatively dry succession of years around 1940 was followed by a wet decade starting in 1951, which in turn was followed by a long drier than normal period through the 1960s and 1970s; the Sahel drought of 1972-73 was the low point of this series and, despite some relatively good years since, rainfall has still not returned to the level of the longer-term mean. Figure 2.1.4, which gives standardized annual rainfall departures for four ecological zones south of the Sahara between 1900 and 1980, shows that these patterns in the project zone are part of much wider climatic trends, in which the severe droughts of 1911-1915 and 1972-73, and the lesser drought of the 1940s, as well as the wet 1950s, were very generally felt throughout much of west Africa on a scale which is unusual for such phenomena elsewhere.

There is considerable discussion among climatologists and others about the existence of these long-term trends and their causes, including possible feedback mechanisms resulting from land-use pressures. No firm conclusions can be drawn on the basis of the present state of knowledge about this, nor about whether present dry trends will continue in the Sahel. For planning purposes, it is probably wise to assume that the Sahelian climate will be at least as variable in the next few decades as it has been in the past ones, and that there may even be a tendency towards greater variability (Hare 1983: 50).

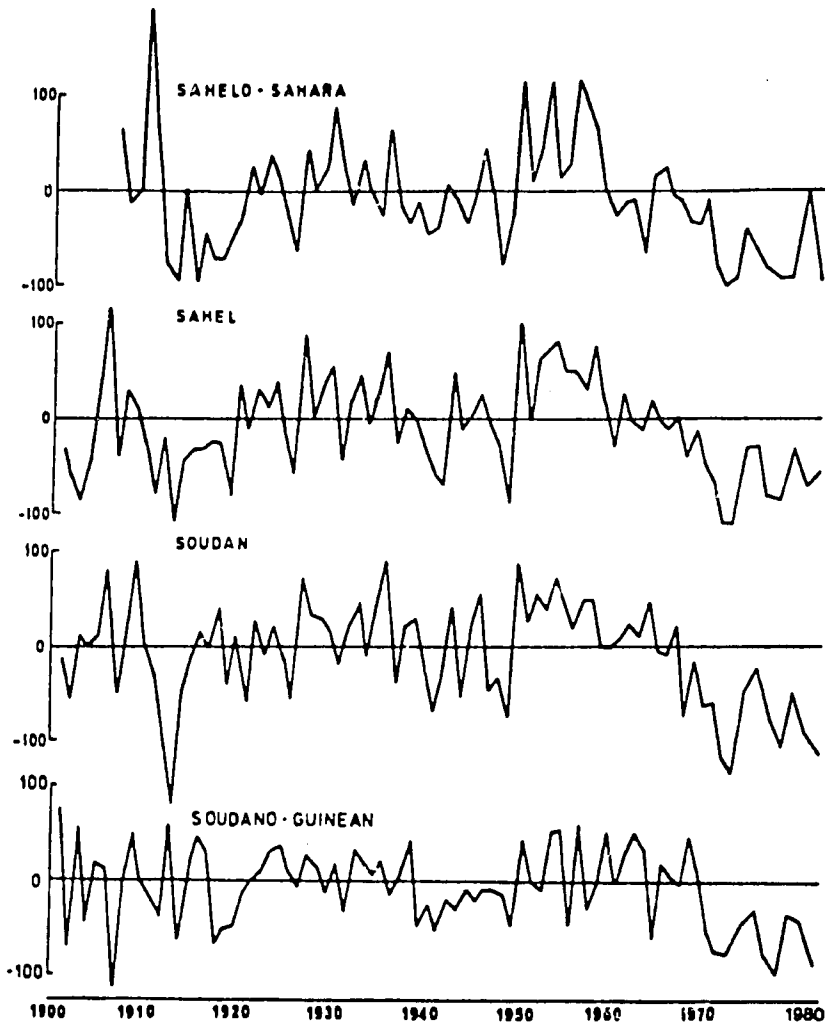


Figure 2.1.4 Standardized annual rainfall departures for four sub-Saharan ecological zones (after Nicholson 1982 in Hare 1983)

Conclusion

Rainfall in the project area, as in the Sahelian pastoral zone generally, is low, with an annual variability around the mean which rises from around 25 percent in the farming zone to the south to well over 40 percent in the north of the pastoral zone. Rainfall at the start and end of the short rainy season is especially risky, and rainfall distribution through the season, rather than the annual total, is one effective determinant of pasture production, especially in the north of the pastoral zone. Extreme spatial variability in rainfall adds to the risk faced by herders.

The record since 1900 suggests that wet and dry periods of variable length are common and that, following a wet 1950s, a dry period has been very widespread since the early 1960s; the possiblity that local land-use practices in the Sahel have influenced climatic feedback mechanisms cannot be rejected. The future Sahelian climate is likely to be at least as variable, and possibly more so, than the climate of recent decades.

2.2 LANDSCAPE AND GEOGRAPHY

The project area is a square of approximately 81,500 km^2 in the pastoral zone of central Niger (see figures 2.2.1 and 2.2.2). The project zone covers the land area between 05°15 to 08°00' East and 14°50' to 17°20' North, lying between the 100 and 350 mm isohyets. Administratively, it falls within the boundaries of four departments (Agadez, Tahoua, Maradi, and Zinder) and six arrondissements (Tchin Tabaraden, Tahoua, Keita, Agadez, Tanout, and Dakoro).

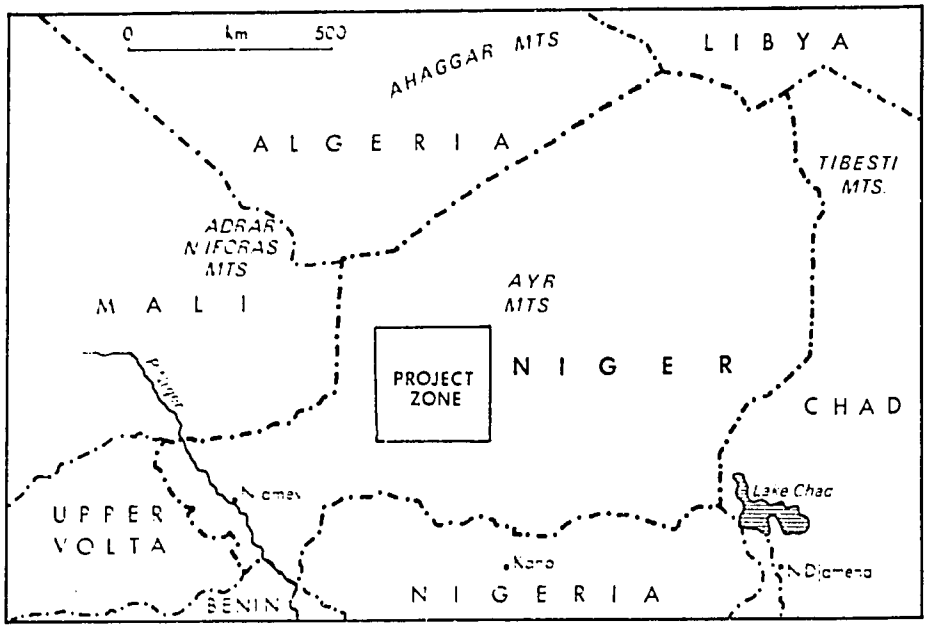


Figure 2.2.1 Location of project zone

The project zone is part of the broad Sahelian savanna belt which stretches across West Africa, from Senegal to Chad, and is inhabited primarily by nomadic pastoralists. Agriculture is practiced in scattered locations in the project zone, mainly in the extreme south and in irrigated areas around

some of the larger towns, but the low level of annual rainfall and poor soil quality make the region generally unsuitable for agriculture. There are a few large and several smaller permanent villages and towns in the project zone, some with long histories linked to trans-Saharan trade, others more recently developed. The zone is crossed by a paved highway from Tahoua to Agadez which is one leg of the "Uranium Road", constructed in the late 1970s to connect Tahoua and the south with the uranium mines north of Agadez. There is also a network of laterite roads and dirt tracks that connect larger markets, towns, and the main water points. But the dominant feature of the project zone is its extensive pastures, scattered with permanent and temporary water points: these pastures provide the natural resource base which supports 150,000 Tuareg and WoDaaBe herders and their herds, numbering over one million animals, as well as another 50,000 agropastoralists.

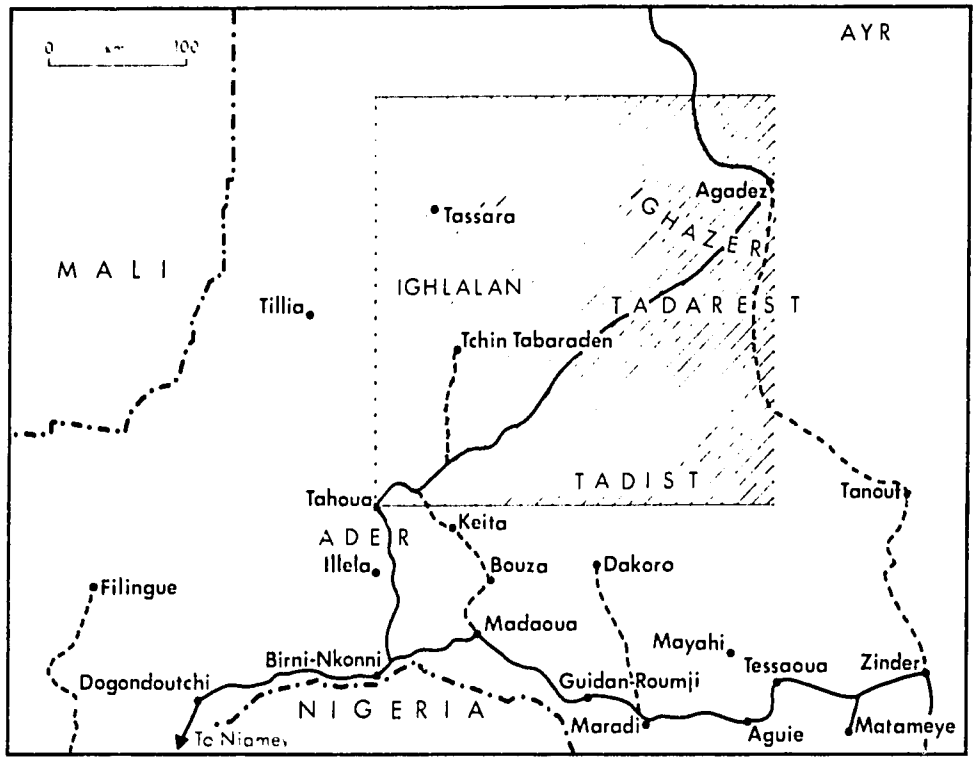


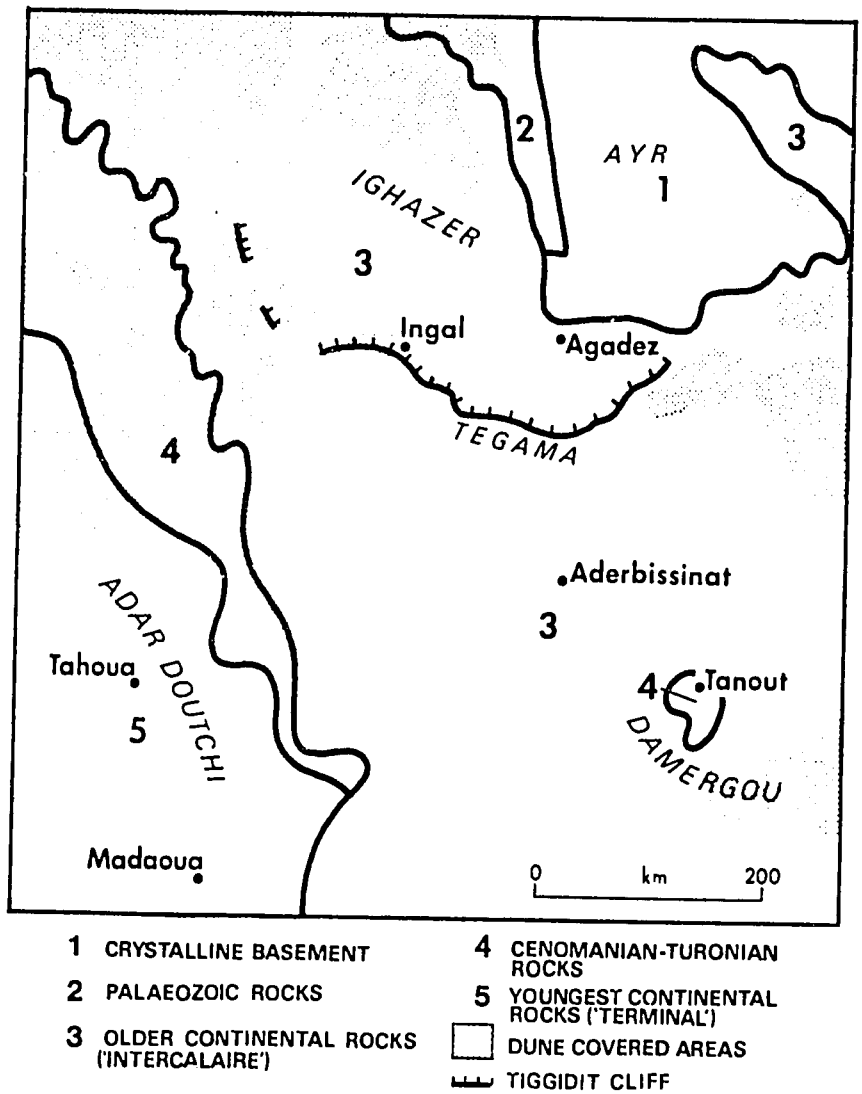
Figure 2.2.2 Project zone

The project did no extensive ecological survey research on the project zone as a whole other than that done as part of the air survey (Milligan 1982 a, b, c), so the following short sketch of the project zone is based largely on secondary sources, especially Bernus (1981), Rippstein and Peyre de Fabrègues (1972), Peyre de Fabrègues (1973) and Greigert (1968).

GEOMORPHOLOGY AND TOPOGRAPHY

The project zone is located in the large sedimentary Iwllemeden Basin, named after the Twareg confederation occupying this area. The basin is bordered to the north by a discontinuous mountainous region extending from the Adrar n Iforas to the Ayr, to the south by the northern Nigerian Pre-cambian formation, and to the east and west by the Damagaram and the Gourma eroded platforms. The major relief structures of the Iwllemeden Basin and their underlying geological formations are shown in figure 2.2.3 (adapted from Bernus 1981: 39).

The project zone, located in the northeastern part of the basin, can be divided into four areas demarcated by some of the main relief structures that break up the uniform flatness of the Basin. The foothills of the Ayr mountains extend into the northeast corner of the zone, in the region north of Agadez. These foothills drain into the clay Ighazer floodplain, which stretches from the Ayr to the Tiggidit Cliff and covers over one-fifth of the total project area (Milligan 1982). The main floodplain is criss-crossed by a network of channels formed from the drainage of the Ayr mountains; these channels collect in the west in a major artery, the Ighazer Valley. The Tiggidit Cliff, a semi-circular formation 100-150 km from the base of the Ayr mountains, separates the Ighazer flood plain from the Tegama plateau, a large savanna plain covering almost three-quarters of the project zone (Milligan 1982a). This savanna plain consists largely of undulating, stabilized sand dunes, fossil valleys, and plateaux. The southwest corner of the project zone, Tahoua, is a hilly region marking the beginning of the Ader Doutchi Plateau.



1 CRYSTALLINE BASEMENT
2 PALAEOZOIC ROCKS
3 OLDER CONTINENTAL ROCKS ('INTERCALAIRE')
4 CENOMANIAN-TURONIAN ROCKS
5 YOUNGEST CONTINENTAL ROCKS ('TERMINAL')
DUNE COVERED AREAS
TIGGIDIT CLIFF

Figure 2.2.3 Geology of project area

VEGETATION AND PASTURE DISTRIBUTION

Pastoral zone vegetation varies according to latitude, soil fertility and type, topography, climate, rainfall, patterns of use and altitude. The complex way in which these factors interact determines the nature of vegetation found in a given area.

Density of plant cover generally decreases from south to north, and primary production and species composition change according to local factors such as the pattern of rainfall, soil type, fertility and micro-topography. The Saharan zone, above the 100-150 mm isohyet, is characterized by perennial species, such as Panicum turgidum, in widely-spaced tufts. On clay soils such as the Ighazer valley other species such as Sorghum aethiopicum predominate.[1]

In the north Sahelian zone, roughly between the 100 and 350 mm isohyets, which forms the central and most important part of the project area, there is a pseudo-steppe dominated by annual grasses (Aristida, Cenchrus, Schoenefeldia, Brachiaria, Chloris, Tragus) shrubs and trees (Acacia, Commiphora, Boscia, Maerua, Combretum, Balanites). The dominant grass species may change from year to year as a result of changes in the pattern of rainfall. Calotropis procera, a tree found on poor soils and widely thought to be associated with declining land productivity, is widespread in this region, and is concentrated in the center, west and southwest of the project zone.

In the southern Sahelian zone, south of the 350 mm isohyet, cultivated fields become an increasingly important feature of the landscape; indeed, the 350 mm isohyet roughly defines the legal northern limit of agriculture, that is, the line legally establishing the division between the agricultural and pastoral zones. Figure 2.2.4 shows the distribution of cultivation in the project zone. In this area, forage species are more varied and cover more continuous. Common grasses include Aristida funiculata and Panicum laetum.

---

1. This section draws on syntheses by Bernus (1981: 29-43), and UNESCO (1983).

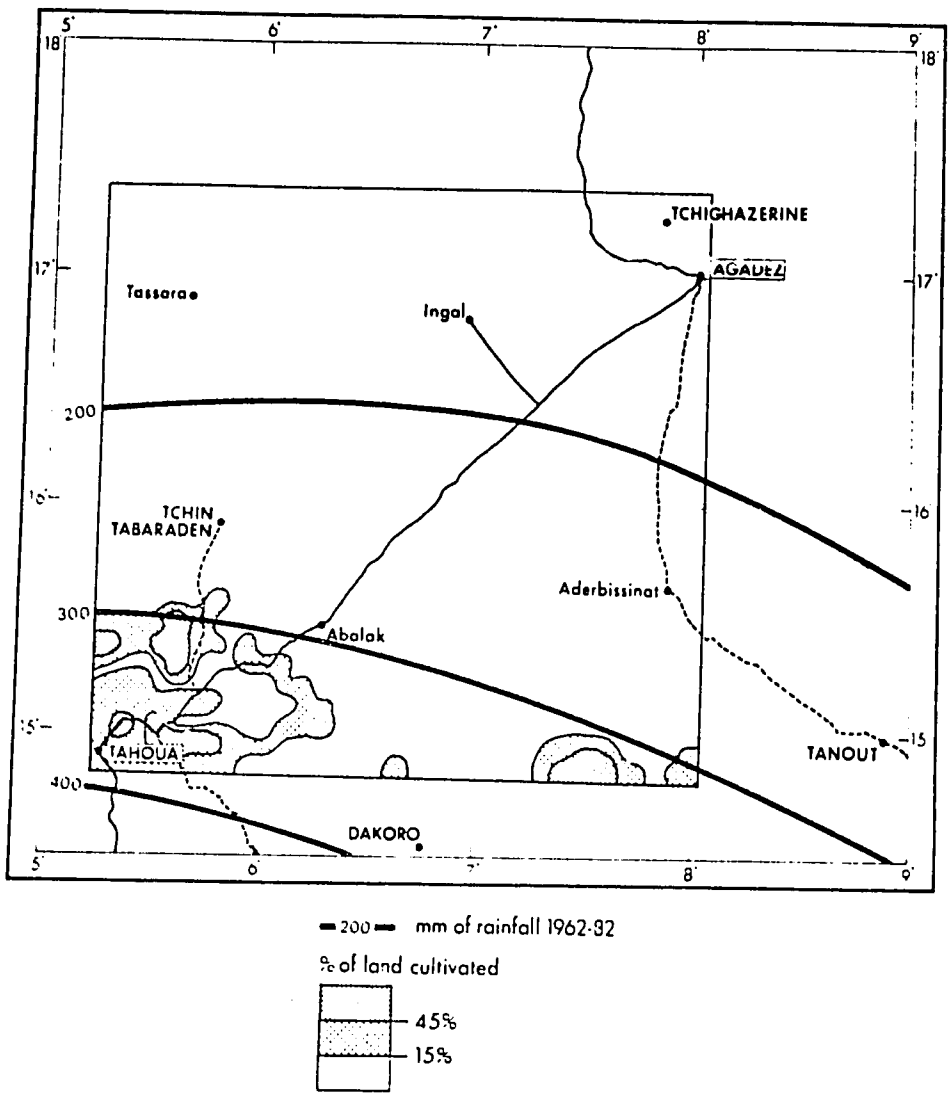


Figure 2.2.4 Distribution of cultivation in project area

The effects of latitude are locally modified by variations in soil types. Both Twareg and WoDaaBe distinquish between several types of soil in the pastoral zone, and indeed Maliki (1981: 46) reports that "Plants are categorized (by the WoDaaBe) according to the type of soil in which they grow and in which they are best able to flourish". Certain plants are likely to be found in clay soils, others on laterite plateaux. This means that there is a high level of local variation in vegetation type within identified ecological units.[1]

Air survey estimates of dry and wet season grass cover, measured as percentage ground cover, indicate that the most abundant dry season pastures are in two distinct areas: northwest of Tchin Tabaraden and along the south central and south eastern part of the zone. Pasture is generally more abundant in the late rains and immediate post rains periods, but follows the same geographic pattern of distribution, with substantial variations between years. These air survey estimates are shown in the Pastoral Atlas of Central Niger which accompanies this report.[2]

The 1970s drought killed a large number of trees in the project zone, especially on the Tadaress plateau in the center and east of the zone.

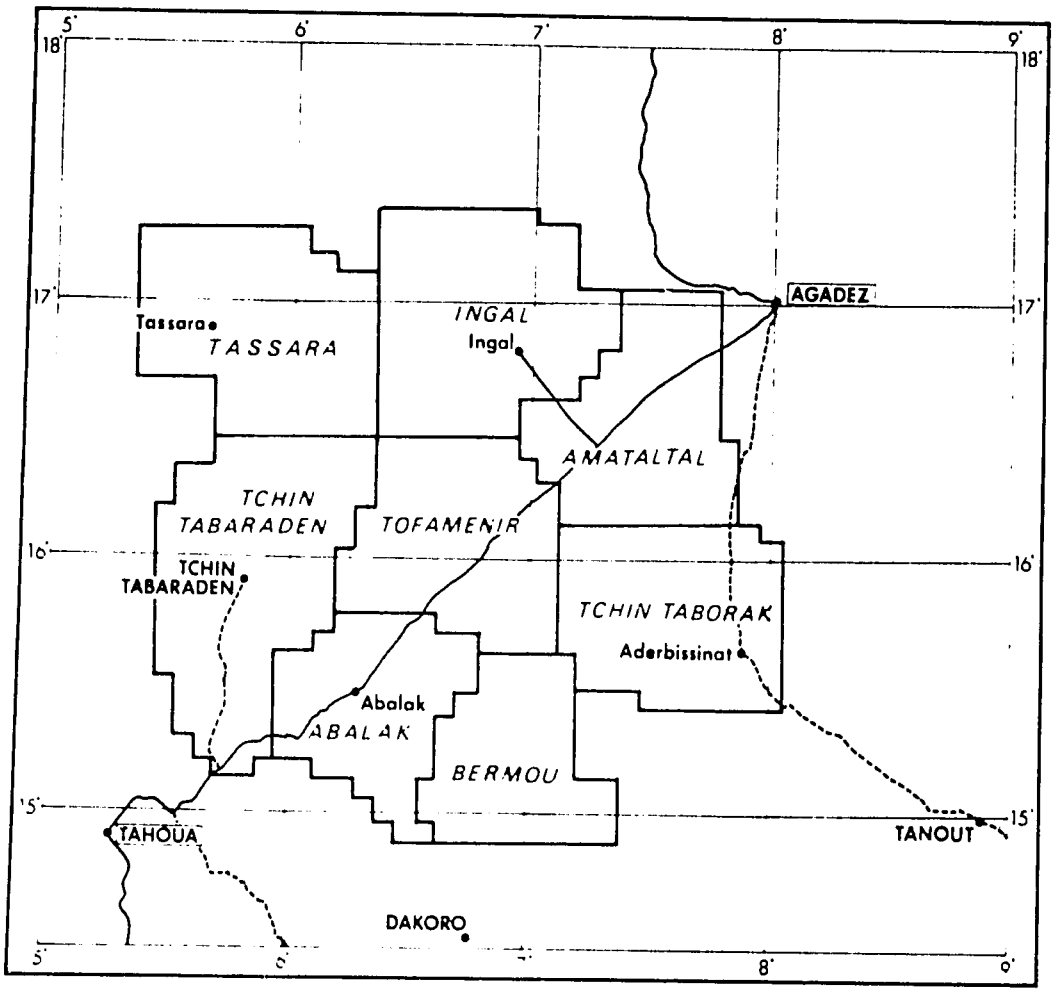
PASTORAL REGIONS

The project divided the zone into eight "pastoral regions" according to ecological, pastoral, and economic criteria; these regions are shown in figure 2.2.5. Within each region, groups tend to frequent the same markets, have similar movement patterns, and use the same techniques of resource management. For example, the Abalak region extends south into the agropastoral zone of west Dakoro because many of the Twareg and WoDaaBe groups that inhabit this area move to the south in the heart of the dry season. In contrast, the central region of Tofamanir is a rainy season concentration area, attracting herds that reside for the rest of the year in the surrounding regions (Ingal, Tchin Taborak, and Abalak). This geographic division of the zone thus combines both physical and socio-economic characteristics.

---

1. See Bernus (1981) and Maliki (1981) for WoDaaBe and Twareg names and classifications of associations between plants and soil types.

2. Jeremy Swift et al (1984).



AGADEZ	Departement capital
TANOUT	Arrondissement capital
Ingal	Poste administratif
———	Paved road
- - - - - - - -	Laterite road

0 km 100

Figure 2.2.5 Pastoral regions in project zone

2.3 WATER

The distribution and characteristics of water points in the pastoral zone are a major influence on the way pasture is used. A water point survey was undertaken by the project in order to describe the water resources of the project zone and to answer the following general questions: to what extent does absence of water limit pastoral production and in particular pasture use, to what extent does ownership or control of water limit access to pasture by other herders, and can control of water by clearly defined groups of herders be used as a policy instrument making control of pasture use possible? A major part of the findings of this research consists of mapped data on water point distribution and technical characteristics; syntheses of these data are presented in the Pastoral Atlas of Central Niger (Swift et al 1984), and the original survey data are kept for reference in the NRL project offices in Tahoua. This chapter summarises the more general findings. The survey was originally intended to cover the entire zone though when the survey ended, at the start of the 1981 rains, some areas had not yet been covered. The survey was planned from an atlas prepared by the French Bureau de Recherches Géologiques et Minières (Greigert and Sauvel 1970); the atlas is based on cumulative information from 'Hydraulic Resources Inventory' (IRH) cards, kept at the responsible Ministry in Niamey, which record locations, types and names of water points, as well as physical descriptions, estimates of capacity, comments on geological features and accessibility, and recommended improvements. For the project survey, sample frames containing about 30-40 water points were chosen from the BRGM atlas; most sample frames were selected to fall entirely within a single 1:200,000 IGN map to simplify administration of the survey. The BRGM atlas was found to provide a fairly good overall picture of the spatial distribution of water points and their type, mix and density, though it was considerably more useful in the case of permanent than of temporary water points. A number of water points encountered in the NRL survey were not listed in the atlas, and BRGM capacity figures differed significantly from those obtained in the NRL study.

Thus, the project survey verified and supplemented existing data on the project zone's water resources. In addition, questionnaires were administered to people encountered at each water point in order to gather information on other aspects of water point use, such as ownership of a well, the number of users, their ethnicity and use arrangements. Discussion of the survey results is here divided into two sections: first, a description of the distribution and characteristics of the different types of water points found in the project zone, and second, a presentation of the more general findings of the survey.

TYPES OF WATER POINT

Ponds

These are natural surface water catchments which collect and store rainfall runoff. The number of ponds in the project zone reaches a maximum at the peak of the rainy season and falls in most years to less than a dozen during the dry season immediately before the rains begin again. There is a high degree of variation in the number of ponds and the amount of water in them, as ponds are a complex function of total rainfall, geology, residual water charge, and plant cover; these factors change from year to year and from site to site. Efforts to map the distribution of ponds in the zone are made virtually impossible by their temporary nature.

Among the types of water point in the project zone, ponds are the simplest and least labor-demanding means of watering animals. Herds are watered by leading them to the pond site and allowing them to drink freely. Pond water is used extensively for human drinking water and other household purposes, though people are aware of health hazards involved and stop using the water when it becomes contaminated. Pollution accumulates rapidly as the dry season advances, both from animal use and as the amount of water is reduced by evaporation.

Some attempts to extend the life of ponds have been made in the project zone, usually through deepening. Although these techniques have been used with success in other Sahelian countries, in the project zone they have not

worked well, as the impermeable layer holding the water in the pond has been pierced, which leads to its faster disappearance. Pollution would in any case continue to be a problem. The method preferred by herders of extending the period of usefulness of pond sites is to dig sand wells in and around the bed of the pond after the surface water disappears; this technique is discussed below.

Springs

Natural springs are found in two areas of the project zone: in the salt cure region north of Ingal and at the base of the Tiggidit cliff. Springs in both areas depend on the high water table and significant subterranean flows characteristic of the Agadez flood plain (Ighazer wan Agadez). Water from the springs is quite salty, particularly in the Ingal area.

The springs north of Ingal are found at the center of shallow depressions in the floor of the Agadez flood plain. These springs are permanent and of high to moderate capacity; as such they remove the need for artificial dry-season water points for their immediate hinterland. Some of the most important springs (for example Tegguida-n-Tagayt) were improved during the colonial period by constructing concrete revetments, aprons and watering basins. Unimproved springs are generally not used for human consumption due to pollution from animal excrement; however, such sites tend to have shallow cement wells from which water for human use is drawn so there is no demand for improvement.

Springs at the base of the Tiggidit cliff are permanent in the sense that water can always be found at this site, although after poor rainfall years the water level may subside below the ground surface; when this happens, sites are partially excavated to reach spring water. These springs, however, are of minor economic importance; they are used in an incidental and opportunistic way due to their difficult access and lack of surrounding pasture.

Boreholes

Boreholes are small diameter deep wells with motor driven pumps to bring water to the surface; they are constructed and maintained by the government Office des Eaux du Sous-Sol (OFEDES). In the pastoral zone, borehole sites are equipped with watering troughs, a fountain to dispense water for household use, and a water storage tank. OFEDES watchmen live at each borehole, where they operate the pump, fill the trough, report breakdowns, and safeguard the installations. An access road and regular traffic are associated with each borehole for maintenance and fuel supply. Easy access and the fact that large numbers of herds and herders are found at boreholes mean that these water points tend to become centers of communication and commerce and generate some permanent settlement.

All boreholes in the project zone are in the Tchin Tabaraden arrondissement or just across the arrondissement boundary in neighbouring arrondissements, and are serviced from and supervised by the OFEDES office in Tahoua.[1] Except where pastoral wells are also used as municipal water supplies, as at Abalak, boreholes are usually not used to water animals year-round; they are closed at the beginning of the rainy season and reopened after an administrative decision usually made by the department or arrondissement-level technical committees (COTEDEP and COTEAR). The factors considered in these decisions are the state of pasture and the amount of water available from other sources.

As a water source for animals, boreholes offer the advantages of low labor requirements, great capacity, and public access. The only significant labor input required is that needed to control animals watering at the borehole, as the lifting and moving of water is done mechanically. The most obvious disadvantage of boreholes is their cost, as construction and maintenance are expensive. This is not a burden for herders, as the state finances all borehole operations. However, herders do bear the risk of breakdowns, which occur not infrequently in the pastoral zone. This risk is particularly serious where alternative water sources are not readily available.

---

1. Exceptions to this are the boreholes at the Dakoro Ranch and those for municipal use at Agadez and Ingal.

Cement wells

These are large-diameter wells which, like boreholes, are planned, financed, constructed and maintained by OFEDES. Sites are selected in Niamey based on information provided by the IRH and other sources. When funding for construction is obtained, an OFEDES crew is sent to the site. The well tube is cleared with picks and shovels, and concrete tube sections are poured into place; as digging progresses, the first section is underdug and allowed to slide down the shaft, and new sections are poured into place at the top as the assembly gradually slides downward. Watering basins are sometimes provided as well.

The lifting equipment at cement wells is provided by herders themselves. The permanent installations at the well are the pulley support and watering basins. The family who installs the pulley support, made from the fork of a tree and recognized as the property of the family, has priority in its use; otherwise, it is used as common property. Watering basins, made from half of a 200-liter drum, are similarly private and are also left in place. Portable equipment owned by each family includes a leather bucket (usually with a capacity of 40-80 liters), a well rope, and a wooden pulley and pulley rod.

Animal traction is used to draw water from the well; Twareg tend to use donkeys for this purpose while WoDaaBe usually use oxen. At least two people are needed to water a herd at a cement well: one (usually an adult man) to handle the rope and bucket, and another (often a woman or child) to guide the draft animal away from the well. The system works better with two adult men in addition to the animal driver, since lifting, carrying and emptying the heavy water sack from the well mouth to the basin is much easier with two people. The second person can also control the animals while the water is being shared out; when several herds attempt to water at the same time and there are not enough people to control them adequately, the system is less efficient and the possibility of an accident is greater.

Water for household use is also taken during watering. A goatskin bag is filled from the watering basin and strapped to the underside of a donkey, and the animal is led back to camp. This system may present a health hazard for

herders who rely on cement wells for drinking water, as animal excrement and soil are picked up by the well rope and carried into the well. The greatest danger at the cement well is the possibility of a broken well-rope, as the person managing the pulley may be caught by the rope as the bucket falls and dragged into the well.

Traditional wells

Traditional wells are the commonest type of water point in the zone surveyed. These are privately-owned permanent deep wells with the same range of depth and capacity as cement wells, but they are dug under private arrangements with local labor, expertise, tools and materials. In the eastern part of the zone, Hawsa well-diggers, who normally live in the cultivated area immediately south of the project zone, are contracted by a herder or group of herders wishing to have a well constructed. In the west, wells are dug by former Twareg slaves. Normally, the future proprietor is responsible for choosing the site of the well, obtaining administrative authorization for its construction,[1] providing tools and materials, and feeding the crew while the job is in progress. The fee for construction, agreed upon by the future owner and the contractor, varies according to soil conditions, the depth of the well, and general economic conditions. The prices reported for newly constructed wells (two years old or less at the time of the survey in 1980 and 1981) in the project zone ranged from 150,000 CFA to 250,000 CFA, not including food, tools or material. In most cases, half of this fee is paid to begin construction, with the balance falling due when water is found and the well is finished. Most wells are completed in six to ten weeks. The lifetime of such wells varies from 15 to 25 years.[2]

---

1. Authorization to dig a well is obtained from the most directly relevant government office or customary authority (chef de poste, sous-prefet, traditional chief); it may be written or verbal and is rarely recorded.

2. Most wells go out of service when erosion of the reinforced tube wall expands the diameter of the tube to the point where the reinforced mouth collapses. Variations in the lifespan of wells result from soils which erode at differing speeds; sandier soils erode more rapidly and wells in such areas collapse sooner.

Maintenance of the well is the owner's responsibility and includes three tasks: replacement of worn-out tree forks serving as pulleys; reinforcement with additional layers of branches and packed earth of worn-out or rotting tube mouths; and removal of accumulated silt from the well bottom, which reduces the water charge and impairs well capacity. The methods and equipment used in watering animals from traditional wells are generally the same as those described for cement wells.

Most traditional wells in the zone surveyed became the property of the present owners by inheritance or by payment for construction, and some by purchase from a previous owner. Prices for purchased wells are higher than those for wells dug to order; the highest price reported for a well in the course of the project survey (300,000 CFA) was for such a purchase. The stated reason for these higher prices is that such wells already have a proven water capacity: their purchase is thus not such a gamble as digging a new well.

Although traditional wells are privately owned, and the owner and his household always have priority in water use, access to a well is by no means closed to persons outside the proprietor's immediate circle. There is general acknowledgement of a temporary right to water at private wells in passing, generally after the habitual users of the well have completed their watering.[1] Water is also sold, although information on this is considered sensitive and is not easily gathered. The commonest form is the sale of the right to use a well for a fixed fee for a finite period; a frequently quoted rate for use of a traditional well was 5,000 CFA per herd per season. WoDaaBe are the most frequent purchasers of water in this fashion, while Twareg are the most frequent vendors.

---

1. During the survey, one case was encountered where a Twareg (Kel Fadey) herder re-opened an ancient well on the crest of the Tiggidit cliff, as an investment; he did not use the well himself (watering his own animals at nearby shallow wells), but charged passing WoDaaBe 5,000 CFA per month of use by 20 cattle.

Shallow wells

Shallow wells (puisards in French) are small, temporary waterholes, which individually are usually of low capacity. They are dug to last one dry season, and are normally abandoned at the start of the rainy season, although, if a good shallow well is not silted in or does not collapse, it may simply be cleaned out and used for another season. In the western third of the project zone, shallow wells are dug in and at the margins of pond sites, while north of the Tiggidit cliff they are dug in the sandy beds of intermittent watercourses or at the low points of extensive shallow depressions.

Like permanent traditional wells, the methods of construction and the finished form of shallow wells is quite uniform throughout the zone surveyed. Unlike permanent wells, shallow wells are generally dug by the owner himself and the members of his household. In general, the skills and equipment used in the construction and exploitation of shallow wells are very simple. They are dug with unspecialized hand tools at the site selected at the moment of need. In sandy soils, the shaft is often reinforced with bundles of grass or twigs, installed in the course of digging or when the shaft walls begin to collapse. The mouth of the shallow well is almost always reinforced with a framework of branches, usually in the form of a square. To make up for the low individual capacity, great numbers may be dug at a single site.[1]

At shallow wells used to water stock, water is invariably drawn by hand, using a short piece of cord (often made of plastic) and a great variety of buckets (small leather buckets of 5-15 liter capacity, calabashes and cans). Animals are watered from small, easily portable wood or metal basins. Water for household use is usually poured directly into waterskins. Watering equipment is rarely left near shallow wells, both because of its portability and because camps are often close to the well sites.

---

1. At one such site (Tiggidit proper) well over 200 shallow wells were counted.

Shallow wells are the most completely private category of water point in the zone surveyed; there was little indication of any institutionalized forms of water sharing such as that found generally at deep permanent wells. There is casual water sharing, especially among herders from a single camp, but each herder generally relies on his own shallow wells. This reflects the fact that shallow wells are dug to meet each herder's specific needs: a herder will not dig more than the number required to water adequately his herds and household. There is thus no great surplus of water to share out.

The number and distribution of shallow wells varies greatly from year to year. For example, only about half the shallow well sites shown on the 1970 BRGM atlas had been opened during the year of the survey, while roughly the same number of working sites encountered were not marked on the atlas. Shallow well siting is especially a function of available pasture. If pasture is sparse, fewer shallow wells will be opened, while in areas of abundant pasture they may be dense. This was particularly marked in the region between the Tiggidit cliff and Agadez, where two adjoining areas were surveyed a year apart, the first after the rains of 1979, which were very poor for that area, and the second after the rains of 1980, which were excellent. Very few shallow wells had been opened after the poor rain year, while most known sites were still in at least occasional use during the second survey.

Artesian wells

These wells result from deep drilling into a pressurized aquifer. Within the survey zone, such wells are found only in the salt cure region north east of Ingal, between Tegguida-n-Tessoumt and Tegguida-n-Tagayt. They are largely a side product of uranium and petroleum exploration in this area; when geological soundings have been completed and the drilling equipment removed, water flows to the surface from the artesian stratum.

Most such wells are unimproved, although some have been upgraded with the addition of water-storage tanks and water troughs. Unimproved artesian wells are used in a fashion similar to high capacity springs, while improved ones are used like boreholes.

These artesian wells are of particular interest primarily because they contribute to the surprising density of high-capacity permanent water points in the extreme north of the project area. They also show how the composition and capacity of water resources in the project zone can be affected by operations not related in any obvious way to the herding economy; the line of small ponds created as a result of laterite excavation along the Uranium Road is another example.

DISCUSSION

In regard to water points, the project zone as surveyed consists of three basic areas. The most important, at least in terms of the localization of project activities to date, is the western quarter of the zone, west of 6°30'E and south of 16°15'N. This is a region of heavy depedence on surface water and shallow wells, supplemented by boreholes. This part of the project zone is largely within the arrondissement of Tchin Tabaraden. The remainder of the project zone south of the Tiggidit cliff is dominated by high-capacity traditional wells, supplemented by cement wells and some major ponds. There are no functioning boreholes in this area except those at the government north Dakoro ranch. This area lies within the arrondissements of Dakoro and Agadez. The third major area lies north of the Tiggidit cliff and is a region of mixed surface water sources, including springs and artesian wells, shallow wells, traditional and cement wells, and improved artesian wells. There are no operating boreholes in this area, apart from those installed for municipal or service center water at Agadez, Ingal, and Tegguida-n-Tessoumt; those previously found in this area have been replaced by cement wells. This third area is entirely within the arrondisement of Agadez.

This division in terms of water points corresponds to geological differences. North of the Tiggidit cliff, the important waterbearing stratum is the Thirezrine Sandstone, which is tapped by most permanent water points except shallow wells. As elsewhere, these wells tap a shallow surface layer. South of the cliff, in the rest of the project zone, the water-bearing stratum is the Tegama Sandstone. In the traditional well area to the east, the aquifer is open, and is recharged by rainfall. In the shallow well area to the west,

the aquifer is closed by an impermeable layer which is probably the cause both of the region's marked capacity to retain runoff in sub-surface catchments and the difficulty of successfully digging wells there. The Tahoua-Tassara-Chadawanka triangle is particularly complex in this regard, and is not understood well enough to ensure successful exploitation even by the most modern means, as the OFEDES record in this area indicates. The Tegama Sandstone has been identified as the most important hydraulic system in Niger, and is known for its productivity.

In general terms, in the project zone since the 1970 BRGM study there has been an increase in the number of high or moderate capacity permanent water points and they have extended into areas previously relatively poorly endowed. There has been an increase in the number of artesian wells in the extreme north of the project area, as a result of geological exploration, and a corresponding reduction in the importance of unimproved natural springs and shallow wells. South of the Tiggidit cliff, there has been a significant increase in the number of traditional wells, both in areas already well-equipped with such wells according to the earlier study and into areas where they were not previously inventoried. There has been a significant decrease in the number of boreholes in the area surveyed. No new boreholes have been drilled since 1970 except at government ranches, and a number have been withdrawn from service, especially south and east of Agadez. There has been virtually no growth in the number of permanent water points in the shallow well-dominated western quarter of the project zone, except for the installation of cement wells in villages in the southwestern corner of the project zone.

The water point survey and project socio-economic research suggests that although the project area as a whole is reasonably well provided with water, there are many places where shortage of water in the dry season is a serious constraint on production and on the use of available pasture.

The water point survey indicated three particular large areas where water was generally inadequate. Two of these are in the geologically difficult region in the extreme west of the project zone and within the arrondissement of Tchin Tabaraden; the third is near the center of the project zone in the southwest corner of the arrondissement of Agadez. These regions are as follows:

(1) Between Dembutan and Durum (a 15 km radius from UTM coordinates 07801745).

This area has no permanent functioning water points and few suitable shallow wells sites. The area is difficult to exploit for geological reasons; an OFEDES cement well constructed near the center of this area failed to reach a suitable aquifer. Because of the great depth which would be involved, even a successful cement well in this area may not answer its needs owing to the technical problems of lifting water from great depths. A borehole would be the best means to solve the water problem in this case; such a borehole was proposed in the 1970 BRGM study (proposition N^r-9-2). This site is on the margin of the affected area; a better site would be near the unsuccessful OFEDES well (IRH N^r-10798).

(2) Tin Salatin (UTM coordinates 08001775).

Tin Salatin is the site of a borehole which has been out of service for two years; since its closure, the area has had no permanent high-capacity water point. One informant identified a site some 15 kilometers east of Tin Salatin proper as best for a cement well. However, given the poor rate of success for cement wells in this area, the most appropriate way to address this problem may be to renovate and reopen the Tin Salatin borehole. Judging from superficial indications, it may also be possible to install a traditional well near one of the present shallow well sites.

(3) South of Tamayo and east of Marikini (a 20 km radius from UTM coordinates 02751730).

This area was reported as deficient in water by both Twareg and WoDaaBe, who also both requested the installation of a cement public well; this was a change from the more usual requests for additional private wells. However, three Igdalen-owned traditional wells not charted on the BRGM atlas were

encountered in this area and an additional well was under construction; the Igdalen who habitually use this area reported no particular problems with water adequacy. This region is an Igdalen heartland, and it appears that they have successfully closed it to dry-season exploitation by non-Igdalen, both other Twareg and WoDaaBe. This degree of control of a specific area by a single group was unusual in the zone surveyed, and in marked contrast to the more general pattern of ethnic interpenetration.

Elsewhere in the project zone, there are not such large areas where lack of water constrains pasture use, but there are many places where dry season water shortage constrains production. This happens because of the long distances between water and pasture which obliges animals to expend considerable energy in walking, and also because of the low capacity of many water points, especially shallow sand wells, which causes herds to wait many hours to be watered and consequently lose this time for grazing. Further development of water in the project zone could from a technical point of view improve pasture use and dry season production in many places. The key considerations in determining whether and where such water development should take place are economic (determined mainly by hydrogeological considerations), and social and legal, concerning ownership and control of access to new water sources created in this way. One proposal made later in this report is for groups of herders organised into herders' associations to be given credit to construct water points, in which the group would have full rights of ownership. Under traditional rules concerning access to water this would be sufficient, if sensibly administered, to control pasture use in the immediate area around the well as long as no other public water point occurred in the immediate neighbourhood. Because of the generally wide distribution of existing water points in the project area, such activities will have to be considered on a case by case basis.

Sale of water and of water points is increasing in the project area, although there is too little evidence to describe the trends in detail. Any substantial change in this direction, in particular the purchase of many water points by rich herders or by non-herders, would have important consequences for the organization of the pastoral economy, by concentrating control of dry season pasture access into a smaller number of hands and creating a market in water and pasture, which are key production factors.

CHAPTER 3 ANIMAL PRODUCTION

3.1 ANIMAL NUMBERS AND DISTRIBUTION

NATIONAL HERD AND ITS DISTRIBUTION

In 1980, Niger's national herd consisted of 13.7 million animals, of which 24 percent were cattle, 22 percent sheep, 51 percent goats, and 3 percent camels. Livestock-raising is the basis of the economy of Niger's pastoral zone, though it is also widely practiced in other regions of the country. Figure 3.1.1 shows the distribution of the national herd in terms of Tropical Livestock Units (TLU) per square kilometer.[1] The south of the country is more densely populated, with livestock density steadily decreasing northwards into agropastoral and pastoral areas. This reflects the intensiveness of livestock raising in some southern agropastoral production systems: in some southern arrondissements (such as Aguie, Birni N'Gaouré, Konni and Madaoua), where agriculture is the main activity, livestock densities are over 20 TLU per square kilometer, although livestock per person ratios are low. Conversely, areas where extensive, often nomadic, livestock-raising is common are characterized by livestock densities of under 5 TLU per square kilometer, but high numbers of livestock per person. Figure 3.1.2 shows that the highest TLU per rural capita ratios are found in Niger's pastoral zone, where people depend almost exclusively on livestock for their production requirements.

These general patterns - high livestock densities in the southern areas but high TLU per rural capita ratios in the pastoral zone - are true of the periods both before and after the Sahelian drought of the early 1970s. Nonetheless Niger's livestock population has undergone significant changes in its distribution in the past fifteen years. At the time of the drought, in addition to substantial animal deaths, there was also a significant shift in owenership of animals, as impoverished herders sold animals to farmers and urban people in the south. As a result, the portion of the national herd in the pastoral zone, which was most severely struck by the drought, has reconstituted at a slower rate than elsewhere in the country, and is consequently still considerably smaller than it was in the pre-drought period. In contrast, the portion of the national herd located in the farming zone

---

1. Camels, cattle and sheep/goats are 1 TLU, 0.7 TLU and 0.1 TLU respectively, with 1 TLU representing an animal of 250 kg liveweight.

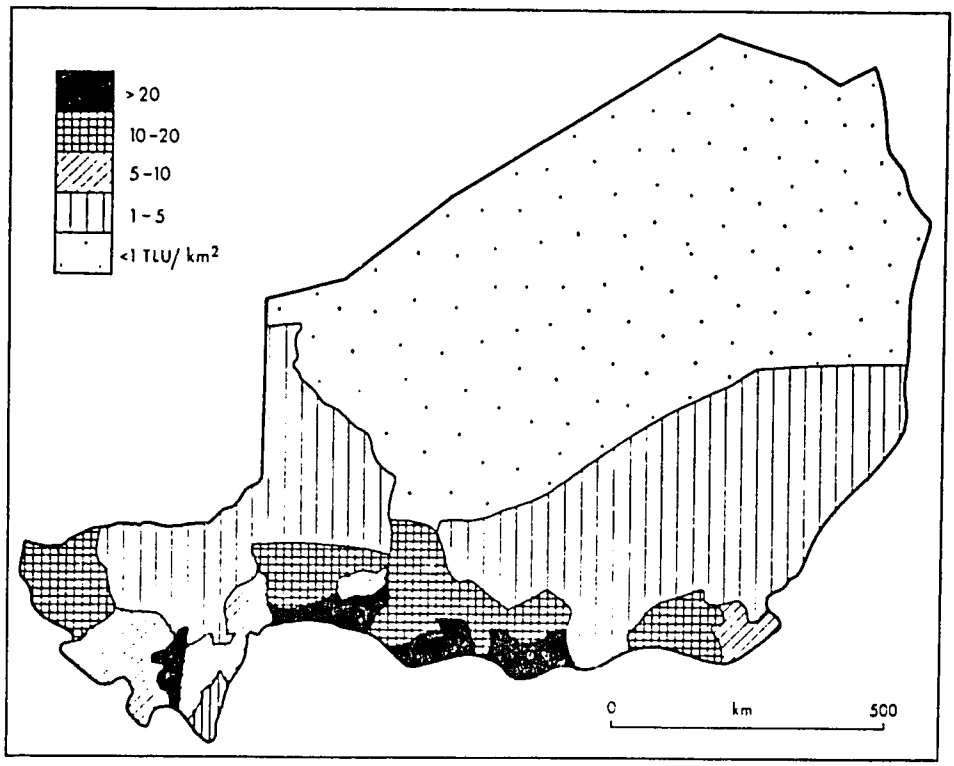


Figure 3.1.1 Distribution of national herd: TLU/km^2

reconstituted much more rapidly as a result of these shifts. Moreover, evidence suggests that an increasingly large part of the pastoral zone herd belongs to absentee owners, non-pastoralists who invest in livestock and hire herders to take care of them. Thus since the drought not only has there been a geographical redistribution of animals from north to south and from pastoral to agro- pastoral production systems, but even within the overall pastoral zone herd there has been a redistribution of ownership of animals from herders to non-herders.

The real nature and extent of these changes are difficult to document in the absence of reliable macro-level data. Yet some trends can be outlined and their scale estimated by using case studies and Livestock Service figures for

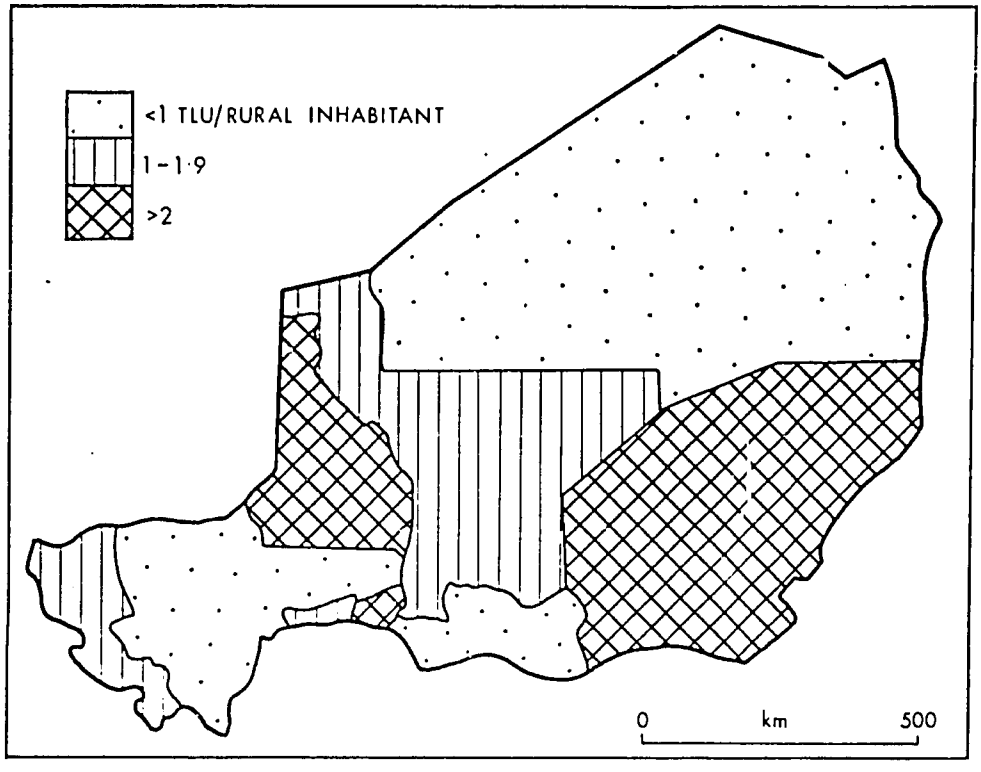


Figure 3.1.2 Distribution of national herd: TLU per rural inhabitant

the size of the national herd and its geographic distribution. This section uses the available material to document and analyse as far as possible these changes in Niger's livestock sector. Three main issues are discussed: the reliability of government statistics; the scale of animal losses due to the drought; and herd reconstitution afterwards. The purpose here is not to examine in detail the economic, ecological or social implications of current trends, which are dealt with in later chapters of this report, but to present what empirical evidence is available on the nature and extent of macro-level changes in the national herd, particularly that part in the pastoral zone, in the last fifteen years.

Reliability of government statistics

Livestock Service statistics on the size and distribution of the national herd are estimates, not based on a systematic survey but on information from several sources: the vaccination campaign, market surveys, data from the Economic and Animal Industries divisions of the Livestock Service, and the Departmental Veterinary Services' monthly reports. As few other data on the national herd exist, it is difficult to evaluate the accuracy of Livestock Service estimates. However, the aerial survey conducted by the International Livestock Centre for Africa (see Milligan 1982 a, b and c, and the following section of this report) collected data on the size and composition of herds within the project zone, and p ovides an opportunity to cross-check the reliability of Livestock Service figures.

In comparing the Livestock Service estimates of the number of animals in the project zone with those of the air survey, the problem of the units in which data are recorded has to be solved. The Livestock Service estimates are subdivided into administrative units - arrondissements - while the air survey estimates are for the project zone as a whole, subdivided by ecological units. To compare estimates of the total number of animals in the zone, some assumptions have to be made. The aerial survey covered the entire project area, which represents approximately 1/3 of the surface area of the Agadez arrondissement, 1/3 of Dakoro, 1/3 of Keita, 1/6 of Tahoua, 1/2 of Tchin Tabaraden, and 1/3 of Tanout. Calculating from the surface area of each arrondissement, this gives a total surface area of 83,000 km^2, which is close to the area of the air survey's study zone.

If an even livestock population density in each department is assumed, the number of animals within the study area is proportional to the share of the department in the study area. The assumption is not entirely sound, since densities vary between ecological zones; nonetheless, as there are a variety of ecological zones within the study area, differences in density should tend to even out. The exception is Agadez, where although around one third of the arrondissement is in the study area, this is closer to half the usable area of the arrondissement, the rest being desert.

Table 3.1.1 shows estimates of the number of each species within the project zone calculated in this way from each arrondissement's reported livestock population. From these statistics, and using the assumptions discussed above, the livestock population of the project zone is estimated to be 262,000 cattle, 630,000 small ruminants, 98,000 donkeys and 74,000 camels.

Table 3.1.2 gives these estimates alongside those of the air survey. There is a relatively good agreement between the Livestock Service's figures and the air survey's dry season (May 1981) estimates for cattle, small ruminants and camels. In the cases of cattle and camels, the Livestock Service estimates fall within the range of standard error given for the air survey figures. However, with the exception of donkeys, the Livestock Service figures are lower than those of the air survey. In particular they do not take into account the large influx of herds of all species into the project zone during the rainy season. The air survey methodology is more likely to underestimate than to over estimate animal numbers, since it is possible either to miss a herd entirely or to count fewer animals than there actually are in a herd, but it is not possible to invent herds or count them twice. Serious underestimation appears to have taken place with donkeys; the air survey estimate of the number of donkeys in the zone during the dry season is less that 15 percent of that of the Livestock Service. Nonetheless, the Livestock Service estimate may be too high, largely because of the fact that 150,000 donkeys are estimated to be in the arrondissement of Tchin Tabaraden (75,000 in the part of the arrondissement in the project zone); this would imply that the arrondissement's donkey population is almost three-quarters the size of its cattle population, which is highly unlikely.

Table 3.1.1 Estimated animal population of project zone derived from Livestock Service figures

Arrondissement	Estimated number of animals in project zone			
	cattle	sheep & goats	donkeys	camels
Agadez	11,000	64,887	5,000	15,500
Dakoro	54,333	109,000	3,333	5,000
Keita	28,333	44,584	5,333	1,000
Tahoua	33,000	56,092	3,600	1,500
Tanout	33,333	72,128	6,000	10,666
Tchin Tabaraden	102,500	283,386	75,000	40,000
TOTAL (rounded)	262,000	630,000	98,000	74,000

Source: Calculated from the Livestock Service's Annual Report, 1980, assuming that the project zone contains the following proportions of each arrondissement's total population: Agadez and Tchin Tabaraden (1/2), Dakoro, Keita and Tanout (1/3), Tahoua (1/6).

The fact that there is a fairly good correspondance between air survey dry season figures and Livestock Service estimates with respect to cattle, camels and to a lesser extent small ruminants suggests that Livestock Service estimates of herd size and distribution are a relatively reliable guide to pastoral zone dry season animal numbers. This comparison of air survey and Livestock Service data suggests that Livestock Service estimates can thus be used to discuss recent general trends in animal numbers.

Table 3.1.2 Comparison of air survey and Livestock Service estimates of livestock population in project zone

	Air survey[1]			Livestock Service[2]	
	May 1981	October 1981	September 1982	1980	Projected 1981
Cattle	288,653 (12)	376,533 (16)	331,135 (13)	262,000	270,000
Sheep and Goats	780,289 (8)	1,147,914 (11)	829,610 (8)	630,000	650,000
Camels	70,162 (9)	89,314 (8)	155,708 (32)	74,000	75,000
Donkeys	13,540 (14)	20,041 (11)	23,375 (12)	98,000	100,000

Notes:

1. Numbers in parentheses refer to standard error in percent.
2. 1980 figures from table 3.1.1. Projected 1981 figures derived from Livestock Service estimates of annual growth rates for each species: 3 percent for cattle, 3.25 percent for small ruminants, and 2 percent for camels and donkeys (1980 Annual Report, page 57).

Sources: Milligan (1982 a, b) and Livestock Service 1980 Annual Report, pp. 60-62.

DROUGHT LOSSES AND RECOVERY

The precise extent of animal losses in the 1970s drought is unclear since available information is sketchy and often of questionable accuracy. Although ten years have passed since the worst year of the drought, the issue continues to be important since drought-related losses have had continuing implications, especially in the way different initial losses have affected the reconstitution process. Data from two sources are discussed here: the Livestock Service, and a study undertaken in late 1973 by the Communauté Economique du Bétail et de la Viande. The first gives the Niger government's estimates of animal losses nationally; the second provides estimates specifically for the pastoral zone, and also describes the nature and consequences of reactions to the drought.

National losses

According to the Livestock Service, the size of the national cattle herd dropped between 1968 and 1973 from 4.45 million to 2.2 million; sheep from 2.8 million to 1.8 million; goats from 6.4 to 5.3 million (with a further decline to 4.9 million in 1974); and camels from 360,000 to 285,000 (also with a further drop to 235,000 in 1974). In percentage terms, losses were slightly over 50 percent for cattle, 36 percent for sheep, 27 percent for goats, and 35 percent for camels.[1]

The level of animal losses varied by region as well as by species. Although precise estimates of the decline in herd sizes by department and arrondissement between 1968 and 1973 are not available, table 3.1.3 shows the livestock population by species for each department in 1968 and 1975.

---

1. For detailed figures see tables 3.1.13 to 3.1.17 in the annex to this chapter.

Table 3.1.3 Regional differences in drought-related animal losses: livestock populations by department, 1968 and 1975 ('000 head)

	Cattle			Sheep			Goats			Camels		
	1968	1975	1975/1968 %	1968	1975	1975/1968 %	1968	1975	1975/1968 %	1968	1975	1975/1968 %
Agadez	160	15	(9)	123	20	(16)	224	60	(27)	100	10	(10)
Diffa	560	380	(68)	364	200	(55)	565	520	(92)	25	30	(120)
Dosso	300	261	(87)	189	174	(92)	350	404	(115)	12	48	(400)
Maradi	500	390	(78)	438	330	(75)	1,219	1,453	(119)	29	30	(103)
Niamey	880	520	(59)	420	324	(77)	865	436	(50)	16	21	(131)
Tahoua	980	439	(45)	730	472	(65)	1,822	1,429	(78)	130	42	(32)
Zinder	1,070	503	(47)	530	639	(121)	1,385	1,591	(115)	48	60	(125)
TOTAL	4,450	2,508	(56)	2,794	2,159	(77)	6,430	5,893	(92)	360	241	(67)

Source: Livestock Service, Annual Reports, 1975 and 1978

Although some recovery was already underway in 1975, the table nonetheless clearly illustrates the uneven geographic impact of the drought. Agadez department was the most severely affected, with cattle at 9 percent, sheep at 16 percent, goats at 27 percent and camels at 10 percent of their pre-drought numbers. All departments registered losses for cattle, with 1975 herd sizes as a percentage of 1968 levels ranging from 9 percent in Agadez and 45 percent in Tahoua to 87 percent in Dosso. But although there were overall losses for all other species at the national level, some departments actually registered increases in herd sizes between 1968 and 1975: the sheep population in Zinder grew by 21 percent; the goat populations of Dosso, Maradi, and Zinder increased by 15, 19 and 15 percent respectively; and the numbers of camels in all departments except Agadez and Tahoua (which suffered severe losses) rose during this period by 20 percent in Diffa, 3 percent in Maradi, 31 percent in Niamey, 25 percent in Zinder and almost 4 times in Dosso.

Although Livestock Service statistics do not reveal whether animal deaths or shifts in the geographic distribution of the livestock population account for the gains and losses in each department, it is probable that both factors were at work although it is difficult to determine their relative importance. In the case of camels, geographic redistribution is obvious: while the camel population in Agadez and Tahoua together decreased by 178,000 animals (from 230,000 to 52,000 head), in the other five departments it increased by 58,300 animals (from 130,000 to 189,000 head). Even if a normal 2 percent growth rate for camels had been sustained throughout the drought for these five departments (which is unlikely), the number of camels there would have risen to less than 150,000 head. For all species there were clearly substantial deaths, although in the case of sheep and goats rapid recovery by 1975 masks the full effects of these.

While care is needed in drawing conclusions from these estimates, they certainly indicate that the drought had a highly uneven impact, and that both deaths and changes in geographic distribution were substantial. This has important implications for recovery, in terms of herd reconstitution rates by species and by region.

Pastoral zone losses

The second set of data on animal losses casts more light on some of these issues. In late 1973, the Communauté Economique du Bétail et de la Viande (Arnal and Garcia 1973) made a thorough survey of 64 herds in eight arrondissements in Niger's pastoral zone. Estimated animal losses are shown in table 3.1.4.

Table 3.1.4 Estimated animal losses due to 1970s drought in pastoral zone and nationally

	Pastoral zone			National
	Total animals			
	Pre-drought	1973	percent losses	percent losses
Cattle	4,013	1,474	63	50
Sheep	1,591	843	47	36
Goats	2,095	1,390	34	27
Camels	-	-	38	35
TOTAL	7,699	3,707	52	32

Source: Pastoral zone: Arnal and Garcia (1973), survey of 64 herds.
National: Livestock Service, Annual Reports, various years.

It can be seen that cattle numbers within the survey herds declined by 13 percent more than the overall national estimate, sheep by 11 percent more, goats by 7 percent more, and camels by 3 percent more. While national animal numbers fell by around a third, within the pastoral zone survey herds the total number of animals dropped by half.

Cattle were most severely affected, with losses of 63 percent. The impact of the drought varied according to age and sex categories, as shown in table 3.1.5.

Table 3.1.5 Differential impact of 1973 drought on cattle herds in pastoral zone

Category	Percent of total losses
Adult females (5 years +)	55
Animals 1 year and under (both sexes)	19
1-4 year females	12
1-3 year males	8
Adult males (4 years +)	6
All categories	100

Source: Arnal and Garcia (1973)

In terms of the extent of losses within each age-sex category, 83 percent of all animals less than one year old died during the drought, 71 percent of adult females, 60 percent of adult and 1 to 3 year old males, and 35 percent of 1 to 4 year old females.

The uneven impact of animal losses changed the age and sex structure of cattle herds. As the figures in table 3.1.6 illustrate, the proportion of males over one year of age remained basically the same (15-16 percent), but females between one and three years rose from 21 to 37 percent, and animals under one year of age and adult females together dropped from 64 to 47 percent. This decrease in calves and adult females seriously reduces the herds' reproductive capacity, both in terms of their immediate ability to reconstitute, and also later when the present generation of cows must be replaced. Interestingly heifers seem to have suffered less than other age-sex categories, perhaps as a result of herders' priority efforts to keep them alive.

Table 3.1.6 Pre- and post-drought cattle herd structures

	Herd structure (percent)	
	Pre-drought	1973
Calves < 1 year	15	7
Bullocks 1-3 years	9	10
Heifers 1-4 years	21	37
Adult cows	49	40
Adult males	6	6
TOTAL	100	100

Source: Arnal and Garcia (1973).

The problem of reduced productivity due to these changes in herd structure was exacerbated by marketing patterns typical of the drought. During the extremely bad 1973 rains, prices of cereals increased due to the poor harvest, while animal prices fell due to low demand and poor quality. Herders' purchasing power and terms of trade declined, as herders were forced to sell more, cheaper animals from their dwindling herds to buy expensive millet. By 1973, most male animals - usually the majority of sales - had already died or been sold, so herders had to begin selling off their capital base, their reproductive females. Arnal and Garcia found a greatly increased proportion of females in slaughterhouses and export herds. At the Niamey slaughterhouse, while females were 30 percent of cattle slaughtered in 1968, in 1973 they accounted for 70 percent, at a time when the slaughter rate itself was accelerating: in Niamey, in the first 10 months of 1973, more animals were slaughtered than in the previous five years.[1] Livestock export figures

1. It was difficult to know whether Niamey was representative in this respect because data are less available in other regions. Nonetheless, the nature of the trend and the fact that it was widespread are clear.

similarly reflect the increased offtake rate (though data on the age and sex of animals exported is not available). According to official figures, the number of cattle exported tripled between 1967 and 1972.

After cattle, Arnal and Garcia (1973) found that sheep were the most heavily affected species; the number of sheep within the sample herds decreased from 1,591 to 843 head, a loss of 47 percent. The study noted that rapid sheep reproduction would speed up flock reconstitution, but many herders reported that the vulnerability of this species would lead them to postpone sheep reconstitution in favour of the hardier goat.

Goat losses were lower, in the order of 30 percent. Herders considered that goats would form an important part of herd reconstitution strategies due to their short reproductive cycle and good milk production; most importantly, the sale of goats gives herders an income to meet basic needs while cattle and camel herds are reconstituting.

Herd reconstitution

Three points emerge from this discussion of available data on animal losses. First, the rate of animal losses varied by species and by region; in general, cattle were the most severely affected species, and overall animal losses were heaviest in the pastoral zone. Second, at least some, and possibly quite considerable, geographical redistribution of the national herd occurred during and after the drought. In addition, though not visible in macro-level statistics on livestock numbers, shifts in animal ownership patterns have accompanied this geographical redistribution; an increasing proportion of the animals in the pastoral zone is owned by sedentary investors but herded by pastoralists whose herds are no longer large enough to meet their families' subsistance requirements (the nature, extent and implications of this are discussed in chapter 4). The third related point is that these changes in the size and composition of livestock capital available to herders after the drought have had a serious impact on rates of herd growth and reconstitution in the pastoral zone.

Given this, it is not surprizing to find that herd reconstitution has not meant a simple return to pre-drought conditions. In the early 1980s, the national herd has returned to its pre-drought level of approximately 14 million animals.[1] However, the national herd can be said to be reconstituted only in broad numerical terms, as reconstitution has varied significantly by species and by region. An analysis of the way in which herd reconstitution has been progressing points to several important issues for the present and future development of Niger's livestock sector.

Livestock Service estimates of herd reconstitution levels by species and by department are shown in figures 3.1.3 and 3.1.4. In 1980, goat, sheep and camel populations in fact surpassed pre-drought sizes, standing respectively at 109, 106 and 109 percent of their 1968 numbers. However, the national cattle population was not - and probably is not - reconstituted; in 1980, it had reached only 75 percent of its pre-drought level. Assuming that the cattle herd continued to increase at the annual growth rate estimated by the Livestock service (3 percent), it would have attained almost 80 percent of its 1968 size in 1982 but theoretically would not reconstitute until 1990.

Rates of reconstitution for cattle vary significantly by department, ranging from 14 percent in Agadez to 108 percent in Dosso (the only department in which cattle numbers now surpass pre-drought levels); cattle reconstitution levels, plus those for other species, are shown by department in figure 3.1.4. Reconstitution is relatively well-advanced in the Niamey, Diffa and Maradi, where cattle populations are respectively 91, 88 and 87 percent of their 1968 sizes. In Tahoua and Zinder departments, however, cattle numbers remain at only 61 and 63 percent of their pre-drought levels. Thus for these departments, plus Agadez, it would be wrong to consider cattle herds to be reconstituted and stop allocation of resources to rebuild herds.

---

1. The most recent year for which complete statistics are available is 1980, at which point the Livestock Service estimated that the total number of animals in the national herd was about 13.7 million. Even assuming a conservative growth rate of 2 percent (less than the Livestock Service approximates), the national herd would have passed 14 million in 1982.

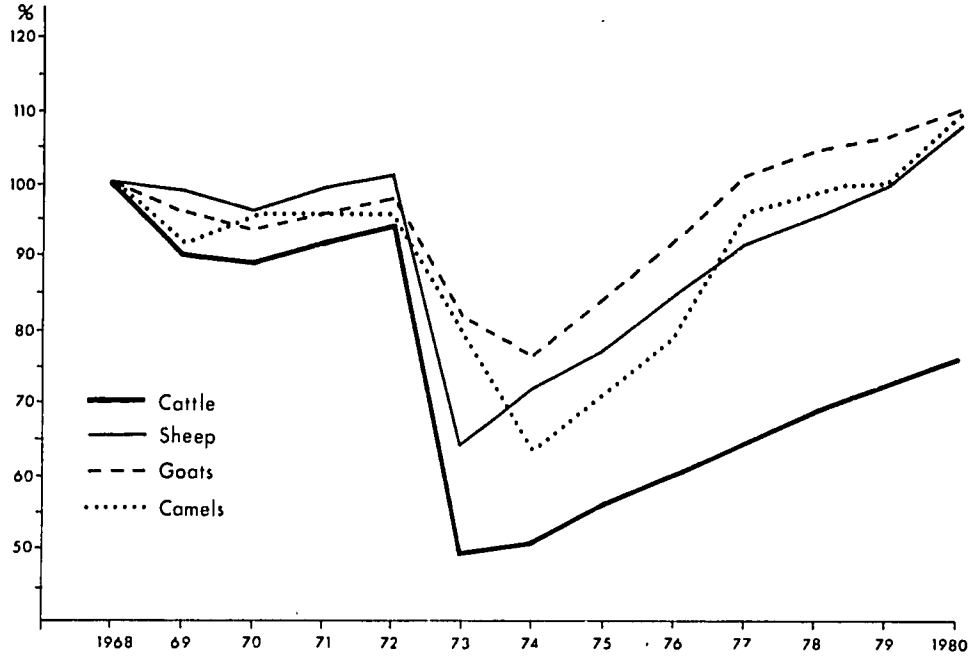


Figure 3.1.3 Changes in national herd size by species, 1968-1980 (1968=100)

For other species, regional differences in rates of reconstitution are also apparent though they are less important than with cattle. The national goat herd was the first to regain its pre-drought size, and in four out of seven departments goat numbers have surpassed 1968 levels. Nonetheless, in 1980, while in Diffa, Dosso and Zinder goat herds were 130 percent reconstituted or more, Agadez remained at 42 percent and Niamey at 82 percent. Tahoua's goat herd was at 112 percent of its 1968 size, and Maradi was on the brink of reconstitution at 97 percent.

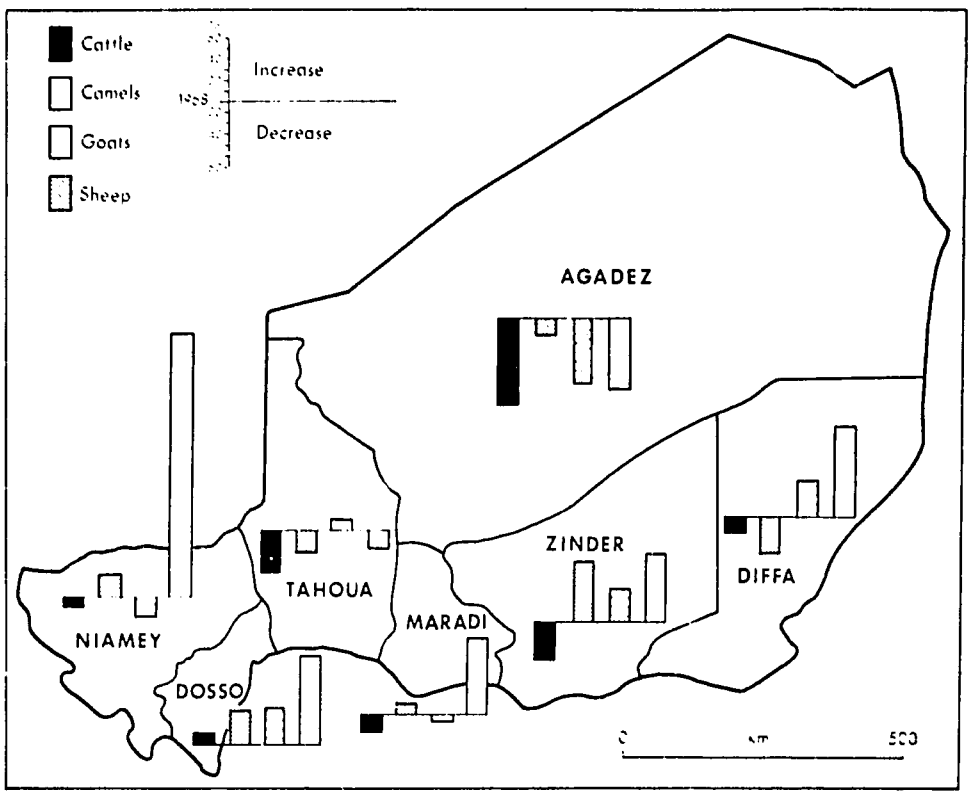


Figure 3.1.4 Herd reconstitution levels in 1980 by department: animal numbers as percent of 1968 population

Reconstitution rates for sheep range from 65 percent in Diffa to 157 percent in Zinder. Agadez, Diffa and Tahoua sheep herds remain below 1968 levels.

Camel populations are reconstituted in all departments except Agadez and Tahoua, which are at 45 and 83 percent of 1968 levels respectively. In the other departments, however, some fairly spectacular rates of growth are observable, according to Livestock Service estimates. In Niamey Department,

camel numbers are 150 percent greater that they were before the drought, having increased from 16,000 in 1968 to 40,000 in 1980. An inflow of camels from Mali at and after the drought is likely. Camel populations in Diffa, Dosso, Maradi and Zinder have increased by between two-thirds and nine-tenths. In the case of camels, the shift in the departmental distribution of the national herd since the drought is fairly marked: while almost two-thirds of the national herd was located in Tahoua and Agadez in 1968, in 1980 this proportion had dropped to less than two-fifths and appears to be continuing to decline.

Implications of current trends

The trends just described for Niger appear to be occuring throughout Sahelian West Africa. Table 3.1.7 shows that the number of animals in the Sudan ecological zone of Sahelian countries has increased by 16 percent while the number of animals in pastoral and desert regions has decreased by about 20 percent. In relative terms, this means that whereas two-fifths of the Sahelian countries' livestock population was found in the Sudan ecological zone before the drought, at the end of the 1970s this proportion had increased to almost a half.

Table 3.1.7 Distribution of livestock population across ecological zones in Sahelian countries, 1970 and 1979 ('000 TLU)

	1970		1979	
	number	percent	number	percent
Sudan	9,960	40	11,545	49
Sahel	13,450	54	11,070	47
Desert	1,430	6	1,130	5
TOTAL	24,840	100	23,745	100

Source: Jim Dickey, USAID/SDPT, personal communication.

Although the TLU per capita ratio declined in all regions (due to a combination of drought losses and human population growth), it declined considerably more in pastoral than in agricultural areas. Table 3.1.8 shows that TLU per capita decreased by 34 percent in pastoral and 25 percent in desert regions between 1970 and 1979, compared to 12 percent in the Sudan ecological zone.

Table 3.1.8 TLU per capita ratios across ecological zones in Sahelian countries, 1970 and 1979.

	TLU per capita		1979 as % of 1970
	1970	1979	
Sudan	0.58	0.51	88
Sahel	2.39	1.57	66
Desert	3.42	2.58	75
TOTAL	1.08	0.78	72

Source: as for table 3.1.7

All of this suggests that several important things are now happening. Significantly heavier drought losses and consequently slower rates of herd reconstitution have put serious strains on the pastoral economy: a reduction of over half of the livestock capital available to herders has made pastoral production a much more precarious occupation for herding families, obliging them to supplement their incomes with new economic activities, especially migrant labour and herding animals belonging to sedentary people. In contrast, lower drought losses, faster rates of reconstitution, and purchase of pastoral zone animals during and since the drought have made southern non-pastoral livestock-raising areas the focus of the national herd. If the pastoral zone is to play its part in national economic activity and if its inhabitants are to produce optimally, an important effort of pastoral zone herd reconstitution remains to be carried out.

ANIMAL NUMBERS AND DISTRIBUTION WITHIN THE PROJECT ZONE

In order to develop a better picture of how human and animal populations relate to the project zone's natural resources, aerial surveys were conducted by the air survey unit of the International Livestock Centre for Africa (ILCA) in May and October 1981 and September 1982.[1] The May survey was intended to cover dry season conditions, and the other two, rainy season conditions. In each survey, low altitude flights along sample strips enabled data to be gathered on the distribution and composition of populations and resources throughout the project zone. This section summarises the surveys' findings on the size and distribution of the project zone's livestock population. For each sample strip flown, the numbers of Bororo and Azawak cattle[2], small ruminants, camels and donkeys encountered were recorded; photographs were taken of herds of more than 10 animals so that an accurate count could be made after the flight.

Although this methodology has many advantages, particularly its systematic coverage of the entire project zone, it also has some limitations. First, the survey results were not ground-truthed; this would have required considerable additional resources. Second, some results are subject to relatively large standard errors so should be judged accordingly. Third, the high interannual variability of nomadic movements in and around the project zone means that the air survey results are snapshots of a dynamic situation at a particular moment. There are for example significant differences in the findings of the two rainy season surveys, which no doubt accurately reflect real differences in animal numbers at the time of survey, but it is impossible to know what causes these differences. Nonetheless, the aerial surveys are an important start to an accurate description of patterns of animal numbers, distribution and movement within the project zone.

---

1. See Milligan (1982 a,b,c) for detailed reports on methods and results.

2. That is to say herds composed entirely or mainly of one race of the other.

The following discussion focusses on the total animal population in the project zone, dry season animal numbers and distribution, and rainy season changes in the size, composition, and distribution of the livestock population.

Total animal population

Table 3.1.9 shows the number of animals found in the three surveys and table 3.1.10 the percent of the total, expressed in TLU, accounted for by each species.[1] Relative changes in number between surveys are shown in table 3.1.11.

Table 3.1.9 Total animal numbers in the project zone: air survey results

	May 1981		October 1981		September 1982	
	No.	(±SE%)	No.	(±SE%)	No.	(±SE%)
Cattle	288,650	(12)	376,530	(16)	331,140	(13)
- Bororo	(152,810)	(15)	(246,900)	(17)	(191,990)	(18)
- Azawak	(135,840)	(12)	(129,630)	(17)	(139,140)	(14)
Small ruminants	780,290	(8)	1,147,910	(11)	829,610	(8)
Camels	70,160	(9)	89,310	(8)	155,710	(32)

Source: Project air survey

1. Donkeys are not discussed here because the air survey donkey results are probably serious underestimates.

Table 3.1.10 Relative importance of different species in project zone: percent of TLU

	May 1981	October 1981	September 1981
Cattle	58	56	49
- Bororo	(31)	(37)	(29)
- Azawak	(27)	(19)	(21)
Small ruminants	22	25	18
Camels	20	19	33
TOTAL	100	100	100
(Total TLU	350,244	467,672	470,462)

Source: Project air survey

Note: Camels, cattle and small ruminants counted as 1, 0.7 and 0.1 TLU respectively.

Table 3.1.11 Seasonal changes in total project area animals (May 1981=100)

	May 1981	October 1981	September 1982
Cattle	100	130	115
- Bororo	(100)	(162)	(126)
- Azawak	(100)	(95)	(102)
Small ruminants	100	147	106
Camels	100	127	222
Total TLU	100	134	134

Source: Project air survey

The overall species composition of the zone's animal population, expressed in TLU, remains roughly the same throughout the three surveys: around 50 percent cattle, 20 percent small ruminants, and 20 to 30 percent camels. The total number of TLU in the May 1981 dry season survey was 350,000 which probably represents the project zone's permanent animal population. During the October 1981 (immediate post-rains) and September 1982 (late rains) surveys, the total number of TLU increased by over a third to around 470,000. Although the rainy season and immediate post-rains increase in animal numbers in comparison to the dry season is the same magnitude in both surveys, the causes are different. Azawak cattle (herded mainly by Twareg) numbers remain essentially the same throughout the three surveys, suggesting a population that is, despite seasonal movements, largely resident within the boundaries of the project zone. By comparison with dry season populations, Bororo cattle (herded mainly by WoDaaBe and FulBe) increase substantially in the October 1981 survey, and also increase, although to a lesser extent, in the September 1982 survey. These additional 50 to 100,000 Bororo cattle which enter the project zone in the rains are probably mainly in agropastoral FulBe herds. Small ruminants increase substantially in the October 1981 survey, although in September 1982 their numbers were close to dry season levels. Large numbers of sheep from the southern agropastoral area enter the project zone in the rains, and these probably account for the big October 1981 increase in small ruminants (an additional 370,000 small ruminants over the dry season total), but the small increase in September 1982 over the 1981 dry season figure is puzzling.

Camels increase in the wet season over the dry, with September 1982 totals (when camels account for a third of the total TLU in the zone) more than double those of May 1981, due mainly to a strong influx of Saharan herds into the north east of the project zone.

These changes indicate that, with the exception of the Azawak cattle population which remains stable, there are important seasonal and interannual changes in the total animal population of the project zone.

The aerial survey results also show that the rainy season livestock population tends to be grouped in fewer but larger herds. Table 3.1.12 shows changes in mean herd and flock size between surveys and figure 3.1.5 shows rainy season changes in the mean sizes of herds of different species as a percent of dry season (May 1981) figures. Here the results of the September survey are assumed to represent an earlier phase in the annual transhumance cycle than the October 1981 results. In general, in the rainy season the number of herds is smaller but the mean size of herds is larger than during the dry season. This tendancy is most pronounced in September, when relatively abundant resources permit concentrations of people and animals; in October, when the rains (and social gatherings characteristic of this season) are over, surface water is evaporating, and herds are moving back towards their dry season pastures, herd numbers and sizes begin to return to dry season patterns.

Table 3.1.12 Seasonal changes in mean herd and flock size in project area

	Mean herd/flock size		
	May 1981	October 1981	September 1982
Cattle	33	38	42
- Bororo	38	45	49
- Azawak	29	28	36
Small ruminants	46	70	77
Camels	5	6	20

Source: Project air survey

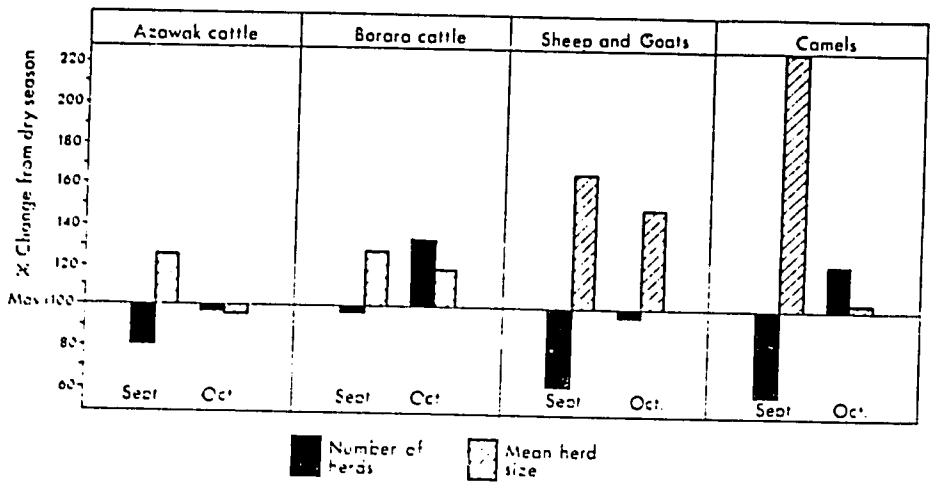


Figure 3.1.5 Project area: rainy season changes in number of herds and mean herd size as compared to dry season (May 1981 = 100)

Dry season distribution

The overall dry season density of the livestock population in the project zone is 5.1 TLU/km^2. However, as figure 3.1.6 shows, there is regional variation in density levels; highest levels are found in the southwest quarter of the project zone, and density decreases towards the north and east. In terms of the pastoral regions defined by the project (see chapter 2.2) Tchin Tabaraden is the most heavily animal-populated area, with a dry season density of 7.5 TLU km^2. The regions to the east of Tchin Tabaraden, that is, Abalak, Tofemanir, and Bermou, are of medium-to-high density, with between 5.8 and 6.5 TLU km^2. Tchin Taborak in the southeast and Tassara in the northwest have medium densities, around 4.4 TLU km^2. The two northeast regions, Ingal and Amataltal, have the lowest density levels of 2.7 and 3.2 TLU/Km^2 respectively. These gradations in density level are related to regional variation in the capacity of dry season pasture to support animal populations.

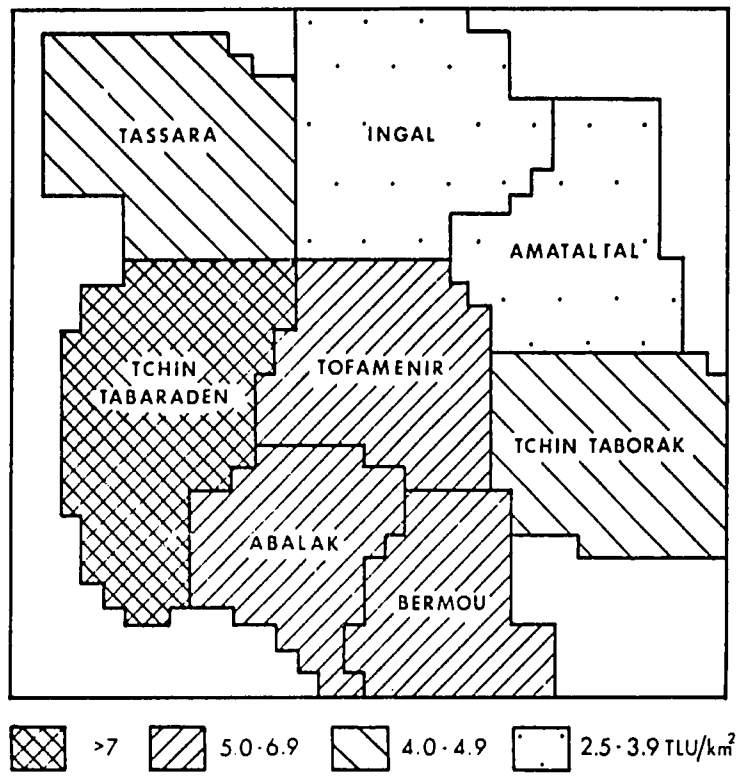


Figure 3.1.6 Dry season livestock densities in project pastoral regions (TLU/Km²)

Similarly, there are changes in the species composition of the regions' animal populations from southwest to northeast. As can be seen in figure 3.1.7, small ruminants increase in importance from the south and west, towards the north and east; the highest dry season concentrations are in Tofamenir and Tchin Taborak, where they amount to about a quarter of total TLU. Camels also become more important from south to north; in Ingal, Tassara, and Amataltal

camels make up between one third and one half of total TLU. Cattle in contrast, decrease in importance from southwest to northeast, accounting for between half and three quarters of total TLU in Tchin Tabaraden, Abalak, and Bermou; half in Tofamenir and Tchin Taborak; and around one third in Tassara, Ingal and Amataltal.

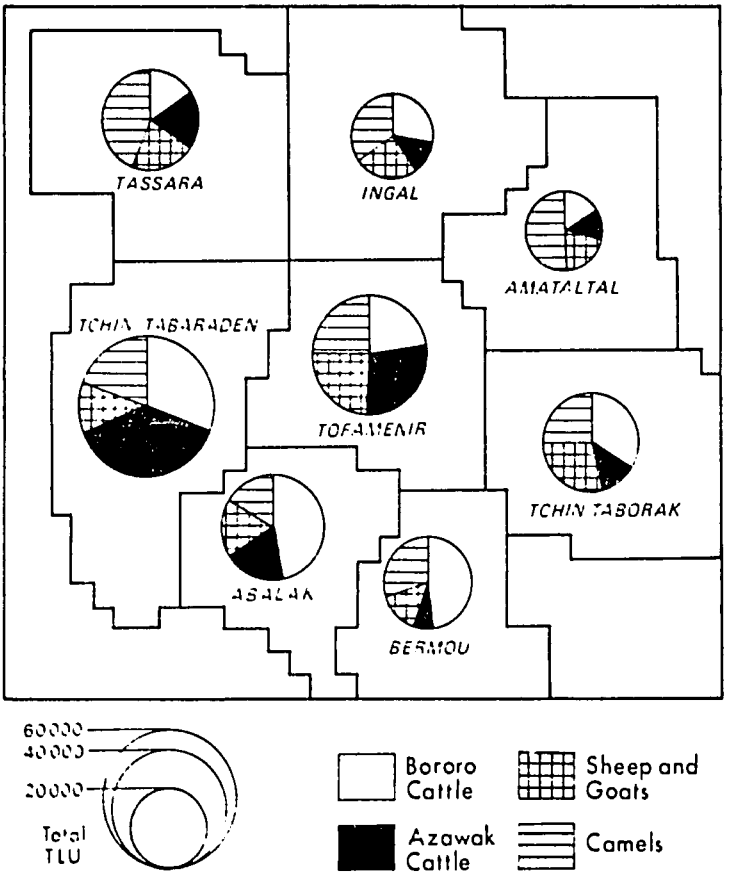


Figure 3.1.7 Dry season species composition within 8 project zone pastoral regions

Rainy season changes

In the rainy season, the numbers and distribution of animals in the project zone are altered by the movements both of herds resident year-round in the zone and those entering the zone in search of rainy season pastures. There was considerable variation by region and between the two rainy season surveys in animal numbers and herd sizes: some regions were virtually unaffected by the influx of southern herds, while others clearly became zones of concentration. Wet season changes in animal numbers in each pastoral region are shown in figure 3.1.8. The general trends of statistical significance in each region are as follows:

- In the Abalak region, the only significant increase in animal numbers between the dry and rainy season surveys was for Azawak cattle, which more than doubled between the May 1981 and September 1982 surveys; this increase did not entail a greater number of herds but rather a doubling of average herd size. Numbers of Bororo, the main cattle race in this region, remained similar in all periods, and in contrast to the Azawak, the largest average herd size was in the dry season, although seasonal differences in mean herd size were rather low. The small ruminant population similarly did not change in size during the three periods but was concentrated into fewer and larger herds during the rainy season.

- In the Bermou region, cattle, sheep and goat and camel numbers were similar in May and September but increased notably in October: Bororo cattle and small ruminants more than doubled. However, largest mean herd sizes for all species occurred in September.

- The region of Tofemanir clearly emerged as a rainy season concentration area, particularly for Bororo cattle which tripled between the May and September surveys; however, Azawak cattle declined in September and October. Bororo numbers were greatest in September and the herd size was over 100, or twice the mean size for the other two periods. Small ruminants were most abundant in May but average herd sizes were larger in September.

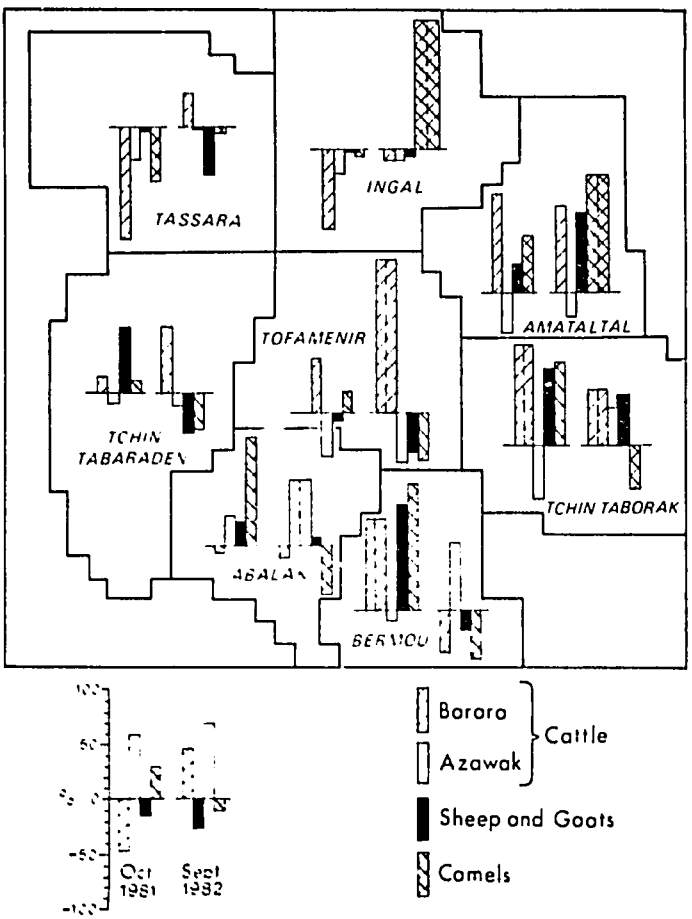


Figure 3.1.8 Wet season changes in herd size and composition as compared to dry season, by pastoral region

- In Tchin Tabaraden, the most densely animal-populated region throughout the three survey periods, there was no significant change in the size on the cattle population, though Bororo numbers increased in September 1982. Small ruminant numbers were lowest in September though at this time flocks were much larger than in the dry season. Cattle herds were also

largest in September, with the mean herd size for Bororo at 58 head (compared to 46 in May) and the mean size for Azawak at 41 head (compared to 24 in May). These results suggest that Tchin Tabaraden's animal population is relatively less mobile than those of other regions, though rainy season concentrations are still pronounced.

- In the northwestern region of Tassara, cattle numbers were lowest in October due to the virtual absence of Bororo cattle at this time. Azawak and small ruminant numbers changed little across the three survey periods, and Bororo numbers in May and September were not significantly different. Camel populations were relatively large in the Tassara area during both May and September.

- In the northcentral region of Ingal, cattle and small ruminant numbers remained roughly the same throughout the survey periods, though Bororo numbers dropped in October 1981. The most striking change in this region was an influx of more than 15,000 camels in September 1982; this influx was associated with a fourfold increase in the mean size of camel herds (from 6 to 21 head), though the overall number of herds did not increase significantly.

- The north eastern Amataltal region similarly experienced a large influx of large camel herds in September 1982; the number of animals increased by 17,000 and the mean herd size increased from 6 to 15 head. Bororo cattle and small ruminants experienced a slight significant increase in September.

- The eastern Tchin Taborak region saw an increase in cattle in the rainy season, due primarily to a large influx of Bororo cattle; Azawak numbers varied less in the course of the year, increasing by a few thousand head in September. Cattle herd sizes were also larger in the rains. Small ruminants were more numerous in the rainy season, and the mean flock size increased from 41 to 78 head.

Annex Table 3.1.13 Changes in national herd size by species, 1968 - 1980 ('000 head)

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Cattle	4,450	4,130	4,000	4,100	4,200	2,200	2,312	2,508	2,671	2,850	2,990	3,257	3,354
Sheep	2,800	2,770	2,700	2,765	2,850	1,800	2,136	2,159	2,354	2,556	2,650	2,764	2,973
Goats	6,430	6,200	6,000	6,165	6,300	5,300	4,918	5,395	5,946	6,540	6,700	6,871	7,043
Camels	360	330	345	345	345	285	235	253	283	345	352	359	391
Total	14,040	13,430	13,045	13,375	13,695	9,585	9,601	10,315	11,254	12,291	12,692	13,191	13,761

Source: Livestock Service.

Annex Table 3.1.14 Changes in national herd size by species, 1968 - 1980 (1968 = 100)

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Cattle	100.0	90.5	89.8	92.1	94.3	49.4	51.9	56.3	60.0	64.0	67.2	73.2	75.4
Sheep	100.0	98.9	96.4	98.7	101.8	64.3	72.7	77.0	84.1	91.3	94.6	98.7	106.2
Goats	100.0	96.4	93.3	95.8	97.9	82.4	76.5	83.9	92.4	101.7	104.2	106.5	109.2
Camels	100.0	91.6	95.8	95.8	95.8	79.1	65.3	70.3	78.6	95.8	97.7	99.7	108.6

Source: Calculated from data in table 3.1.13.

Annex Table 3.1.15 Changing composition of national herd, 1968 - 1980 (% each species)

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
% Cattle	31.7	30.7	30.7	30.6	30.6	23.0	24.1	24.3	23.7	23.2	23.5	24.7	24.4
% Sheep	19.9	20.6	20.7	20.7	20.8	18.8	22.2	20.9	20.9	20.8	20.9	20.9	21.6
% Goats	45.8	46.2	46.0	46.1	46.0	55.3	51.2	52.3	52.8	53.2	52.8	52.1	51.2
% Camels	2.5	2.4	2.6	2.6	2.6	2.9	2.4	2.4	2.5	2.8	2.8	2.8	2.8
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100

Source: Calculated from data in table 3.1.13.

Annex Table 3.1.16 Rates of reconstitution for cattle: cattle populations by department, 1968 and 1980

Department	1968	1980	1980 as % of 1968
Agadez	160,000	23,000	14.0
Diffa	560,000	492,000	87.8
Dosso	300,000	325,000	108.3
Maradi	500,000	434,000	86.8
Niamey	880,000	800,000	90.0
Tahoua	980,000	600,000	61.2
Zinder	1,070,000	680,000	63.5
TOTAL	4,450,000	3,354,000	75.4

Annex Table 3.1.17 Rates of reconstitution for goats: goat populations by department, 1968 and 1980

Department	1968	1980	1980 as % of 1968
Agadez	224,000	94,000	41.9
Diffa	565,000	761,000	134.6
Dosso	350,000	472,000	134.8
Maradi	1,219,000	1,186,000	97.4
Niamey	865,000	707,000	81.7
Tahoua	1,822,000	2,026,000	111.2
Zinder	1,385,000	1,795,000	129.6
TOTAL	6,430,000	7,043,000	109.5

Source for tables 3.1.16 and 3.1.17: Livestock Service, Annual Reports, 1978 and 1980.

3.2 ANIMAL PRODUCTION

This chapter is divided into three parts: the first two parts summarize and analyze the results of a survey of animal production technical parameters among Twareg and WoDaaBe herders in the project zone carried out on behalf of the project by the International Livestock Centre for Africa (Wilson and Wagenaar 1982); the third part summarizes project observations and measurements on animal production, including experimental results (Louis 1982a).

The study of technical parameters described in the first two parts was carried out as a single round retrospective survey designed to provide baseline information for future experimental animal production work in the project zone. A rapid survey of the Twareg pastoral system was carried out in the Ingal area. Information was collected on camels, goats, sheep and donkeys, with emphasis mainly on camels because of their importance in this production system (as the previous chapter showed, they account for between one fifth and one third of total TLU in the project zone), and the lack of knowledge otherwise available.

A more intensive survey was carried out of WoDaaBe cattle production in the Abalak area, which had been subject to intense project activity. The WoDaaBe herders' associations were used as the sample frame for the study and more detailed information was obtained on individual holdings with particular reference to cattle productivity, with supplementary information on other classes of stock.

TWAREG ANIMAL PRODUCTION SURVEY

(1) Materials and methods

The dry season concentration area for camels around Ingal was selected by the project as the sample area, specifically a segment of a circle extending from south-west to south-east up to a distance of 40 kilometres from Ingal. This area was surveyed from 13 November to 22 November 1982.

Camel studies were mainly undertaken in camps selected after discussion with herders contacted at wells. Camels were identified individually, their sex determined and age provided by the owner, confirmed in a number of cases by inspection of teeth. In the case of breeding females a career history was then established by reference to other animals in the herd, and to animals which had already disappeared from the herd and by enumerating abortions. Animals not included in this census but present in the herd (almost all males) were then enumerated separately. A number of recently dead or sold breeding females were included in order to improve the sample size for the career histories. With the exception of abortions and deaths of very young calves, it soon became apparent that the number of deaths was either being greatly exaggerated or that deaths were being projected backwards over a longer time frame than was requested. A total of 215 breeding female career histories was established and 649 animals were enumerated to establish the herd structure.

All goats and sheep were individually handled and aged by dentition, occasionally supported by owner information, particularly for young animals up to the age of eruption of the first pair of incisors. About half the flocks were examined first at water points, the remainder completely at camps. Those examined at water points were mainly goats (which proved much more amenable to handling at this site than at the camp, where the majority was prone to disappear as soon as the first animals were handled), but in all cases flocks were followed to camps where all young and any sick animals were examined and included in the flock structures. After initial discussions with owners and attempts to establish career histories and mortality rates both these parameters were abandoned in favour of indirect methods involving flock

structure, distribution of births and comparative estimates based on firm data from other areas. Because of the very early age at which offtake of males starts, the secondary sex ratio at birth has been assumed to be 1:1. A total of 1,761 goats and sheep were enumerated.

Donkeys were sexed and aged by individual handling. Animals both at camps and at water points were taken in totality when encountered. Because of the small numbers held by individual families and camps no attempt was made to establish ownership and, particularly at water points, the sexing and ageing was done on an all-comers basis. Reproductive and offtake rates have thus been calculated from herd structures and from the numbers of foals following dams (which they invariably do from the first day of life). Altogether 365 donkeys were handled.

(2) Management

Management of all species by Twareg herders in the Ingal area is very extensive. Camel calves up to about 18 months of age and goat and sheep young up to about three months of age are restrained in camp, the former by means of leg ties to a picket, the latter by neck loops on a single rope stretched between two pickets. Very young goats are occasionally put in a small thorn enclosure in the shade of a bush or tree. Camel calves from the age of 4-6 months and small stock young from the age of 2-3 weeks are allowed a period of free grazing at some time during the day.

Male and non-lactating female camels are hobbled and allowed to wander freely within a short distance of the camp. Lactating camels are not hobbled and these return systematically to the camp every evening to suckle and be milked. They leave camp again very shortly after daybreak after being milked a second time.

In common with many other camel-owning groups (Williamson and Payne 1978) the Twareg do not allow new-born calves access to their dam's colostrum, suckling being permitted only from the third day of life. The whole herd is rounded up every five or six days for watering although watering is more frequent in the hot period of March to May. No attempt to control the

breeding season is made and, indeed, we saw two forced matings during our stay: these, if successful, would result in calves in November 1983 at the start of the most difficult period for food. An assurance of some continuity in milk is obviously important.

Goats and sheep are managed slightly differently. Goats are not herded except when going to water. They graze and browse within a limited distance of the camp, remaining together as a loose flock and returning to the camp as a unit at nightfall or shortly before. Sheep, on the other hand, are herded by a young member of the family, their homing instincts being less developed than those of goats, and are conducted to various pastures and brought home to camp some time after dark. Milking of both goats and sheep is done by women and children, much of the sheep's milk being conserved in the form of pressed cakes of curds. Watering frequency is at two or three day intervals depending on distance from the water point and owner preference. During the survey there was no evidence of attempts to control the breeding season in goats and this is apparently rarely practised, although there is considerable evidence (which agreed with observations elsewhere) that social factors within individual flocks lead to grouping of births. The breeding season of sheep is artificially controlled so that births occur between June and early November, this being achieved by means of a cord attached from the scrotum to the prepuce of the male causing the penis to deviate and making sexual union (in theory) impossible.

Donkeys are almost entirely unmanaged. The hierarchical dominant (often a female) is generally hobbled to prevent wandering and the other animals of the group remain with it. They are used mainly for the transport of water but also carry the products of exchange when needed. The camp "herd" generally goes as a unit to the waterhole but, unlike the other species, once there does not remain as a separate entity. Instead it mingles with other donkey groups to form a conglomerate single species unit.

(3) Technical coefficients

Camel herd structure

Holding or group size

In all 31 people claiming to own 649 camels were interviewed in the seven camps, with individual owners having between 2 and 83 animals. Details of the percentage of owners keeping groups of various sizes are shown in table 3.2.1. The mean group size was 20.9 (± 17.01 SD) camels; excluding the one large herd of 83 animals the mean was 18.9 (± 12.90 SD) camels.

Table 3.2.1 Twareg sample: percentage of owners having specified number of camels

Number of camels in group	Percent of all groups	Percent of all animals	Mean no of breeding females
1 - 5	19.4	3.4	1.33
6 - 10	12.9	4.5	2.50
11 - 20	25.8	17.7	5.50
21 - 40	35.5	54.8	9.50
> 40	6.5	19.6	18.00

Herd demography

The sex and age distribution of the 649 camels censused is shown in figure 3 2.1. Of the total 387 (59.6 percent) were female and 262 (40.4 percent) were male. Of the latter, 231 (35.6 percent of the total) were entire males and 31 (4.C percent of the total animals, 13.4 percent of all males) were castrates. It is obvious from figure 3.2.1 that some errors in ageing have been made, particularly in males, or that calving occurs very unevenly between years. The reduction in the number of females is much lower in terms of relative age in comparison with other species until about 10 years of age. A number of reasons, each or any in combination, might be responsible for this phenomenon:

- a marked reluctance to sell breeding females until well into middle age;
- a very low death rate in camels after the first 18 months or 2 years of life;
- a high death or sale rate occurring throughout the herds about 10 years before present (which would, of course, be about the time of the 1968-1973 drought).

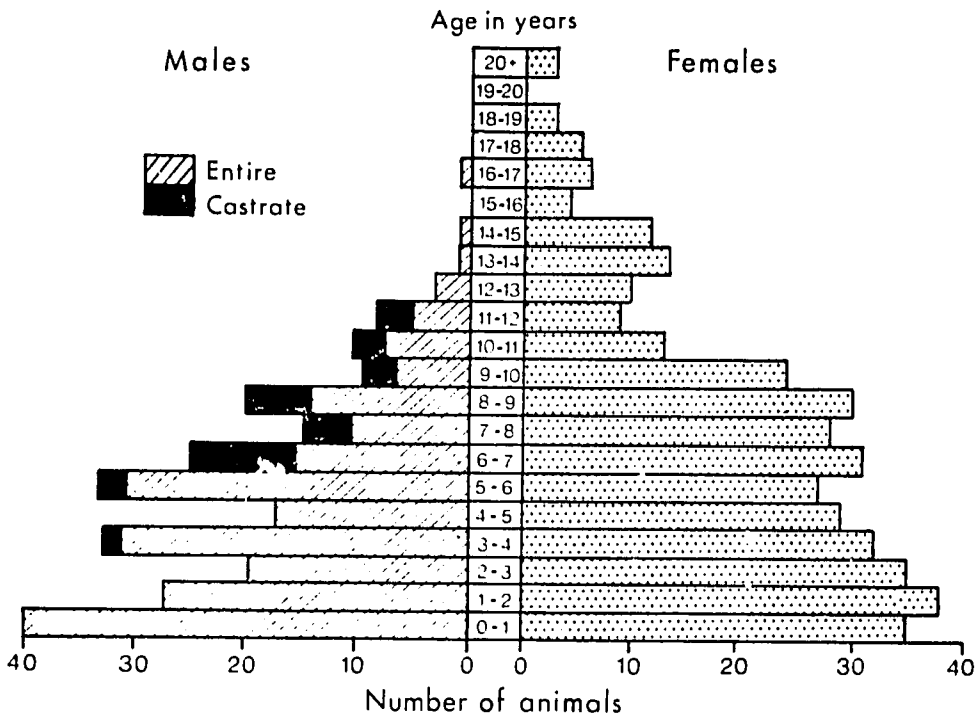


Figure 3.2.1 Age and sex distribution of the camel population

With the exception of two castrates at 3 years old, castrated animals do not occur until over the age of 5 years. Mature size is almost achieved by this age and castration of males not required for breeding has obvious biological and probable economic value. Some offtake of males obviously occurs from about 6 or 7 years upwards: the WoDaaBe, many of whom keep one male camel (see later section) are an obvious market for these animals.

Males of breeding age (8 years and upwards), or at least males capable of dominating other males in the herd and thus acting as progenitors, constitute six percent of the herd (39 animals). Breeding females, considered here as those over 5 years old, number 220 (compare with the 215 females censused actually having given birth to one or more young) or 33.9 percent of the herd. When females in the 4 year old group are added (as most of these are apparently mated) the ratio of potential breeding males to females is 1:6.3. Table 3.2.2 illustrates in percentage terms the status of animals in the herds.

Table 3.2.2 Percentage of animals in Twareg camel herds by function and production categories

	Males	(Castrates)	Females
under 2 years	10.3		11.2
2 - 5 years	10.6	(0.3)	14.5
5 - 8 years	11.2	(2.3)	13.6 (a)
8 -10 years	4.5 (g)	(1.2)	8.3 (b)
10 -13 years	3.2 (g)	(0.8)	4.9 (c)
13 -15 years	0.4 (g)	(0.2)	3.9 (d)
15 -17 years	0.2 (g)		1.5 (e)
over 17 years			1.7 (f)

Notes: (a) - (f) Females having had, respectively, 1 to 5 and 6 or more calves on the average
(g) Males capable of breeding.

Camel reproduction

Seasonality

Data on the season of birth was obtained for 520 births including abortions and stillbirths where these were specified. Although six seasons were named by respondents only the four principal ones for the Ayr region as

defined by Nicolaisen (1963) have been used for establishing seasonality, as the two transitional seasons, the one between the cold dry tigrest and the hot dry ewilen and the one between the hot dry and the rainy akasa, appeared to vary considerably between years. The distribution of births according to this calendar is thus confined to 3-month periods and is shown in figure 3.2.2. From this rather global picture we have attempted, by means of trending the births, to arrive at a possible monthly distribution of births, which is also shown in figure 3.2.2. There is a highly significant difference (X^2 = 66.1; d.f. = 3; P < 0.001) in the distribution of births between seasons and, on the adjusted monthly figures, between months (X^2 = 78.8; d.f. = 11; P < 0.001).

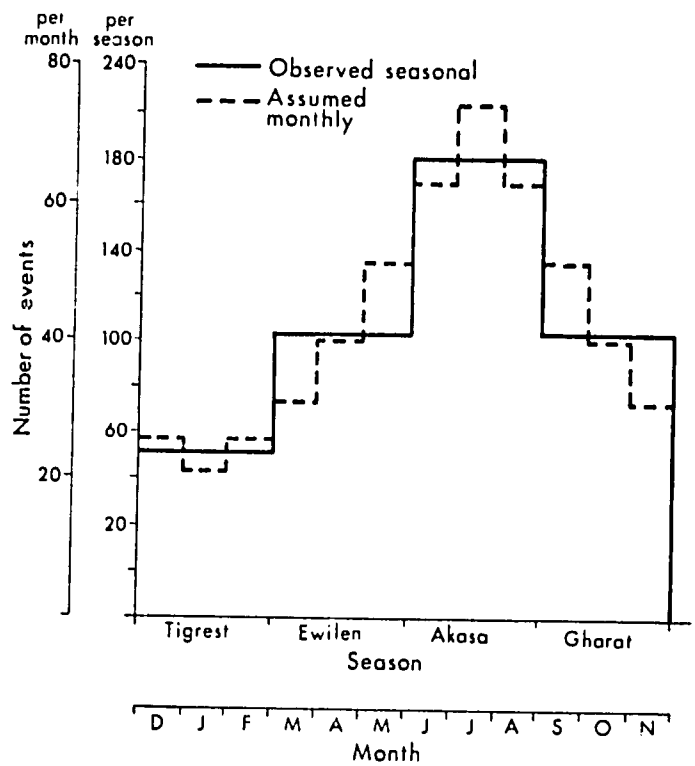


Figure 3.2.2 Seasonal and monthly distribution of births in camels (n=520)

In camels it is generally accepted that the breeding season is principally controlled by the rut, the period of greatest sexual activity, of the male. The pattern suggested by figure 3.2.2 is that of a single rather prolonged breeding season starting with the onset of the hot season and continuing until temperatures begin to cool during the short rainy period.

Age at first parturition

Calculated on the 215 camels for which data are available, the age at first parturition was 4.96 (± 1.69) years in the range 2-11 years. Some misreporting has obviously occurred, the age of two being exceptionally early for first birth in a camel.

The general opinion of herders was that puberty was attained at three years with first parturition thus occurring at four years.

Calving interval

A total of 329 intervals between births was suitable for analysis. Because of the method of recording births by season the birth intervals have, of necessity, been grouped within periods of 3 months, the frequency distribution on this basis being shown in figure 3.2.3. Some of the intervals are shorter than the actual gestation period: this is explained by the inclusion of abortions in the total of births. Similarly some of the intervals of 12 and 15 months (as well as a small number of longer intervals) are due to abortions. It needs to be noted that there was an often stated and strongly held conviction among owners that abortions and still-births resulted in virtually automatic and immediate conception. That is, owners are well aware of the consequences of lactation on oestrus. How much this belief that an unsuccessful birth resulted in a very short interval before the next parturition affected the overall result in terms of the calculated interval could not be ascertained.

The mean overall calving interval for all 329 events was 26.21 (± 10.6) months: the calving intervals for individual parities are shown in table 3.2.3 which shows that the interval between the first and second parities is

longer than that between all subsequent parities, a result no doubt of the drain of pregnancy and lactation on the physical and physiological states of the young mother.[1]

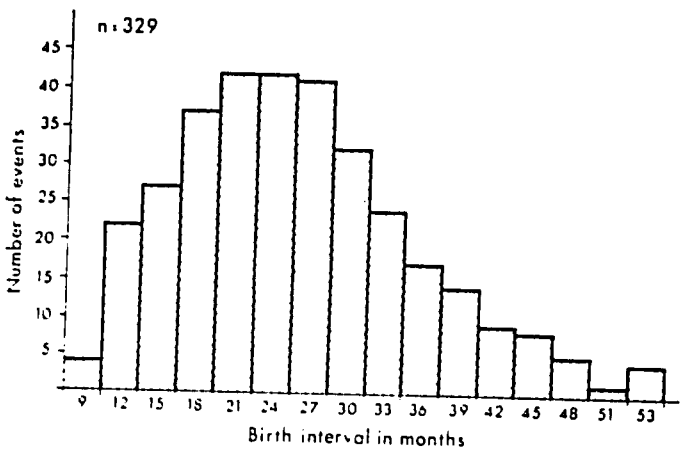


Figure 3.2.3 Frequency distribution of birth intervals in camels

1. It should be recalled that the unit of time measurement was a traditional season of 3 months; birth intervals and their standard deviations should be read accordingly.

Table 3.2.3 Twareg sample: means and standard deviations for birth interval for specified parities in camels

Parity	Mean interval (months)	± SD (months)	Number in sample
1 - 2	28.6	9.10	144
2 - 3	24.0	9.63	97
3 - 4	25.8	8.89	54
> 4	20.1	7.55	34

Annual reproductive rate

The annual reproductive rate (number of young born per breeding female per year) is normally one of the most difficult parameters to estimate in traditionally managed livestock systems. One method occasionally used is that involving the interval between successive births and the number of young per birth. Using this method in this case (no twin births recorded) gives an annual reproductive rate of 45.8 percent (365/interval between births). This method has the disadvantage of taking into account only those animals which reproduce regularly and ignores a number of long intervals before the beginning and after the end of the reference period. It therefore tends to overestimate slightly the true rate.

As a check on this method we have calculated the total number of young reported born (alive and dead and abortions) as a percentage of all breeding females in the herd in the year preceeding the survey. This amounted to 93 births which gives a total annual reproductive rate of 42.3 percent.

It thus appears that the annual reproductive rate can be taken to be in the region of 40-45 percent.

Number of births per breeding female

The 215 females included in the survey had given birth to a total of 573 calves. The percentage of females having given birth to specified numbers of calves is shown in figure 3.2.4.

The average number of calves produced by each female camel in the herd is 2.67: this makes the mean age of female at withdrawal from the herd some 10 years 9.4 months (age at first parturition + 1st interval + 2nd interval + (0.67 x 3rd interval)) which agrees well with the herd structure shown in figure 3.2.1.

Secondary sex ratio at birth

Of 528 known births in which sex was recorded (the total excludes some abortions, the sexes of which are seldom, indeed sometimes cannot be, determined) 273 were males and 255 were females, a male : female ratio of 1.07:1.00. This figure does not differ significantly from an expected 1:1 value (X^2 = 0.61; d.f. = 1; P > 0.05).

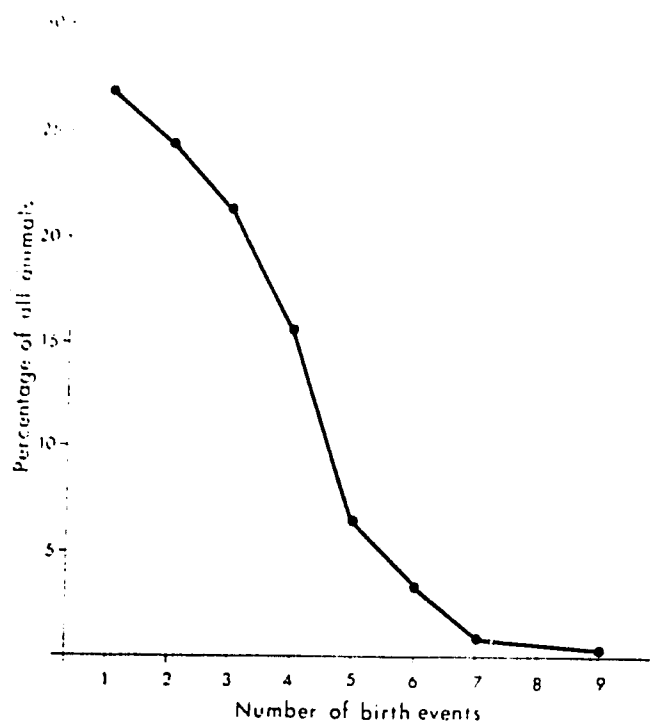


Figure 3.2.4 Percentage of female camels having a specified number of birth events (n=215)

Camel mortality

Young stock to 12 months of age

A total of 120 calves were reported as dead or aborted before the age of one year out of the total of 573 calves recorded. This is equal to 20.94 percent of the total.

Deaths in older stock

As mentioned earlier information on deaths in older stock was considered to be grossly inaccurate. It appears from the herd demographic structure presented in figure 3.2.1 that at least over the last few years the death rate in animals over one year old and under ten has been very low: it can be estimated in the region of five percent or less per year. Over ten years the picture is complicated by the after-effects of the 1968-73 drought and, probably, by some sales of older females for slaughter.

Camel offtake

Very few females of breeding age are disposed of, the low breeding rate in relation to human nutritional requirements undoubtedly being responsible for this. There is some offtake of males from about 6 years of age with a greater rate of offtake taking place from 9 years of age. Commercial offtake may be estimated to be in the region of 6 to 8 percent per year, which would enable the average herd owner to have just over one animal for sale every year.

Goat flock structure

Holding or group size

Seven flocks with a total of 418 goats were censused. Flock size varied from 39 to 83 animals with a mean flock size of 59.7 and a standard deviation of 15.36 animals.

Flock demography

The sex and age distribution of the 418 goats is shown in table 3.2.4. The 359 females, amounting to 85.9 percent of the total flock, indicates an offtake of males starting very early in life and continuing at a fast rate

until virtually all males are eliminated from the flock at or slightly after the age of one year. There were no castrates in the flocks and it seems that castration is not generally practised in goats; it would certainly not be worthwhile at the ages at which they are withdrawn from the flocks.

Breeding females have been considered as all females in excess of 10 months of age. The figure thus derived is 279, equivalent to 66.75 percent of the flock, which is rather high by the standards of other West African flocks. Breeding males of over six months of age totalled only 16 animals, representing only 3.8 percent of the total flock. While in theory this allows an adequate ratio of breeding males to breeding females of 1:17.4, in practice it is possible that overall breeding performance is reduced due to temporary male infertility and also due to the fact that some flocks have no males at all of breeding age. The number of females over approximately 5 years of age (13.9 percent) is very high.

Table 3.2.4 Twareg sample: sex and age structure of goats

Age (months)	Males		Females		Total	
	No	% of total flock	No	% of total flock	No	% of total flock
0 - 6	43	10.3	58	13.9	101	24.2
6 - 14	11	2.6	44	10.5	55	13.2
14 - 19	4	1.0	20	4.8	24	5.7
19 - 24	1	0.2	35	8.4	36	8.6
24 - 30	-	0.0	38	9.1	38	9.1
30 - 60	-	0.0	106	25.4	106	25.4
> 60	-	0.0	58	13.9	58	13.9
Total	59	14.1	359	85.9	418	100.0

Coupled with the high percentage of total breeding females it probably means that reproductive rates are comparatively low and, in order to ensure an adequate number of lactating goats, more females are kept for a longer period than is normally the case.

Goat reproduction, mortality and offtake

Seasonality of breeding

Breeding is not controlled in goats and therefore some births occur all the year round. In fact the structure of the flocks supports a hypothesis of year-round breeding with peaks due to social factors within the flock with a more prominent peak occuring in the cold dry season of tigrest. A more detailed analysis of breeding is given in the discussion section, below.

Age at first parturition

A number of goats with temporary incisors and 16 out of the 20 with one pair of permanent incisors had already given birth to young at the time of the survey. In the majority of goats therefore, first parturition occurs before 18 months of age and probably averages about 15 months.

Deaths in older stock

Actual death rate is probably low, as most sick animals are slaughtered and eaten before death supervenes. The flock structure, as for camels, gives no indication of any serious age-specific losses and the number of older females also supports a supposition that death rates have been low for the last few years.

Offtake

Offtake is of young and very young males, mainly for consumption within the camp. Some males and older females are sold commercially.

Survey information was insufficient to calculate other technical parameters for goats. However discussion with owners, inferences from flock structure and comparison with similar production systems in similar ecological conditions enables the main remaining coefficients for Twareg goat flocks in the survey area to be estimated, although these should be treated with caution. These estimates are given in table 3.2.5.

Table 3.2.5 Twareg sample: some estimated technical coefficients for goats

	Coefficient
Kidding interval (days)	280-310
Multiple births (% of births giving twins)	12-15
Annual kidding rate (%)	108
Number of births per breeding female:	
- mean	5
- maximum	8
Average age at which breeding females are withdrawn from flock (years)	4.6
Annual mortality:	
- 0-12 months (%)	30
- 12 + months (%)	5
Annual total offtake (%)	25-28

Sheep flock structure

Holding or group size

Thirteen flocks with a total of 1,343 sheep were censused. Flock size varied from 25 to 190 animals with a mean group size of 103.3 and a standard deviation of 53.29 animals. Seven (53.8 percent) of the flocks were of more than 100 animals and six (46.2 percent) contained less than 100 animals.

Flock demography

The sex and age distribution of the 1,343 sheep is shown in table 3.2.6. Females total 1,098 animals or 81.8 percent of all animals. While early offtake of males is not quite as heavy as with goats, it still starts at a very early age and is quite intensive. Unlike goats, a number of male sheep are allowed to grow on to ages of 12-15 months before being castrated, these castrates then being slaughtered for religious or ceremonial purposes at ages of approximately 1.75 to 2.25 years when weighing some 55-60 kg.

Table 3.2.6 Sex and age structure of sheep in the Iwarey sample

Age (months)	Males						Females		Total	
	Entire		Castrate		Total					
	No	% of total flock	No	% of total flock	No	% of total flock	No	% of total flock	No	% of total flock
0- 6	100	7.4	-	0.0	100	7.4	161	12.0	261	19.4
6-15	54	4.0	9	0.7	63	4.7	158	11.8	221	16.5
15-21	18	1.3	34	2.5	52	3.9	215	16.0	267	19.9
21-27	9	0.7	14	1.0	23	1.7	110	8.2	133	9.9
27-35	1	0.1	5	0.4	6	0.5	87	6.5	93	6.9
35-60	-	0.0	1	0.1	1	0.1	278	20.7	279	20.8
>60	-	0.0	-	0.0	-	0.0	89	6.6	89	6.6
Total	182	13.6	63	4.7	245	18.2	1098	81.8	1343	100.0

As with goats, breeding females have been considered as all those in excess of 10 months of age. This gives a total of 858 animals or 63.9 percent of the total sheep flock. This, as with goats, is a comparatively high figure. Breeding males over six months total 82, representing 6.1 percent of the flock. The ratio of 1:10.5 breeding males to breeding females probably assures a more than adequate cover. Females over 5 years of age are 6.6 percent of the flock, a percentage of this age of sheep comparable with that of other flocks in similar or slightly better endowed environments. It probably indicates a general satisfaction with current levels of production in sheep flocks, allowing a relatively early culling of breeding females to take place.

Sheep reproduction, mortality and offtake

Seasonality

Breeding is controlled in sheep by means of ligaturing the penis of the male. It appears that in practice the reproductive season is regulated so that all births (although in practice a small number do not) occur in the period from mid-June to mid-November, that is in the local seasons of akasa and gharat. The flock structure supports this interpretation of the system to a considerable extent, with the group of animals of 12-15 months and 15-21 months being the 1981 crop of lambs, and the two groups of 21-27 and 27-34 months being the 1980 crop. There still appears to be a slight excess of 1981-born sheep compared with the 1982 and 1980 crops which is difficult to explain in view of the fact that rainfall in that year (and therefore presumably grass production) was the worst of the three.

Age at first parturition

Some sheep with temporary incisors (i.e. under 15 months of age), but 157 (73 percent) of those with one pair of permanent incisors, had already produced a lamb. It appears, therefore, that first lambing in sheep occurs at about 18-20 months of age on the average but in practice, because of the controlled breeding season, occurs in two distinct age groups of sheep, those in their first year (12-17 months) and those missed in their first year but conceiving early in their second season (19-24 months of age).

Lambing interval

As a result of the controlled breeding season the mean lambing interval is probably in the region of 12 months, with a few animals having intervals shorter than this, and with a very small number dropping a lamb only every two years on occasions.

Multiple births

Twin births are apparently very rare and not particularly liked by owners as they are considered to put an unnecessary strain on ewes. The estimated percentage, from observations and owner response, is in the region of 3-6 percent of all births.

Offtake

Offtake is of young males, mainly for home consumption for religious and ceremonial purposes. The flock structure indicates some offtake of females in the 5-6 year old range, perhaps as a result of an increase of flock numbers over recent years.

As with goats, an attempt was made to estimate those technical coefficients which could not be calculated reliably from the survey data. These estimates, which assume sheep flocks in the area are like those in similar ecological conditions, are shown in table 3.2.7.

Table 3.2.7 Twareg sample: some estimated technical coefficients for sheep

	Coefficient
Annual lambing rate (%)	90-100
Number of births per breeding female:	
- mean	4
- maximum	7
Average age at which breeding females are withdrawn from flock (years)	4.5
Annual mortality:	
- 0-12 months (%)	25
- 12 + months (%)	5
Annual total offtake (%)	22-25

Donkey herd structure

Holding or group size

No attempt was made to determine this parameter with any accuracy. Donkeys are allowed to roam at will within the grazing orbit of a camp. Some three or four donkeys of all ages per tent satisfies the needs for transport of water and exchange goods.

Herd demography

The sex and age distribution of 365 donkeys censused at camps and taken on an all-comers basis at wells is shown in table 3.2.8. Females amount to just over 70 percent of the total herd. Some offtake of males is apparent, starting at the age of about 18-24 months. While the herd is basically kept for work, it also acts as a breeding herd supplying males and probably a few surplus females to a mainly urban but also agro-pastoral market to the south.

Breeding females over 2.5 years of age total 188 animals, equivalent to 51.5 percent of the herd. The male:female ratio is more than adequate to ensure a satisfactory breeding rate. Maximum age of a very small number of females was estimated at approximately 20 years. Most animals disappear before 15 years of age, probably being simply allowed to die of starvation or thirst when they are no longer capable of work.

Table 3.2.8 Age and sex structure of donkey population in the Twareg sample

Age	Males		Females		Total	
	No	%	No	%	No	%
0 - 6 weeks	1	0.3	2	0.6	3	0.8
6 -36 weeks	13	3.6	11	3.0	24	6.6
8 -33 months	43	11.8	55	15.1	98	26.8
33-45 months	9	2.5	22	6.0	31	8.5
45-57 months	15	4.1	35	9.6	50	13.7
4.75-8 years	24	6.6	98	26.8	122	33.4
> 8 years	4	1.1	33	9.0	37	10.1
Total	109	29.9	256	70.1	365	100.0

Note: Males include a small number of castrates in the three senior age classes, not enumerated separately.

Donkey reproduction

Seasonality

No attempt at control of breeding is exercised and there is no evidence of any seasonality in breeding.

Age at first parturition

A few donkeys with temporary incisors (less than 30 months old) had foals at foot but average age at first parturition appears to be at about the eruption of the second pair of permanent incisors at 3.5 years of age.

Foaling interval

Based on the composition of family groups estimated at 27-30 months.

Annual reproductive rate

Again on the basis of family group composition and estimated foaling interval, estimated at 40-45 percent.

Number of births per breeding female

Maximum of seven or eight foals and an average of four or five, giving an average age for females disappearing from the herd of 13.5 to 16 years of age.

(4) Discussion and comparison with other data

Camel herd structure

Comparative data on herd demography from different populations of camels are given in table 3.2.9. This shows a rather wide range of herd structures with females accounting for 78 percent in the most extreme case (although some males were considered to be away on salt transport at the time of the survey) to as low as 50 percent in a mixed transport subsistence economy. A general model from the six groups would give a herd with total females in the herd being somewhere between 30 and 40 percent of total animals. Population demography as influenced by the owning group is the outcome of the consumption or other requirements of the group. In the extreme case of the Somali who do not use camels for pack, breeding females account for a greater percentage

than in any other group except the Mali Twareg. The latter case may be due to census errors or perhaps to the effect of the 1968-73 drought which was at its

Table 3.2.9 Comparative demographic data of African camel populations

Owning group/country	Males (%)		Females (%)		Source
	Total	> 4 years	Total	"Breeding"	
Twareg/Niger	40	18	60	34	This study
Twareg/Mali	22	2	78	57	Swift 1979
"Jamala"/Sudan	50	?	50	25	Wilson 1978a
Somali/Somalia	26	15	74	42	Swift 1979
Rendille/Kenya	35	?	65	40	Spencer 1973
Gabbra/Kenya	44	?	56	37	Bremaud 1969

height when the census was undertaken. The animals of the present study conform to a general hypothesis of milk production as a primary function with subsidiary roles of transport and income by sale for males. In this study animals were of both the so-called "white milking" and "pied transport" camels (Bernus 1981) with no apparent differences being observed in either population demography or performance.

Camel reproduction

Seasonality

Female camels were once considered to have a distinct breeding season but it has been shown (Shalash and Nawito 1964) that they are in fact polyestric. Any peaks in breeding are thus primarily controlled by the rut of the male. The factors governing the rut are not fully understood but in most of northern Africa it (and thus the period of peak calving as the gestation period is of about 12 months in length) corresponds to increasing day length and the rising

level of maximum temperatures associated with the hot season of March to May or June. The results of this study confirm in general this pattern which is similar in Egypt (e.g. Shalash and Nawito 1964; Osman and el Azab 1974), in Morocco (Charnot 1963) and in Sudan (Wilson 1978a). In Mali there are said to be two short peaks in the reproductive cycle, one in February and March and another in August and September (Swift 1979). The only other exception to the single hot season peak is in Somalia (Leese 1927) where there are peaks in June and September to November but as this region is astride the equator some variation might be expected.

Age at first parturition

Few comparative data are available other than in general terms. First calving apparently occurs naturally between 4 and 6 years of age in most cases for which any information is forthcoming.

Calving interval

The conventional wisdom is that calving in camels occurs every two years giving a calving percentage of 50 percent. Bernus (1981) has indicated that this is the pattern for the Ayr. The overall picture is however rather complicated. While the results from this study indicate an overall calving interval of 26 months, this includes all recorded instances of abortions, still-births and neo-natal deaths which often result in almost immediate reconception and a shorter subsequent calving interval. As we have stated in the section on technical results the inter-year variation is probably very great. In Sudan a series of poor years followed by an exceptionally good one resulted in a rate of 70 percent (Wilson 1978a), and in Tunisia among army camels the rates in four successive years have been given as 23.1, 30.8, 15.4 and 57.8 percent (Burgemeister 1975). The distribution of all intervals by various periods is of some interest, comparative data for this being shown in table 3.2.10.

Table 3.2.10 Reported intervals between successive camel calvings in three different studies

Country	No of observations	Percentage of intervals occuring in specified periods (months)					Source
		< 12	12-15	18-21	24	> 24	
Niger	329	1.2	14.9	24.0	12.8	47.1	This study
Mali	43	0.0	20.9	27.9	44.2	7.0	Swift 1979
Kenya	26	0.0	11.5	3.9	53.8	30.8	Bremaud 1969

Annual reproductive rate

The estimated annual reproductive rate of camels in the study area is of the order of 40-45 percent of breeding females including a considerable percentage of abortions or stillbirths. These types of birth do not result in lactation (except in odd cases). The consequences of this low reproductive rate coupled with the low percentage of total breeding females in the herd mean that, even if human offtake of milk can be extended to 15 or 18 months, only some 12-15 percent of the total herd is in lactation and capable of providing subsistence to the human population at any one time.

Secondary sex ratio at birth

Calculation of the sex ratio from three other sources available (Sharma, Bhargava and Singh 1963; Shalash and Nawito 1964; Musa and Abusineina 1976), unweighted for numbers, gives a crude rate of 1.04 male births for every 1.00 female, which compares well with the ratio of 1.07 established in this study.

Camel mortality

Early embryonic deaths and resorption of the foetus is a common occurrence in camels (Leese 1927; Shalash and Nawito 1964) and undoubtedly has some effect on the overall calving interval and reproductive rate. Abortions

nearer to term and still births also generally appear to be of considerable importance. In Somalia, for example, 34 (18.3 percent) of 186 pregnancies terminated in one or other of these two states while in Mali 15 (19.5 percent) of 77 pregnancies suffered a similar fate (Swift 1979).

Losses in young up to one year old are said to be as high as 50 percent. It must be assumed that these losses, other than in exceptional circumstances, are grossly overstated. If such were not the case, the population dynamics of camels, in spite of relatively low adult mortality rates would be zero to negative. There is little evidence, for Niger or elsewhere, that this is the case.

Goat and sheep flock structure

In traditionally managed goats in Africa, females always outnumber males in overall flock structure with a general ratio being of the order of 75:25. The primary objective of goat keeping is to produce milk but flock structures do not always fully reflect this fact: sheep are almost invariably kept in addition to goats and it appears that the principal management objectives of sheep influence management practices, and hence to some extent flock demography, of goats. This is clearly demonstrated in table 3.2.11 which shows generalised flock structures for both goats and sheep in several areas of arid and semi-arid Africa. As milk becomes less important in the diet, or as other animals replace small ruminants as the principal suppliers of milk (for example the Baqqara of the Sudan and the Maasai of Kenya where cattle are the principal animals kept for this purpose) the total number of females and the percentage of breeding females is generally reduced. The Twareg of the study area appear near the top of the list, indicating that small ruminants are a main source of milk supply for them.

Table 3.2.11 Examples of management objectives related to sheep and goat flock structures (structure as percent of total animals)

Area/ethnic group	Sheep					Goats				
	Use	Males		Females		Use	Males		Females	
		Total	Castrates	Total	Breeding		Total	Castrates	Total	Breeding
1 Ethiopia/Afar	Milk	7.8	0.0	92.2	61.4	Milk	3.3	0.0	96.7	65.5
2 Niger/Tuareg	Milk (Meat)	18.2	4.7	81.8	63.9	Milk	14.1	0.0	85.9	66.7
3 Mauritania/Moor	Meat/Hair	22.9	6.2	78.1	58.6	Milk/Meat	20.2	1.2	79.8	55.1
4 Sudan/Baqqara	Meat	22.2	0.0	77.8	57.7	Milk/Meat	23.6	0.0	76.4	52.2
5 Mali/Fulani	Meat/Wool	25.5	11.3	74.5	55.9					
6 Chad/"Arab"	Meat/Milk	26.7	"few"	73.3	53.7	Milk/Meat	28.3	"few"	71.7	48.1
7 Kenya/Maasai	Meat (Fat)	31.4	15.4	68.6	54.2	Meat (Fat)/ Milk	33.8	10.3	66.2	48.3

Sources: 1. Wilson 1975; 2. This study; 3. Wilson 1980; 4. Wilson 1976a; 5. Wilson 1983; 6. Dumas 1980; 7. Wilson 1978c

Goat and sheep reproduction

Seasonality

The Twareg in the survey zone follow the general pattern of arid and semi-arid systems with regard to management for breeding of goats, that is to say that no artificial management is applied and breeding and births can thus take place all the year round. With sheep there is some variation in management strategy: in general the pastoral groups exercise some control on the breeding season while the agropastoral groups do not. Control is effected, as already indicated, by means of contraceptive measures applied to the male rather than by means of stratification.

Although in goats it is possible to have births all the year round, social factors in individual flocks (Wilson 1976b; Wilson 1980) have a considerable influence on the pattern of births. One female in heat stimulates coitus which is turn causes hormone flow in other females. Patterns in spatially close flocks may thus be rather different. However, the main effects are seasonal ones. In almost all reported cases, most births in goat flocks in dry areas occur shortly after the rains and are the result of conception shortly before the rains in late May through June and early July. This may be controlled by the build up of humidity and the flush of new growth on browse plants. In Chad, for example, Dumas (1980) reported 68.8 percent of goat births occurring in the four month period from November to February, with 11.7 percent of births in the rains and post-rains period of July to October. In northern Niger, in an earlier survey among the Twareg, 45.5 percent of births occurred from 15 October to 15 February (Haumesser 1975), and in Mali 53.9 percent of 1,114 goat births occurred in the period between mid-September and mid-December (Wilson in prep).

In sheep the birth pattern with unrestricted breeding is rather different, with flock social factors apparently being equally as important as climatic or nutritional ones; in large scale long-term studies such as those currently under way in Mali no such clearly distinct pattern is discernible. Where controlled breeding is practised, as for example by the Maasai in Kenya, it is possible to get up to 90 percent of total annual births within the controlled period (Peacock pers. comm.). In Sudan where some seasonal control

was practised almost 60 percent of all lamb births occurred in the "most desirable" four month period. In the present survey about 70-80 percent of births of sheep appear to occur in the rains and post-rains period as a result of breeding control.

Age at first parturition, parturition intervals and litter size

Some data on these three parameters for arid and semi-arid Africa are given in table 3.2.12. The area of the present study is at the drier end of the range of these examples, this being evident from the figures. In common with other groups such as the Maasai and the Baqqara who attempt to control breeding, it is mainly in sheep that breeding parameters are affected: in all these groups age at first parturition is later in sheep than in goats and parturition intervals are longer.

Table 3.2.12 Some reproduction-related parameters for goats and sheep in arid and semi-arid Africa

Country/owner group	Age at first parturition (days)		Parturition interval (days)		Litter size (No)	
	Goats	Sheep	Goats	Sheep	Goats	Sheep
1 Kenya/Maasai	456	540	289	344	1.16	1.02
2 Sudan/Baqqara	?	?	238	275	1.57	1.14
3 Mali/Bambara	484	470	271	254	1.23	1.05
4 Chad/Arab	416	502	?	?	1.12	1.07
5 Ethiopia/Afar	?	?	?	?	1.10	1.05
6 Niger/sedentary	?	487	?	305	?	1.11
7 Niger/Twareg	407	518	258	290	1.26	1.04
8 Niger/Twareg	460	550	295	365	1.15	1.02

Sources: 1. Wilson, Peacock and Sayers 1983; 2. Wilson 1976a, 1976b; 3. Wilson in prep; 4. Dumas 1980; 5. Wilson 1975; 6 & 7. Haumesser 1975, Gerbaldi 1978; 8. This study.

Goat and sheep mortality

In the absence of substantial evidence to the contrary, it has been assumed that deaths in recent years have been similar to, or slightly less than, those found in comparable areas where detailed studies have been carried out. It is a reasonable supposition that deaths in young stock are not high. In sheep the grouping of births at the best season probably helps in lowering the death rates. The practice of slaughtering young males, especially goats, for food also reduces the real death rate as does the similar practice of slaughtering sick animals on the point of death. These factors make accurate estimates of death and offtake very difficult other than through the medium of longer term or more intensive studies.

Donkeys

The donkey is a much neglected (by research workers, developers and its owners) and often maligned beast in spite of its extremely important role as a transport and pack animal. Many sub-Saharan economies would grind to a halt without donkeys to pump and distribute water, and serve as a personal taxi and a cross-country truck.

In the Twareg economy the donkey is primarily a direct means of servicing the economy with daily and seasonal necessities. Some additional income is generated by the sale of males which probably pass through the agropastoral system into the urban one where heavy demands for work are made on them. A stratified herd structure is apparent in the three separate systems as shown in table 3.2.13.

Table 3.2.13 Donkey population structure in different production systems

Country/system	Percent of total population				Functions
	Males		Females		
	Total	working	Total	breeding	
1 Niger/pastoral	29.9	20.2	70.1	51.5	breeding, work, sale
2 Sudan/agropastoral	51.4	41.8	48.6	31.9	work, breeding
3 Mali/agropastoral	69.4	56.4	30.6	19.3	work, breeding
4 Mali/urban	85.4	83.0	14.6	11.3	work

Sources: 1. This study; 2. Wilson 1978b; 3. & 4. Wilson 1980.

WODAABE ANIMAL PRODUCTION SURVEY

(1) Material and methods

The four established WoDaaBe herders' associations of the project were used as the sample for this study, their contacts with the project being considered a guarantee of cooperation. The survey was carried out between 4 November and 21 November 1982, when the members of the associations were camped within a range of 100 km of Abalak. Both technical assistants of the project helped in locating the camps and one of them served as interpreter.

Market days in Abalak were used to contact the presidents of the associations, to complete questionnaires and to make appointments for the following week. Whenever possible, nights were spent in the camps to allow herds to be visited early in the morning. A considerable amount of time was spent looking for the camps but in total 75 owners were questioned as shown in table 3.2.14.

Sixteen herds (17.5 percent) were not enumerated, 10 because the owner was away doing seasonal migrant work in Nigeria, and the rest because they could not be found or because they were too far away. It is possible that the missing herds might be the smaller ones, assuming that the poorest owners (those with the smallest herds) are the ones who go to work abroad.

The study concerned all the animals owned by the members of the associations, including those owned by their wives, mothers or unmarried sons: loan animals were also included in the sample. No data on camels and donkeys other than simple numbers were obtained. For goats and sheep, data collected were restricted to sex, age, reproductive performance and ownership.

Table 3.2.14 Details of herds surveyed in the WoDaaBe sample

Association No	Herds surveyed	Herds missed	Average family size	Total no of cattle	Average herd size
3	19	3	6	307	16.2
4	21	0	8	340	16.0
5	15	7	7	223	14.9
6	20	6	?	354	17.7
Total	75	16		1224	16.3

Data collection was mainly confined to cattle as these are by far the most important animals in the WoDaaBe society of the study area. A general census was made of production and age categories in order to estimate herd size; the name of each animal, its age, sex, race, use and ownership within each category were obtained; mortality since November of the previous year (1981) was recorded in the same way, and details were asked of season of death and in the case of breeding females life histories were added; finally the life histories of all milk and dry cows in the herd were established and used on the spot as a last cross-check on all the information. In the case of offtake, date of disposal, age and destination were determined.

The WoDaaBe herders expressed the age of their animals by the number of rainy seasons that they had survived. So most animals which "saw" four rainy seasons will, allowing for the seasonality of births, be in their fourth year, thus in the age class 3-4. This convention is followed in the analysis, so that calves of 1981 are two rainy seasons old and members of the age class 1-2 years. Unfortunately this manipulation of age leads to one group of animals (born just after the rainy season) having their ages underestimated.

(2) Management

The project has published sufficient information on the cattle management of the WoDaaBe (Maliki 1981; Glazier 1983), so only a short description will be given here.

Cattle are taken to pasture early in the morning after milking and stay away from camp for the whole day. At the time of the survey the animals were watered every day at pools or shallow wells. Generally the animals rest after drinking and start grazing again in the afternoon, returning to camp around sunset when they are milked. At about eight or nine in the evening the herd leaves again, this time without herder, to graze in the neighborhood of the camp.

Calves are tied up at night and released after their mothers have left to graze. They graze during the day around the camp and are brought back to the calf rope just before the herd returns. No controlled breeding has been detected but it might be that the herders are regulating reproduction by the provision of salts.

Sheep normally leave the camp together with the cattle, separating from the herd when they find suitable pastures. When the owner has enough sheep, one of his sons herds them separately from the cattle. The lambs stay in the camp till they are old enough to leave with their mothers. Ewes are never milked and sheep are kept for sale. Breeding is controlled because herders do not like lambs to be born in the dry season. They attach a cord from the scrotum to the prepuce, as is also done by the Twareg, during the period from September to January.

Even less attention is paid to goats which are left free to roam around the camp for most of the time. WoDaaBe do not have much interest in them: only 101 goats were found among 21 owners. Goats are not milked. At night they leave the camp, again with the cattle, or stay around the camp as they choose. They are never enclosed, ostensibly because of the order of the Forest Service forbidding the cutting of fresh branches.

Camels and donkeys are kept only for transport. They are hobbled and allowed to go their own way, being brought back to the camp when they are needed. Donkeys are bred by the WoDaaBe but camels are generally bought in the market: only one female camel was recorded in the whole of the survey.

(3) Technical coefficients and discussion

Cattle herd structure

Herd size

In total, 75 herds in four project herders' associations were studied. Details of the holdings are shown in table 3.2.15.

Table 3.2.15 Composition of herds in the WoDaaBe survey, by association and animal species

Animal species	Association No				Total animals	Mean herd size
	3	4	5	6		
Cattle	307	340	223	354	1224	16.3
Sheep	68	95	47	52	262	3.5
Goats	51	29	5	16	101	1.3
Donkeys	26	56	14	30	126	1.7
Camels	8	19	13	15	55	0.7
Herders questioned	19	21	15	20	75	

The mean size of the cattle herds was 16.3 (+ 7.1 SD) head. This number is not enough to feed a family of 4-5 people throughout the year, so other sources of income are needed. The WoDaaBe are still building up their herds after the 1973-74 drought, although a further setback has been incured by a high mortality during the 1981-82 dry season (see section on mortality below).

Maliki (1981) stated that an average WoDaaBe herd (sefre) contains some 20-25 head of cattle with a maximum of 60-70 head. The Niger Centre-East project (1981) found in their 1981 survey, mean herd sizes in the Fulani-dominated pastoral samples of 33 head in Maradi, 46 head in Zinder and 48 head in Diffa. Coulomb (1971) gives a mean herd size for Fulani herds before the 1973 drought in the Agadez arrondissement of 46.5 animals. The projects own air survey found Bororo cattle herds to vary from 38 to 49 animals depending on the season (see Table 3.1.12). But it should be noted that all of these refer to herds as management units, which may include the family herds of more than one household, while the present survey, based on the responses of individual household heads, refers to those animals actually available to the average household.

Figure 3.2.5 shows the size distribution of the 75 herds of which the smallest had five animals and the largest 45 head. Table 3.2.16 gives further details of the distribution of animals within the WoDaaBe population.

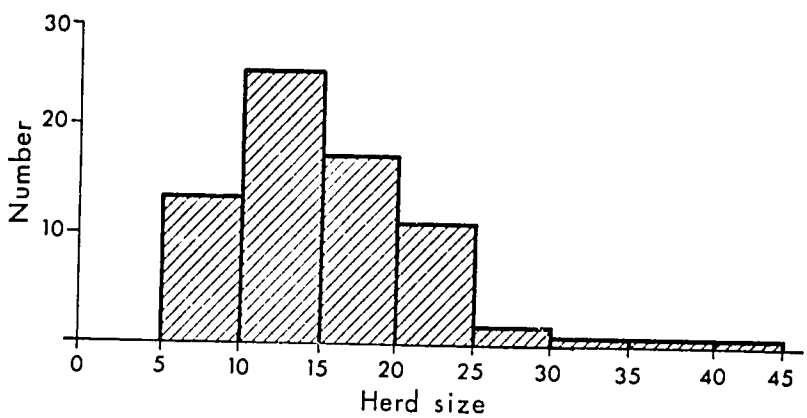


Figure 3.2.5 Frequency distribution of cattle herd sizes in the WoDaaBe sample

Table 3.2.16 Percentage of WoDaaBe cattle herds containing specified number of animals

No of cattle in group	Percentage of all groups (n=75)	Total no of cattle	Percentage of all cattle (n=1224)
5-10	18.7	117	9.6
11-15	34.7	339	27.7
16-20	24.0	320	26.1
21-25	18.0	276	22.5
>25	6.7	172	14.1

As can be seen from table 3.2.17, the number of small ruminants owned increases with increasing cattle herd size, with sheep increasing the most. The increase in number of goats per owner might be an indication that home consumption of meat is increasing. The number of camels per family is more or less constant, showing that these animals are simply used as transport animals for the owner; no breeding of camels was found in this group of WoDaaBe. Donkeys, mostly owned by the women, are used for transport and become more important in number as cattle herd size increases.

Table 3.2.17 Relationship between size of cattle herd and number of other species owned

	Cattle herd size									
Species	5-10		11-15		16-20		21-25		>25	
	a	b	a	b	a	b	a	b	a	b
Cattle	117	8.4	339	13.0	320	17.8	276	23.0	172	34.4
Sheep	19	1.4	80	3.1	96	5.3	47	3.9	20	4.0
Goats	6	0.4	16	0.6	27	1.5	23	1.9	25	5.0
Donkeys	10	0.7	37	1.4	42	2.3	25	2.1	12	2.4
Camels	7	0.5	22	0.8	14	0.8	9	0.8	4	0.8

Note: a) Total number of animals enumerated;
b) Average holding size within size class.

Herd structure

The average herd structure is shown in the first column of table 3.2.18. There was not much difference between the associations. Association 4 had significantly more milking cows (25 percent as opposed to 20.5 percent for the others; $X^2 = 4.81$; d.f. = 1; $P<0.05$). Association 6 had fewer males (25 percent against 28 percent) than the other associations, but this difference was not significant.

It can be seen from table 3.2.18 that the herd structure is rather similar to that observed elsewhere in pastoral herds. The exceptions are the Malian herds, where males comprise a bigger percentage due to the demand for animals in agriculture in and around the Niger river inner delta.

Table 3.2.18 Herd structures found in this survey compared with information from other surveys in Niger, Sudan and Mali

Class of animal	This survey		Niger (%)		Sudan (%)	Mali (%)	
	No (n=1224)	%	Fulani: Centre-Est (2)	Pastoral Zone (3)	Migratory herds (4)	Fulani: delta (5)	Fulani delta (6)
Milk cows	268	22.0)	48.0	43.5	47.0[1]	41.5	35.5
Dry cows	225	18.5)					
Heifers	269	22.0	13.0	19.0)	25.0	17.6	16.0
Female calves	132	10.5	19.0	11.5)		7.3	10.5
Total females	894	73.0	80.0	74.0	72.0	66.4	62.0
Males > 4 years	79	6.5	5.5	7.5)	8.0	13.6	15.0
Males 1-4 years	116	9.5	2.5	9.0)		14.0	12.5
Male calves	135	11.0	12.0	9.5	20.0	6.0	10.0
Total males	330	27.0	20.0	26.0	28.0	33.6	37.5

Note: 1. Age class 2.5 years or more.

Sources: 2. Coulomb 1971; 3. Niger Centre-Est 1981: Annex 1, for the pastoral zone Maradi, Zinder and Diffa; 4. Wilson and Clarke 1975; 5. Diallo and Wagenaar 1981; 6. Coulomb 1972.

The relationship between herd size and herd structure is shown in table 3.2.19. There is a general (statistically significant, $P<0.05$) trend for milking cows to decrease in proportion (and, as a direct consequence of this, the percentage of calves also), while the number of dry cows increases proportionately, as herd size increases. This is a result of the fact that owners of bigger herds tend to wean their calves earlier. They have enough milk to opt for an increasing number of pregnant animals. In smaller herds cows are milked for longer and dry cows have a higher chance of being sold.

Table 3.2.19 Change in herd structure as a function of increasing herd size (percent)

Class of animal	Cattle herd size					Mean
	5 - 10	11 - 15	16 - 20	21 - 25	> 25	
Milk cows	26.5	23.0	23.5	20.0	16.0	22.0
Dry cows	15.5	18.0	14.0	22.0	24.0	18.5
Heifers	21.5	22.5	22.0	20.5	23.0	22.0
Female calves	14.5	11.0	11.5	10.0	8.0	10.5
Total females	78.0	74.0	71.0	72.0	71.0	73.0
Males > 4 years	2.0	5.0	8.0	6.0	10.0	6.5
Males 1-4 years	9.5	7.5	9.0	11.0	10.5	9.5
Male calves	11.0	12.0	12.0	10.0	8.0	11.0
Total males	22.0	26.0	29.0	28.0	29.0	27.0
Total animals	117	339	320	276	172	1224

The male component in the herd increases significantly ($P<0.05$) with herd size but seems to be constant in bigger herds (29 percent). Within the male population there is a relationship between herd size and the percentage of

adult males. The owners of the bigger herds are not obliged to sell all their young males straight away to buy grain so they try to keep some castrates for fattening. The need for adult males also increases with herd size (bulls are needed to ensure adequate rep·oduction and castrates are needed for transport and for drawing water at the wells).

Herd composition

The survey was done on 1,224 animals of which 330 (27.0 percent) were males (57 castrates or 4.7 percent). The age given by the herders was considered to be valid for 1,160 head and this information is preaented in an age and sex distribution in figure 3.2.6. Special distinction has to be made for animals on loan (haBBanaaji and jokkere) because they influence the normal distribution pattern. The distribution seems to be normal although the following remarks can be made:

- the haBBanaaji animals (all females) are found only in the age group from 2 to 7 years;
- there is a marked lack of females in the 3-4 years age group, and the same can be said to a lesser extent about the males. This might be a result of yearly variation (1978 being a bad year to conceive or 1979 being a year with high calf mortality). Another reason might be the herders' inability to give the correct age and use of the reproductive performance of the animal as secondary information (e.g. pregnant animals are about four years of age, so heifers are younger than four years and first calvers are older than four years);
- the effect of the 1973-74 drought is easy to see: the age class 8-9 was born in 1974 and even by 1975 normal reproduction was not re-established, with many females not able to conceive in 1974;
- there is a very strong offtake of males in the age groups 2-3 and 3-4, which corresponds with the information on offtake;

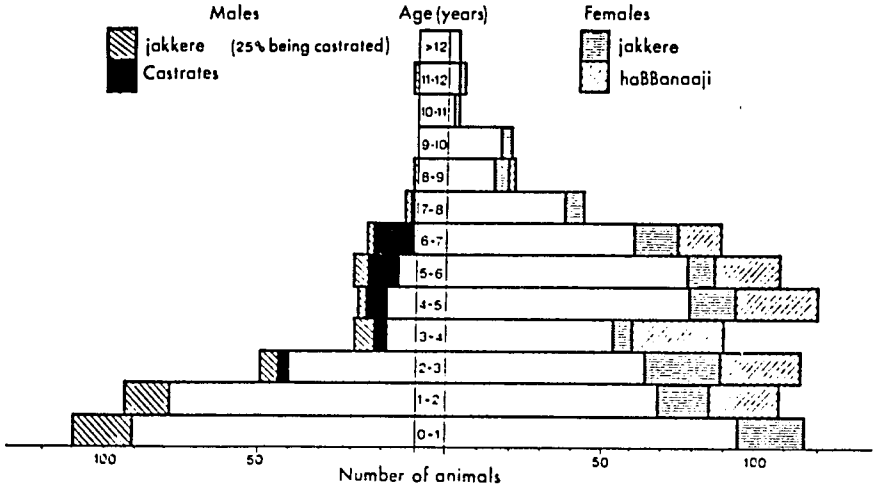


Figure 3.2.6 WoDaaBe sample: age and sex distribution of the studied cattle population (n=1160)

Castration occurs mostly in the fourth year, when a decision is made about the function of individual animals. Eighty percent of the castrates are Azawak and 60 percent of the bulls of four years and more are Bororo, indicating that WoDaaBe herders still prefer a Bororo bull.

Ownership

For all animals, ownership was recorded as personally owned, loaned by other WoDaaBe (haßBanaaji; the first 2-3 calves become the property of the recipient of the loaned animal, who also has the milk), or the property of other ethnic groups (jokkere; the herder only has the right to drink the milk).

As can be seen in the age and sex distribution in figure 3.2.6, haßBanaaji animals are always females, mainly in the age groups 1-2 to 6-7 years. After having produced 2 or 3 calves they are returned to the original owner, while the calves remain the property of the herder who received the

haBBanae animal (Maliki 1981). These loans are regarded socially as proof of friendship, but also serve to redistribute reproductive animals.

The other form of animal transaction, called jokkere, is a more commercial deal. The herder is paid either in milk or money on a vague and uncertain basis for taking care of male (26 percent) and female animala owned by people from outside WoDaaBe society.

In the survey 146 haBBanaaji (12 percent of the total animals) and 214 jokkere (17.5 percent) were found, as shown in table 3.2.20, with a very irregular distribution between the associations. Herds containing jokkere animals received significantly less haBBanaaji cows than herds without ($t=2.79$; d.f. = 73; $P< 0.005$). WoDaaBe herders with jokkere animals have them because they do not have enough animals of their own, but those who accept jokkere animals are less likely to receive haBBanae loans for reasons discussed in chapter 4.2.

Table 3.2.20 WoDaaBe sample: distribution of cattle according to race and ownership

Ownership	Breed			Total
	Bororo	Bororo x Azawak	Azawak	
jokkere	15	25	174	214
haBBanaaji	90	10	46	146
personal	465	90	309	864
Total	570	125	529	1224

A striking difference between the two categories of loaned animals is the race involved. In table 3.2.20 it can be seen that 81 percent of the jokkere animals are Azawak and 62 percent of the haBBanaaji cows are Bororo. The majority of personally owned animals are still Bororo (54 percent) but Azawak cattle are being increasingly accepted by WoDaaBe herders as an integral part of their herds.

Bartha (1971) has remarked on the superior milk producing capacity of the Azawak. Neither Maliki (1981) nor the WoDaaBe agree, claiming that the Bororo is the better milk producer although Maliki agrees that dry season resistance and adaption to low-quality pastures is better in the Azawak. It is possible that tests on the Bororo breed done under the lax management of ranches and research stations produce much less good results in terms of milk production than under WoDaaBe managment.

To conclude, the distribution by age, sex and breed of WoDaaBe herds is given in figure 3.2.7. The following observations can be made :

- 81 percent of the jokkere are Azawak;
- 62 percent of the haBBanaaji are Bororo;
- 74 percent of the jokkere are females;
- 80 percent of the castrates are Azawak;
- 60 percent of the breeding bulls of 4 years and older are Bororo;
- Bororo cows tend to be kept to greater ages.

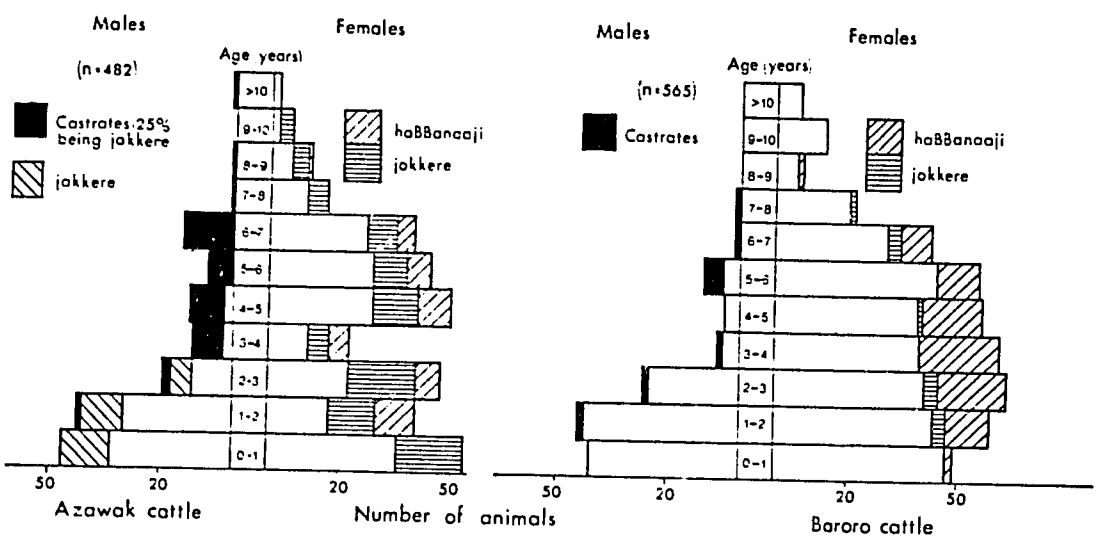


Figure 3.2.7 Age and sex distribution by breed in WoDaaBe herds

Cattle reproduction

Seasonality of calving

All births since November 1980 were registered: these were determined as animals actually present on the calf rope and those reported born in this period but which had already died. Registration was done by season of birth; the results are shown in figure 3.2.8. In a total of 369 births, 7 abortions (1.9 percent) were recorded and one still birth. Although the WoDaaBe make a distinction between early and late abortions (Maliki 1981) and here only the late (visible) abortions (wuftere) were recorded, it appears that the occurrence of this event is much less than found elsewhere: it may for example be compared with 3.9 percent in Niger river delta Fulani animals (Diallo and Wagenaar 1981) and 5.5 percent in the Mopti region (Coulomb 1972), both in Mali.

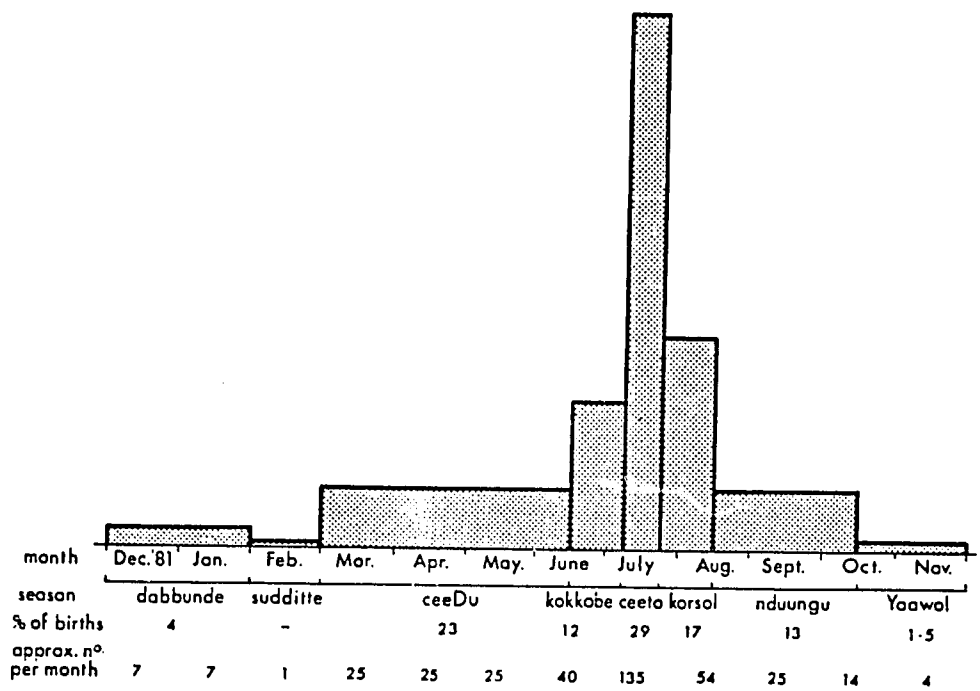


Figure 3.2.8 Seasonal and monthly distribution of births in WoDaaBe cattle herds in 1982 (n=362)

In figure 3.2.8 the seasons are translated into months based on data in Maliki (1981) and on that provided by the herders. The rains were delayed during 1982 so most seasons started later than normal. As is expected in arid zone herds, calving is significantly seasonal (X^2 = 4.05; d.f. = 11; P<0.001), with 60 percent occuring in the early wet season (kokkobe to korsol). This is due mainly to nutritional influences. The same seasonal pattern is found elsewhere in Niger, as well as in Mali and Sudan as table 3.2.21 shows, although the calving periods in Mali and the Sudan tend to be earlier in the year; this is probably due to the later rainfall peak in the Niger pastoral zone.

Table 3.2.21 Seasonal distribution of calving (percent) in Sahelian cattle herds

Calving period	Niger			Sudan	Mali	
	This study	Other[2] WoDaaBe	Pastoral[3] zone	Sedentary[4] + migratory	Agro-[5] pastoral	Trans-[6] humant
Jan-March	8	15	6	22	20	20
April-June	23	32[1]	29[1]	63	56	43
July-Sept	58	27	43	13	14	19
Oct-Dec	11	26	23	3	11	18

Note: 1. May to August probably being the main calving period.

Sources: 2. Maliki 1981; 3. calculated from Coulomb 1971; 4. Wilson and Clarke 1975; 5. Wilson 1981; 6. Diallo and Wagenaar 1981.

Age at first calving

For the sake of accuracy only information on first parturitions in 1981 and 1982 were used for analysis. The ages ranged from 2 to 8 years, the overall average of 280 observations being 4.5 years: breed differences are shown in table 3.2.22.

Table 3.2.22 Mean age at first calving by breed of cow in WoDaaBe herds

Race	n	mean (years)
Bororo	140	4.42
Azawak	111	4.43
Bororo x Azawak	37	4.70
Overall mean	288	4.46

Differences between Azawak and Bororo cows in the system studied are not significant but crossbreds are slightly later at first calving. Coulomb (1971) also estimated age at first calving in Fulani cattle in Niger at 4.5 years but a re-calculation of his original data gives 4.85 years. The survey carried out by the Niger Centre-Est project (1981) indicated an age of 5.31 years in the pastoral zones of Maradi, Zinder and Diffa. In the Malian Niger river delta, the age at first parturition seems to be earlier than in Niger, at about 48 months (Coulomb 1972; OMBEVI 1978; Tamboura 1981), probably as a result of a more regular feed supply. In Sudan, Wilson and Clarke (1975) estimated the age at first calving to be less than four years.

Calving interval

Because the terminology of most of the herders does not allow accurate timing prior to 1980 (rotani) it was decided to calculate the mean calving interval from the information over the last two years only; this gave a total number of 251 intervals, of which only 106 were sufficiently accurate for seasonal analysis. The overall calving interval over the 251 observations was 18.7 months with a range of 1-4 years. The 106 detailed seasonal intervals are shown in figure 3.2.9: the average for these is 17.7 (± 7.1) months but as the figure clearly shows there are two distinct peaks around 12 and 24 months. This phenomenon is often found in Sahelian countries and is a direct result of restricted fodder availability as a result of which most cows conceive at the end of the wet season (see figure 3.2.8). The animals failing to conceive in the first rainy season after parturition generally do not conceive until the following one.

The 106 accurate observations based on seasonal information tend to have a slight recall bias to the longer intervals, so in reality the calving interval is around 18 months. There is a non-significant difference (t=0.88; d.f.=90; p=0.19) in calving interval between breeds: Azawak cows (47 detailed observations) average 16.9 (± 5.5) months against 45 Bororo cows with an average of 18.2 (± 8.2) months.

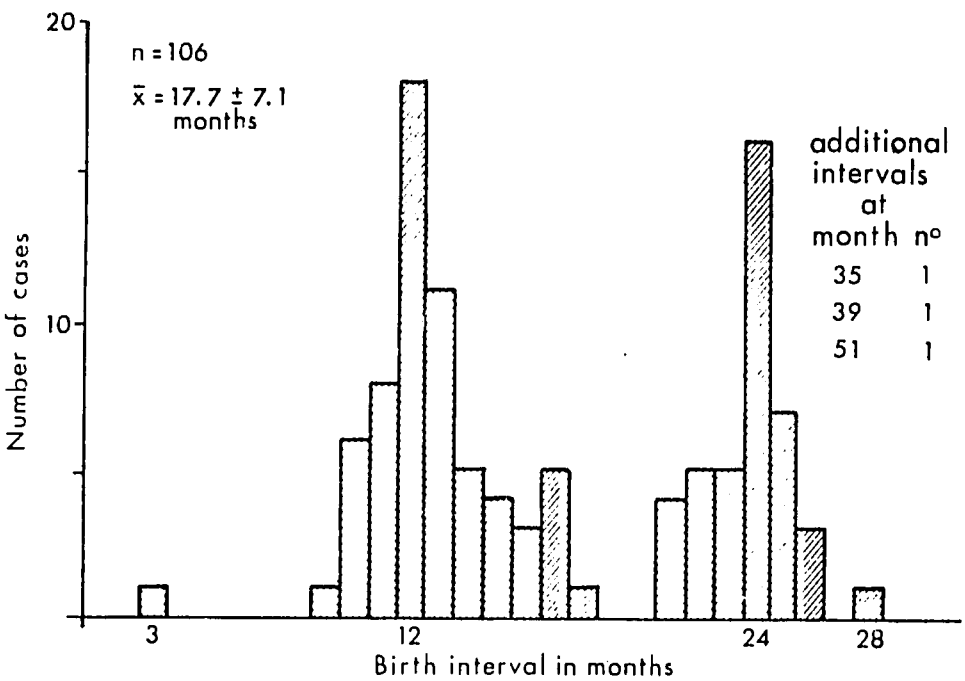


Figure 3.2.9 Frequency distribution of birth intervals in WoDaaBe cattle

As far as the influence of ownership on the calving interval is concerned, the jokkere animals seem to have a shorter interval (16.6 (± 5.5) months, n = 22) than personally owned cattle (18.1 (± 7.7) months, n = 72), with the haBBanaaji animals between these two (17.8 ± 5.6 months, n = 12). These calving intervals are not significantly different (P>0.05). This result is nevertheless surprising because if, as one might expect, the jokkere animals are over-milked, this could result in a longer calving interval. The

haBBanaaji cows, on the other hand are reserved for calf production and a short calving interval could be expected. The unequal number of observations in each group and the fact that the owners know their personal animals best may be responsible for this result. Breed differences may also be important: as table 3.2.20 showed, most jokkere are Azawak and most haBBanaaji are Bororo. Calving intervals by specific parities are shown in table 3.2.23.

The interval after first parturition is longer than all others, the primipares needing a longer period of recovery after parturition. Wilson and Clarke (1975) found an average interval of 18.4 months in the migratory herds they studied in Sudan. Diallo and Wagenaar (1981) calculated an average of 19.0 months in the Delta Fulani herds in Mali while Coulomb (1972) found an overall calving interval of 19.6 (± 0.5) months in pastoral herds around Mopti (Mali). Coulomb's data (1971) on Niger herds are rather vague but give an estimate of about 20 months for Bororo herds.

Table 3.2.23 Calving intervals for specified parities in WoDaaBe cattle herds

Parity	n	Calving interval (months) $\bar{X} \pm SD$
1 - 2	61	18.7 ± 6.4
2 - 3	21	15.4 ± 6.3
3 - 4	10	18.3 ± 11.7
4 - 5	9	16.7 ± 5.8
> 5	5	18.6 ± 7.3
⩾ 2	45	16.7 ± 7.9

Age specific fertility rates

Females start to reproduce when they are in their fourth year (four rainy seasons old) although only a limited number calve at this age. Of 90 animals of this age censused, 32 had given birth once and three animals twice, (probably abortions), making the average calf production in this age class 0.42. Calculations for this and all subsequent age groups are given in table

3.2.24, while more detailed age specific fertility by ownership and breed is given in table 3.2.25.

Table 3.2.24 WoDaaBe sample: distribution of cows by age group and number of calves produced

Age class (years)	Number of calves produced 0	1	2	3	4	5	6	Number of females	Total production to age
2 - 3	115							115	0.00
3 - 4	55	32	3					90	0.42
4 - 5	9	86	25					120	1.13
5 - 6	1	47	45	13	2			108	1.61
6 - 7	0	9	46	29	4	1		89	2.35
7 - 8	0	1	10	17	12	2		42	3.24
8 - 9	0	0	5	7	4	5		21	3.29
9 - 10	0	1	0	7	5	6	1	20	3.40

Note: Due to small numbers, productivity from older cows not calculated.

Table 3.2.25 Number of calves produced per cow by type of ownership and breed in the WoDaaBe sample

Age class	No of calves produced Ownership[1] H	J	P	Breed Bororo	Azawak
3-4	0.24	0.29	0.54	0.36	0.59
4-5	1.07	0.93	1.19	1.11	1.16
5-6	1.29	1.56	1.71	1.38	1.91
6-7	2.29	2.50	2.33	2.14	2.56
7-8		3.50	3.19	3.19	3.33
8-9		3.75	3.33	3.14	3.27
> 9			3.41		3.60
No of cows	91	58	339	255	186

Note: 1. H, haBBanaaji; J, jokkere; P, personal

The personally owned animals seem to produce more calves in the same time, although because the number of observations per group of ownership is very uneven a more detailed analysis would be required before firm conclusions could be drawn. Azawak cattle in all age classes have higher fertility rates than the Bororo. Table 3.2.26 compares age-specific fertility rates from a number of studies carried out in Niger. The conclusions drawn from table 3.2.26 is that the animals in the study herd are more fertile than in the other two studies. The differences are large but this changes when WoDaaBe age classes are pushed back one year. Presumably the age interpretation used in this study is different from those used in other studies. Using these data we calculated the age at first calving to be 4.46 years: when age was pushed back one year at first calving then became 5.46 years which compares with those of 4.85 and 5.31 years in the other studies. The conclusion to be drawn is that age categories must be very carefully defined to be at all useful in this type of rapid survey.

Table 3.2.26 Comparative age-specific production of calves in Niger cattle herds

Source	Age groups									Number of animals
	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10	≥11	
This study 1982	0.42	1.13	1.61	2.35	3.24	3.29	3.40	-	-	490
Coulomb 1971	0.12	0.70	1.29	1.87	2.54	3.21	3.58	4.36	-	13,700
Niger Centre-Est 1981	0.08	0.43	1.00	1.63	2.36	2.96	3.70	4.36	5.85	435

Annual reproduction rate

As already stated in the Twareg section above, it is difficult to give an accurate reproduction rate; approximate rates have been calculated in two ways:

(i) on a calving interval of 18 months the rate is $(\frac{12}{18} \times 100) = 67$ percent;

(ii) from table 3.2.24 it can be seen that 35 cows in the 3-4 age group out of 90 produced at least one calf. In the age class 4-5 this number has increased to (86 + 25) out of 120. Thus at 3-4 years, 38.8 percent produced one calf; at 4-5 years, 92.4 percent produced one calf. The mean age at first calving is found to be 4.46 years which corresponds to a reproduction rate of 38.8 + ((92.5 - 38.8) x 0.46) = 63.5 percent.

It thus appears that the reproduction rate is in the order of 60-70 percent, which is similar to that found elsewhere in the pastoral zone both in and outside Niger. The study done by the Niger Centre-Est project (1981) showed rates between 63 and 65 percent in the arrondissements of Maradi, Zinder and Diffa. After his survey Coulomb (1971) estimated the fertility rate of Bororo cattle to be 60 percent. In Sudan a 65 percent reproduction rate is mentioned in migratory herds by Wilson and Clarke (1975). From Mali several sources give estimates ranging from 55 percent to 65 percent (Coulomb 1972; SEDES 1975; ILCA 1978; Diallo and Wagenaar 1981).

Numbers of births per breeding female

Figure 3.2.10 shows the percentages of Azawak and Bororo cows in the study herds which gave birth to a specified number of calves. The average for 447 observations (including the crossbreds) is 2.11 calves/cow. The average age at culling would thus be 4.5 years + (2.11 x 18 months) = 7.7 years which agrees well with the age structure presented in figure 3.2.6.

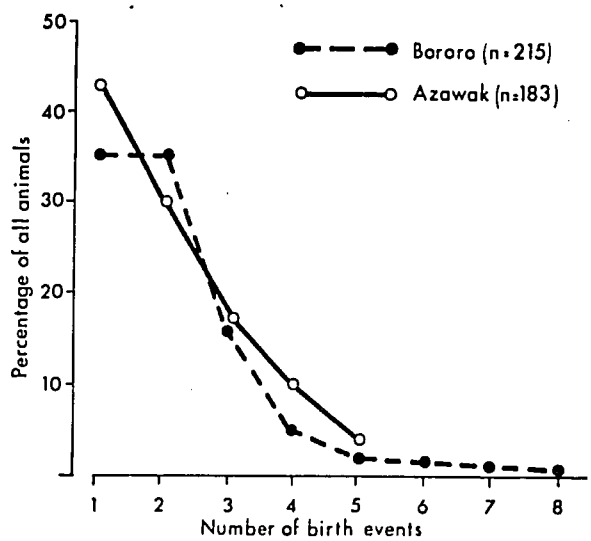


Figure 3.2.10 WoDaaBe sample: percentage of cows having had a specified number of birth events

Secondary sex ratio at birth

The total number of live births registered in 1982 was 362, of which 192 (53 percent) were males. The male: female ratio is 1.13:1.00, which does not differ significantly from the expected 1.00:1.00 ratio (X^2 = 1.33; d.f. = 1; P > 0.05). As a comparison, the sex ratio found by Maliki (1981) in the same region for 444 births is given as 39 percent males.

Cattle mortality

An important part of the WoDaaBe study concerned mortality since November 1981. The herders were asked about the sex, name, race, age, function and offspring (where relevant) of dead animals. In total 720 deaths were registered, 37 percent of the actual sample size. The mortality information might be exaggerated, in view of the fact that the survey was as a part of the project and the herders were looking for material help. Nevertheless the other information given seems accurate and the conditions were indeed very unfavourable during the survey year. Several herders mentioned the last dry season as the worst one since the 1970a drought, due to a combination of a lack of fodder (1981 rains) and a late onset of the 1982 rainy season.

The mortality rates are a mesure of the mortality that occureed during a one-year period in a certain sample. In a one-visit survey one has to reconstruct the original sample size on which the mortality data are calculated. This is doen as follows: the number of animals found in the herd in November 1982 is call N_2 (=1,224). The number of animals present in the herding units in November 1981 is call N1 = N_2 - 1982 calves still alive - animals introduced in the course of 1982 + mortality (1981 and older) + offtake in 1982.

With the exception of the newly introduced animals (estimated to be 20), the total number of animals in the same 75 herds in November 1981 was calculated at 1,620.

The offtake animals (loaned as haBBanaaji, sold etc.) are not exposed during the whole period to the risk of dying because they left the herd some time in 1982. Therefore the sample size in the middle of the year (March 1982) has been taken as the one on which the mortality rate is calculated.

Mortality rates for the main categories of animal are presented in table 3.2.27: calves born during 1982 are excluded from this calculation.

Ignoring the level of the death rates, there are some obvious tendencies. Mortality of Bororo animals seems to be much higher than of Azawak (44.5 percent against 27.5 percent). This is a confirmation of the reputation of Azawak as being more resistant under unfavourable conditions than Bororo. The crossbred Bororo-Azawak seem to resist even better under these circumstances. Because of the small number of crossbreds this supposition should be considered tentative although further research on this aspect of the crossbred seems worthwhile.

Table 3.2.27 WoDaaBe sample: mortaility rates by sex, race and ownership categories over the period November 1981-November 1982 (percent) of animals present in November 1981)

Ownership type	Percent mortality			
	Bororo	Bororo x Azawak	Azawak	Overall mean
jokkere				
male	50.0	0.0	22.5	21.0
female	37.0	0.0	23.0	23.0
haBBanaaji				
female	38.5	31.0	36.0	37.0
Personal				
male	45.5	28.5	29.0	37.0
female	45.5	22.5	31.0	39.5
Overall mean	44.5	21.0	27.5	36.2

Note: For the number involved, see table 3.2.20.

Although one might expect that the herdsmen would take maximum care of his own animals (as they state themselves) table 3.2.27 does not confirm this hypothesis. The overall mortality in jokkere animals is lower than in the other ownership categories, while the personally owned animals have a higher mortality than both the loaned classes. It is possible that the herdsmen gave

false information about ownership of dead animals, being ashamed to lose other men's animals, or perhaps hoping to obtain more aid.

Several biases may influence the ownership/mortality relations:

- the majority (80 percent) of jokkeredji are Azawak cattle;
- most of the jokkeredji (70 percent) are in one Association (No 3);
- the number of jokkeredji censused as entering the herds in 1982 might be too high resulting in an apparent low mortality rate.

Mortality in calves Out of 362 live births registered from November 1981 to November 1982, 133 calves died before the survey started, as is shown in table 3.2.28.

The percentages shown in the table are somewhat higher than found in the literature concerning Niger. Coulomb (1971) calculated for 1970-71 a mortality rate in the first year of 34.4 percent for male and female calves together.

Table 3.2.28 Mortality in WoDaaBe calves born in the one-year period preceeding the survey

Present status	Males	Females	Total
alive	114	115	229
dead	78	55	133
percentage	32.4	40.6	36.7

The Centre-Est project (1981) found 35-40 percent for male calves as an average for the pastoral zone and 20-40 percent for females. Thus, calf mortality in 1982 appears to be slightly higher than the average. The distribution of the mortality over the year is shown in table 3.2.29, which also includes deaths in 1982 of 1981-born calves (101 cases).

The dry season (ceeDu) and the short season in which the first rains fall (kokkebe, ceeto) are the worst periods for young animals. Lack of fodder, lack of milk and diarrhoea are the main cause of death.

The basic data allow the chances of survival by season of birth to be calculated, and has been done in table 3.2.30. Although the yaawol calves had little time to die (they were born in the month of the survey) the table tends to confirm that calves born in the rainy season have the best chance of survival. Table 3.2.30 shows that there is hardly any calf mortality during the cold season.

Table 3.2.29 WoDaaBe sample: Seasonal distribution (%) of mortalitty in the period November 1981 - November 1982 for calves born in 1982 and 1981

Season	Month	Year of birth	
		1982	1981
dabbunde (1981)	Dec/Jan		1.0
suddi'tte	Feb/Mar		0.0
ceeDu	Mar/June	35.5	41.0
kokkobe	June/July	20.5	22.5
ceeto	July	21.0	18.5
korsol	July/Aug	15.0	12.0
nduungu	Aug/Oct	7.0	4.0
Yaawol	Oct/Nov	1.0	0.0

Table 3.2.30 WoDaaBe sample: survival probablity of calves according to season of birth

Current status	Season of birth							
	dabbunde	sudditte	ceeDu	kokkobe	ceeto	korsol	nduungu	Yaawol
Still alive	7	-	30	21	80	45	41	5
Dead	7	1	55	22	24	18	6	-
Chance of survival (percent)	50	0	35	49	77	71	87	100

Mortality in older stock

Mortality rates for older animals by age and sex in table 3.2.31 show similar values for both sexes, with the exception of the eldest group. In this age group, males (because of the general wide classification) are younger on average than females and do not have the physiological stress imposed on females by pregnancy and lactation: their lower death rate is thus expected.

Table 3.2.31 Overall death rates by sex and age in WoDaaBe herds (November 1981 - November 1982)

Age class (years)	Females		Malea	
	n	%	n	%
1 - 2	70	38.7	83	42.6
2 - 4	81	28.2	30	28.3
> 4	304	39.4	22	26.0

The high mortality in the breeding female stock was confirmed by the herders. Due to lack of fodder a lot of pregnant cows were in a bad condition at the time of parturition in June and July. The late onset of the rains in 1982 was the main cause of death in both cows and calves.

Older cows, as can be seen from table 3.2.32, are subject to a higher death rate than younger ones. The mortality rates presented in this table are exceptionally high and in the same range as those quoted in chapter 3.1 for cattle in Niger during the drought of 1968-73.

Table 3.2.32 Age-specific mortality rates for breeding cows in WoDaaBe herds

	Age class (years)							Unknown
	4-5	5-6	6-7	7-8	8-9	9-10	> 10	
No of deaths	62	50	50	34	21	14	16	57
% mortality	34	32	36	44	50	40	59	

Although the interannual variation in mortality is very high and therefore comparisons between mortality rates in different years and regions is doubtful, some rates from the literature are shown in table 3.2.33.

Table 3.2.33 Comparative cattle mortality rates (percent) from different studies in the arid and semi-arid zones of Africa

Age class (years)	Niger, 1981 Centre-Est		Niger, 1971 Coulomb's assumptions		Mali delta 1979-80	Sudan migratory 1973
	M	F	M	F		
1 - 2	3-36	2-5	12	10	4.2	15.2
2 - 3	2-27	3-12	5	5		
3 - 4	15-20	7-10	2	2	5.5	
> 4			2	2		

Sources: see table 3.2.18

The herders' statement that most animals died in the late dry season and with the start of the rains is confirmed by the data shown in table 3.2.34. There is a striking difference in seasonality between the associations, probably due to the regional variations, assuming that herding ability is equally divided within the associations. Another explanation for the differences in distribution might be a different interpretation of the duration of each season by each association. The differences are not alarming, however, because between the end of ceeDu and the end of korsol there are only two months.

Table 3.2.34 Seasonal distribution (percent) of mortality by association and in total for animals born in 1980 and before (n=450)

Season	Month	Association				Overall
		3	4	5	6	mean
dabbunde (1981)	Dec/Jan	0.0	1.5	0.0	1.5	0.7
ceeDu	Mar/June	9.5	13.0	15.5	47.5	26.7
kokkobe	June/July	4.0	16.0	58.0	25.0	28.4
ceeto	July	32.0	33.5	10.5	15.0	20.2
korsol	July/Aug	50.0	19.0	5.0	3.5	16.0
nduungu	Aug/Oct	5.5	16.0	9.5	7.5	7.5
Yaawol	Oct/Nov	0.0	1.0	1.0	0.0	0.4

In comparison with the young animals (table 3.2.29), mortality in the dry season is less severe. The start of the rains however was, in 1982, a bad period for all animals.

Cattle offtake

In addition to the 720 dead animals, 111 were removed from the herds as the components of offtake shown in table 3.2.35, this offtake by age class being compared with that from other studies in table 3.2.36. In this survey

four out of every five animals sold were males, mostly in the age groups one to three years old. Most of the animals sold (44) were also Bororo. The early offtake (which is also in part evident from the demographic structure shown in figure 3.2.6) is indicative of the needs of the WoDaaBe for cash income, which does not allow them to keep animals to maturity before selling them. From table 3.2.36 it is obvious that sales in this study are taking place at an earlier age than determined in other surveys with the exception of that by Coulomb (1971), although the assumption of the latter that 25 percent of males in each group were sold appears to have no basis in fact.

Table 3.2.35 Components of offtake in WoDaaBe cattle herds

Offtake	Sex of animal			Percentage of total enumerated
	male	female	total	
Sold	61	15	76	5.3
habbanaaji (given)	0	18	18	1.3
jokkere (returned to owner)	5	5	10	0.7
Lost	2	2	4	)
Gift	1	0	1	) 0.5
Baptisms, marriage	2	0	2	)
Total	71	40	111	7.8

Table 3.2.36 Cattle sales by class of age in this and comparative studies in Niger (percentages)

	This study		WooDaaBe[1]	Pastoralists[2]		Fulani[3]	
Age class	male	female	male	male	female	male	female
0 - 1	5	0	0	0	4	30	
1 - 2	64	73	3	8	0	15	
2 - 3	25	6	16	37	15	13	
3 - 4	1	0	43	26	15	10	
4 - 5	3	0	20	15	11)		
5 - 6	0	0	9	5	0)		
6 - 7	1	0	7	3	4)	33	
7 - 8	0	6	0	4	11)		
8 - 9	0	6	0	1	7)		
9+	0	6	2	0	33)		
Number	(61)	(15)	(100)	-	-	(695)	(587)
Percent of herd	4.3	1.1		3.5	1.1	7.0	5.9

Sources: 1. Maliki 1981; 2. Niger Centre-Est 1981; 3. Coulomb 1971.

A number of young females were sold in this study but very few older cul cows. The sale of young females can again be considered as due to pressin cash needs and to the lack of old cows; as tables 3.2.32 and 3.2.33 shows, th death rate is high in these older females.

In general, as can be seen from table 3.2.37, a larger number of animals per owner is sold with increasing herd size but the percentage offtake decreases. In the two smallest herd size categories it is probable that different strategies are adopted by the owners: those with 11-15 animals sell while trying to remain pastoralists; those with 5-10 animals hold their animals but instead sell their labour, in Nigeria or elsewhere. A not unimportant part of offtake is the giving of haßBanaaji loans. As might be expected and as is shown in table 3.2.38, the numbers of animals loaned increases with herd size.

Table 3.2.37 Relationship between WoDaaBe cattle herd size and offtake

Herd size	Total No of animals	No of owners	No of animals disposed of per head (1)	Percentage of animals in herd
5 - 10	117	14	0.5	5.9
11 - 15	339	26	1.4[2]	10.9
16 - 20	320	18	0.8	4.7
21 - 25	276	12	1.0	4.3
> 25	172	5	1.2	3.5

Note: 1. Sold, slaughtered or gifted.
2. 0.9 males and 0.5 females.

Table 3.2.38 Number of haßBanaaji cattle loans made as a function of herd size

Period of loan	Herd size class				
	5-10	11-15	16-20	21-25	> 25
during 1982	0.0	0.2	0.3	0.3	0.4
total outstanding	0.2	1.2	2.1	2.5	2.2

Most haBBanaaji animals are in the age class 1-2 years when first loaned although animals up to four years old are also loaned.

Sheep

Sheep were herded together with the cattle herd in all the 51 cases where both species were owned by one person. Five WoDaaBe mentioned the loss of all their sheep in the last dry season: the reasons given were malnutrition, loss in the first big rainstorm and taken by jackals. One owner had loaned out all his small ruminants as jokkere.

In total 262 sheep were found in 51 flocks with a range from 1 to 17 animals (average 5.2 (± 3.5) per owner). Only 16 of them were males (4 rams born in 1981 and 12 lambs in 1982), which is six percent of the flock. Most males are sold in their first year and in most flocks there is no male at all, mating being done by males borrowed from neighbours or relatives. A total of 63 females (or 25.5 percent) were received as haBBanaaji animals, mostly given before 12 months of age. The number of haBBanaaji animals received is positively correlated with cattle herd size, these being 0.36 received in herd size 5-10, 0.69 in 11.15, 1.11 in 6-20, 1.33 in 21-25 and 0.8 in herds greater than 25 cattle. No jokkere were found.

Only in exceptional cases are females kept in the flock after five years of age. As can be seen from table 3.2.39, total lifetime production of young is very low. Breeding control of the males means that in many cases the first young is not born until the dam is two years old with less than 30 percent of ewes in the 1-2 year class giving birth. Reproductive rate appears to be very low (at about 45 percent) probably as a result of the controlled breeding season and the lack of males. However, breeding control is not entirely successful as can be seen from the distribution of births shown in table 3.2.40.

Table 3.2.39 Distribution of female sheep by year of birth and number of parturitions in woDaaBe sample

Year of birth	Total lifetime production of young								Total ewes
	0	1	2	3	4	5	6	?	
1982	29	0	0	0	0	0	0		29
1981	35	11	3	0	0	0	0		49
1980	1	18	7	1	0	0	0		27
1979	0	10	6	2	3	0	0		21
1978	0	0	1	5	0	1	0		7
1976	0	0	0	0	0	0	1		1
Unknown	11	14	10	5	5			68	123

Of the 41 recorded male births 22 animals were sold, 4 died and 15 were still in the flocks. Only 2 females were sold, 5 were given as haBBanaaji and 7 died, out of a total of 58 births. The 11 percent mortality in the first year seems rather low. Taken in consideration with the apparently low reproductive rate it is probably that abortions, still-birtha and early deaths have not been reported in this survey.

Table 3.2.40 Seasonal discribution of lambing in WoDaaBe flocks

Season	Sex		Total
	Male	Female	
Yaawol (1981)	14	24	38
dabbunde (1981)	4	3	7
sudditte	-	-	0
ceeDu	11	10	21
kokkobe	-	-	0
ceeto	1	-	1
korsol	3	-	3
nduungu	2	8	10
	6	13	19
Total	41	58	99

Goats

The total number of goats recorded was 101 in 21 flocks. As with sheep there is a positive correlation between the number of goats per owner and the cattle herd size (see table 3.2.17). Herding goats, however, seems to be related to the social group as 50 percent of the goats and 71 percent of the goat owners were to be found in association 3 (table 3.2.15).

Only six males were noted (one buck born in 1981 and five kids) making six percent of the population. Most goats were personally owned but four were received as haBBanaaji.

ANIMAL PRODUCTION DATA FROM RANCHES AND PROJECT EXPERIMENTAL WORK

Ranch data

In additon to its own survey of herd structures and dynamics reported in the previous section, the project synthesized data on Azawak and Bororo cattle production parameters at the government-run Ibecetene and North Dakoro (Fako) ranches (both in the project zone) and the Toukounous research station west of the project zone but in similar ecological conditions. These data are not directly comparable with those from the herding economy, since ranch animals are managed differently and have better dry season food and water. The Azawak cattle at Toukounous are also genetically selected from within the breed. However the data do show orders of magnitude which in some cases are similar to those recorded in the herding economy.

Table 3.2.41 shows some of the main production parameters at the three ranches. Mortality rates of young animals are probably lower than in pastoral herds. Except for some cases of pasteurellosis at North Dakoro and blackleg at Ibecetene, the most common causes are fractures, enteritis among young animals, and the ingestion of foreign bodies in cases of apparent nutritional deficiencies (in trace elements, for example). Malnutrition may be a cause, but is not known, since at North Dakoro 80 percent of deaths were not diagnosed.

Fertility rates are low by ranch standards, and those at North Dakoro by pastoral standards. The advanced age of the cows, nutritional deficiencies, and brucellosis and rickettsial diseases are probable causes. Rejuvenation of the herd, an improved diet and systematic treatment of these diseases could raise fertility at the ranches.

Table 3.2.41 Some cattle production parameters at the Ibecetene and North Dakoro ranches and the Toukounous station

	Ibecetene	North Dakoro	Toukounous
Race	Azawak	Bororo	Azawak
Fertility rate (calves born/100 adult cows/year)	63.2	48.5	67.0
Sex ratio at birth (males/100 births)	53.3	50.7	-
Age at first calving (years)	3-4	3-4	3-5
Mortality rate (percent/year)			
- adults	2.6	4.8	-
- young animals	0.9	2.7	-
- calves	7.9	10.9	-
Birth weight (kg)			
- male calves	22.8	22.8	
- female calves	19.2	19.2	-
Length of gestation (days)	-	-	272-314
Calving interval (days)	-	-	390-570
Length of lactation (days)	-	-	293 (±43)
Milk production			
- Kg day	-	-	3.0 (±0.9)
- Kg lactation	-	-	908 (±322)

Source: Louis 1982.

Notes:

1. Ibecetene and North Dakoro: data for 1979.

2. Toukounous: data for 1980.

Figure 3.2.11 shows the seasonal distribution of cattle births at Ibecetene and North Dakoro in 1979. The highest concentrations of births take place from May to July (43.9 percent) and from December to February (26.9 percent). This pattern, resulting from unrestricted breeding, has an effect on milk production and calf growth. Calves born during the cold dry season grow more slowly because of lower milk production during the dry season. Calves born in May and June, at the end of the dry season, also grow slowly at first; however, they recover quickly and develop normally during the rainy months of August and September, when the range is better and milk production reaches a maximum.

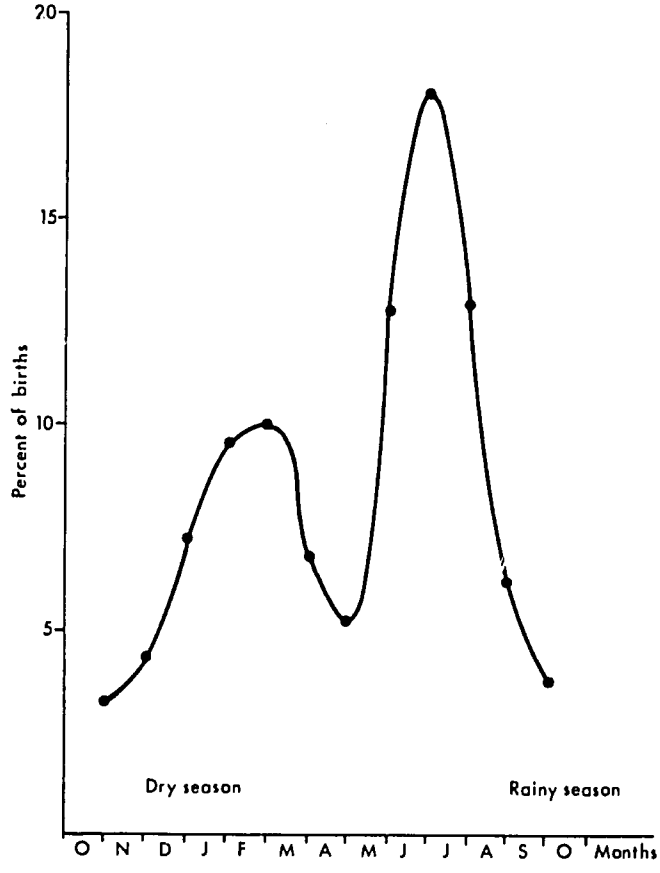


Figure 3.2.11 Seasonal distribution of cattle births at Ibecetene and North Dakoro ranches in 1979

An analysis was made of weight data from the records of the Toukounous station, on genetically selected Azawak cattle. The purpose was to determine the rate of gain from birth to weaning, and to evaluate the effect of the seasons on growth after weaning. The results are shown in figures 3.2.12 and 3.2.13. The growth curve for four calves (figure 3.2.12) is somewhat particular because the calves received all the mother's milk until weaning. Therefore, their growth was good, with an average daily gain of 0.37 kg. However, after weaning individual gain dropped due to adjustment to the new diet. Figure 3.2.13 shows growth during 4 years after weaning.

This figure clearly shows the seasonal influence, with a typical pattern of growth by stages which characterizes cattle in the Sahel. During the 4 years, periods of compensatory growth (CG) in the rainy season are separated by long periods of stable weights or weight losses during the long dry season. After 5 years of age, these animals stopped gaining weight, and after reaching a maximum of 545 kg on average, they gradually lost weight.

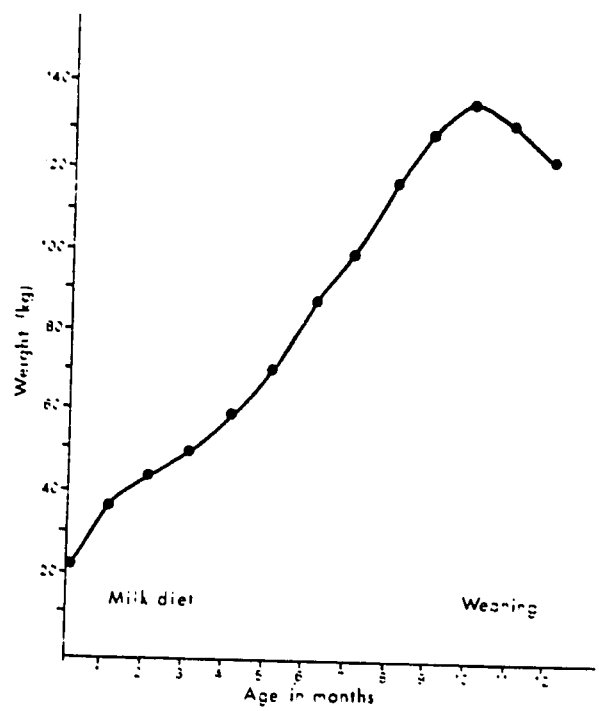


Figure 3.2.12 Azawak calf growth at Toukounous, 1980

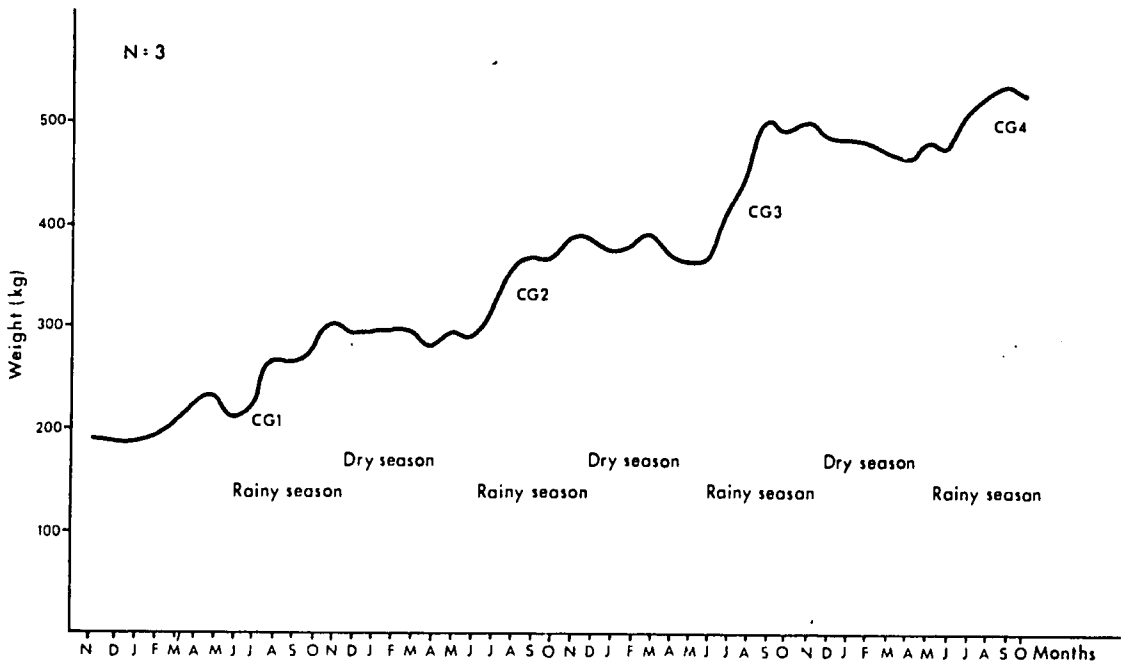


Figure 3.2.13 Growth curve of male cattle after weaning at Toukounous

Project grazing trials[1]

The project measured animal production under three grazing intensities at the ranches at Ibecetene and North Dakoro. In general, climatic conditions are similar at both places. However, there are differences in the breed of cattle under study, the species composition of the pastures and rainfall. At Ibecetene, the dominant cattle breed is Azawak, while at north Dakoro the dominant breed is Bororo. The dominant forage species are Aristida mutabilis

1. The data in the following sections were, unless otherwise stated, collected by the project range team directed by Dr. Robert Bement and supervised by David Blaine and Bruce Wylie.

and Cenchrus biflorus at Ibecetene and Cenchrus biflorus and Schoenefeldia gracilis at North Dakoro. In 1980, the mean forage production was 941 and 1,112 kg/ha respectively; rainfall for the same year was 192 and 238mm respectively. The grazing intensities were heavy, medium and light, or respectively 2, 4 and 6 ha/animal/year.

Seasonal influence on milk production[1]

The influence of the seasons on milk production is shown in figure 3.2.14. Milk production is higher during the rainy season than during the dry season: 5 to 6 times higher at North Dakoro and 2 to 3 times higher at Ibecetene. The lowest average production was observed in April, and the highest in August.

It should be noted that the data shown in figure 3.2.14 are approximate; they represent corrected morning production. Only morning milkings were done, and these were not complete. The traditional herders' method was adopted: the two forward teats were milked when the calf was young, and the two rear teats when the calf was older. The figures therefore approximate milk offtake under traditional pastoral management, not total milk production. Production in each case was measured at three different stocking rates, heavy, medium and light, with four cows per grazing intensity. The seasonal influence is clearly apparent at both ranches and for the three grazing intensities.

Dry season stocking rate has little effect on milk production. Production is drastically reduced at all three grazing intensities. No matter how much straw is eaten by the cows, they cannot maintain milk production because of the decrease in the nutrient content of the fodder. It is only during the rainy season, when the nutritional value of the range is good, that the effect of the stocking rate begins to appear.

---

1. These data were collected by Dana Glazier.

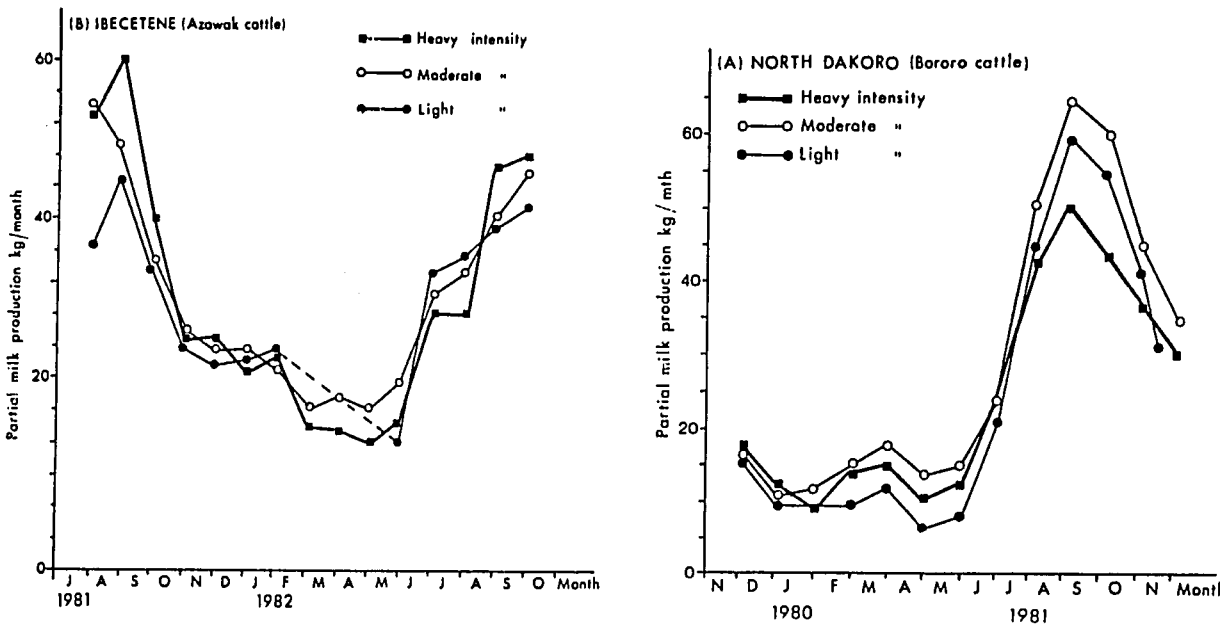


Figure 3.2.14 Influence of season and stocking rate on cattle milk production

The data were statistically analyzed, using the F test and the Newman-Keul test to evaluate differences between the averages obtained under the three grazing intensities. At Ibecetene, for 1981-1982, the differences between the milk production averages for the three grazing intensities were not significant in either the rainy or dry season. At North Dakoro, for 1981, there was similarly no significant difference between grazing intensities during the rainy season. The monthly variations during the rainy months probably increased the experimental error. The lowest milk production during this season was obtained as expected under heavy grazing conditions, and the highest under moderate conditions. Surprisingly, in the 1980 dry season, the heavy and moderate stocking rates produced almost the same production results, in both cases statistically higher than those obtained under low grazing intensity ($P \leq 0.05$).

Seasonal influence on weight of calves and their lactating mothers

Figure 3.2.15 illustrates the influence of the seasons on the weight of calves and their mothers, and, most importantly, the relation between the development of the calf and the physical condition of the cow.

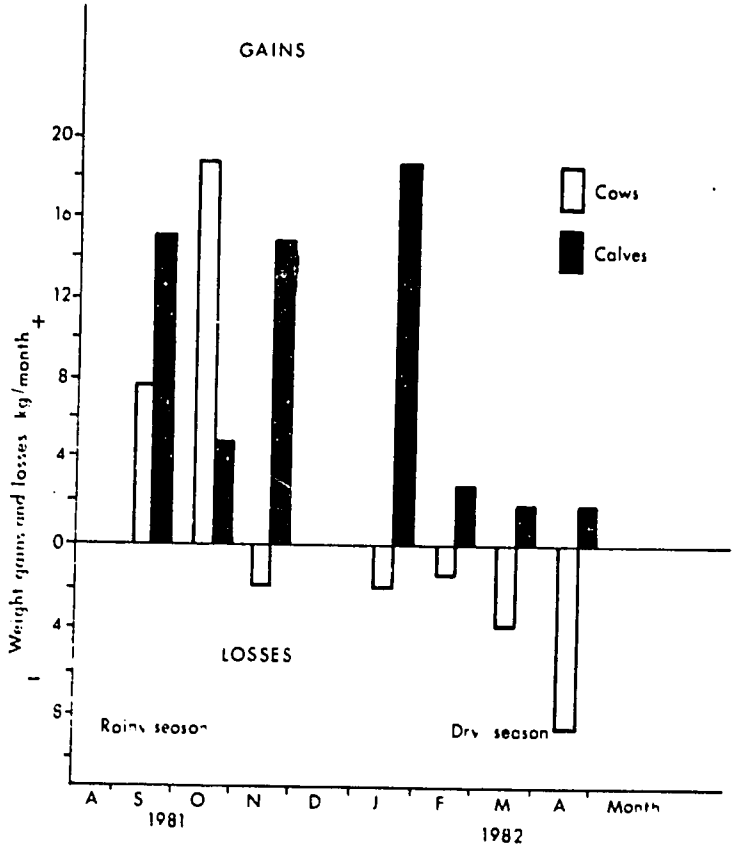


Figure 3.2.15 Seasonal influence on weight of calves and their lactating mothers

During the rainy season, the calf and its mother gain weight, although in this case, the calf gains less than the mother. This reault is rather curious; other ranch data also show the same tendency in October. When the nutritional value of the range begins to decline in November the cow enters a critical period: she gradually loses weight in order to continue providing milk to ensure calf growth. Until January, the calf puts on weight rapidly although the cow is losing weight. But by then the quantity of milk is so low that the growth of the calf slows down considerably, almost to zero during February, March and April. The reserves accumulated by cows in the rainy season do not enable them to produce enough milk to ensure normal calf growth through the dry season.

Rate of individual weight gain

Table 3.2.42 summarizes data from the grazing trials at North Dakoro ranch. Two conclusions are clear. First, whatever the grazing intensity, all animals lose weight during the dry season. Second, during the rainy season, there is a compensatory weight gain by all animals, but it is influenced by the grazing intensity.

Table 3.2.42 Seasonal influence on individual weight gains by Bororo heifers

Period	Individual daily weight gains (kg/day/head):		
	Heavy grazing	Moderate grazing	Light grazing
Dry season (1981)	-0.090	-0.083	-0.063
Rainy season (1981)	+0.390	+0.589	+0.608
Dry season (1982)	-0.163	-0.161	-0.152

Notes:
1. N=12.

2. Heavy grazing: 0.70 hectare/animal/127 days, or 2.01 ha/animal/year; moderate grazing: 4.02 ha/animal/year; light grazing: 6.03 ha/animal/year.

Table 3.2.43 brings together data on seasonal changes in heifers' weight at different grazing intensities.

Table 3.2.43 Seasonal weight changes by heifers at different grazing intensities

Ranch (cattle breed)		Weight change (kg/heifer/day) at different grazing intensities:					
		Rainy season (1981)			Dry season (1982)		
		Heavy	Moderate	Low	Heavy	Moderate	Low
North Dakoro	(Bororo)	+0.42	+0.59	+0.61	-0.18	-0.17	-0.17
Ibecetene	(Azawak)	+0.58	+0.51	+0.34	-0.24	-0.15	-0.09

In general, heifers tend to gain more weight during the rainy season when the stocking rate is low, and similarly to lose less weight during the dry season. However, no clear, consistent trend is shown by the results just presented.

At North Dakoro the difference between the average gains during the rainy season at different grazing intensities is significant ($P \leq 0.01$). The gain for the low stocking rate is higher than for the two other rates, which are not significantly different. This result is expected. During the dry season, however, there is no significant difference between the averages; regardless of stocking rate, the heifers lost about the same amount of weight.

The results at Ibecetene are very different. For example, there is indeed a significant difference between the average weight gains obtained during the rainy season ($P \leq 0.01$). However, the highest gain was obtained with the heavy stocking rate, and the lowest gain with the light one. These results, the opposite of those expected, may possibly be explained by poor forage quality in the light stocking rate pasture. The dry season results at Ibecetene appear

normal. The weight loss for the heavy stocking rate was significantly higher ($P \leq 0.01$) than for the other rates, while there was no significant difference between the moderate and low rates. These results are shown graphically in figure 3.2.16.

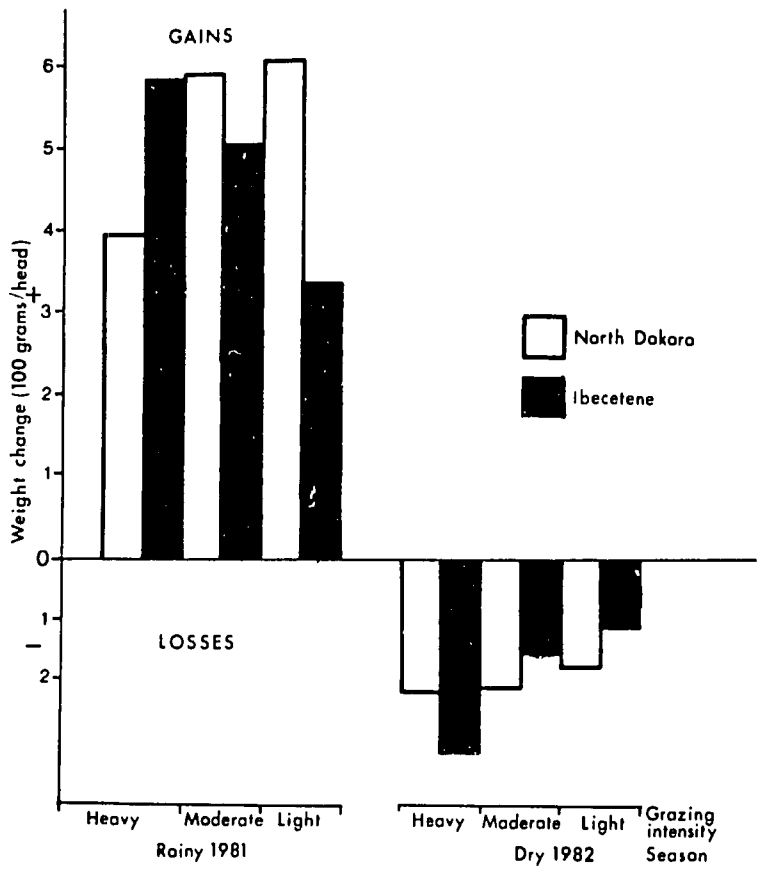


Figure 3.2.16 Double effect of season and grazing intensity on individual weight gain of heifers

The 1982 dry season results at Ibecetene show the relationship between grazing intensities and the length of time that heifers remained above a maintenance level that is, before they started to lose weight. These are given in table 3.2.44. In dry season pastures, the lower the stocking rate, the longer the heifers maintained their weight. Rotation on pastures with a light stocking rate also increased this period.

Table 3.2.44 Length of time before heifers started to lose weight during the dry season at Ibecetene

Grazing intensity	Length of time (days)
Heavy (2 ha/animal/year)	45
Moderate (4 ha/animal/year)	80
Light (6 ha/animal/year)	120
Light in rotation	145

Grazing trials at Ekrafane Ranch

Klein et al (1981) have reported results from trials carried out by INRAN researchers at Ekrafane ranch. Although Ekrafane is located outside the project zone, its climate and environment are similar to those of the project zone. The study compared individual animal production and production per hectare under traditional and improved management, the latter consisting of daily watering in the dry season and every two days in the cold season, together with centripetal grazing, that is, the animals graze the pastures far from water at the start of the dry season and gradually graze nearer the water source as the season advances. The results from this study are shown in table 3.2.45.

Table 3.2.45 Weight gain by young, castrated Azawak bulls under improved and traditional management

Management	Grazing intensity (ha/head)	Individual gain (kg/day)	Gain per hectare (kg/ha)
Improved	11.6 (heavy)	+0.0194	+6.1
Improved	23.3 (light)	+0.242	+3.8
Traditional	23.0 (light)	+0.215	+3.4

Source: Klein et al (1981)

The results may be summarized as follows:

(a) Individual animal weight gain is significantly higher with a light stocking rate than with a heavy rate, under improved management.
(b) At the same stocking rate, improving management significantly increases individual animal weight gain.
(c) However, there is no significant difference in individual weight gain if management is improved and the stocking rate is doubled at the same time.
(d) Finally, whatever the type of management, the gain per hectare is significantly higher with a heavy stocking rate than with a light rate.

There are two difficulties in comparing these results with those of the NRL project's own research on the relationship between grazing intensity and animal growth. The first is that the INRAN study's improved management system combined three treatments: grazing intensity, distance walked to water, and watering frequency. As a result it is impossible to separate out the effects of each of the weight gains. The second difficulty is that even the INRAN study's heavy grazing was, at 11.6 ha/head, considerably lighter than the NRL project's light grazing, at 6 ha/head.

3.3 ANIMAL DISEASE

In the past, animal disease epidemics have from time to time devastated the Sahelian pastoral economy. The eradication of major animal diseases has been the main development goal in the pastoral zone since the colonial period, with particular emphasis on controlling rinderpest and to a lesser extent contagious bovine pleuropneumonia through systematic vaccination campaigns. Although rinderpest is now infrequent as a result of these efforts, little is known about the other animal diseases in the project zone, nor are there systematic programs to control them. The project did epidemiological research in order better to understand the patterns of animal disease in the project zone and to provide the information needed to improve herd health.

The objectives of the animal disease study were (a) to identify the diseases which occur in the herds, (b) to determine the incidence, prevalance, seasonality and geographic distribution of diseases, and (c) to establish the economic importance of the diseases both as production constraints and as they are perceived by herders themselves. The emphasis throughout was on an epidemiological or economic approach to animal health in which the costs and potential benefits of disease prevention or control at the level of entire herds or populations is considered more important than individual treatment.

The study consisted of dry season (April-May) and wet season (July-September) surveys carried out in 1981. Herd conditions were very different in the two survey periods: in the dry season, the animals were under the stresses of inadequate feed and water, high ambient temperatures, and forced treks between pasture and water; in contrast, in the rainy season, environmental conditions were better, the herds' distribution was altered by migration, and production had responded to improved nutrition.

Extensive research methods were used, including interviews with herders and Livestock Service officials, herd and individual animal examinations, autopsies, trials with vaccines and other medications, and sampling of soil and local salt for mineral analyses. The study was an exercise in descriptive epidemiology in which diseases were viewed within the production systems in which they occurred. An effort was made to cover the greatest possible area and to examine the largest number of herds during the time available. Laboratory confirmation was not possible due to limits on time and access to adequate facilities.

LIVESTOCK DISEASES IN THE PROJECT ZONE

In this section, livestock diseases present or reported to be present are discussed alphabetically.

Anthrax. Anthrax occured in isolated herds of cattle and sheep during the dry season in the northern part of the project zone near Agadez and Ingal. There was no obvious association of these outbreaks with any particular grazing areas and, in all likelihood, the entire region is seeded with spores.

Avitaminosis A. This is a widely recognized problem in cattle in the project zone. Carotene, or pro-vitamin A is rapidly lost from the annual grasses as they die during the dry season. In 1981, night blindness appeared in February, and eventually about 10 percent of each herd was clinically affected. By May the deficiency became severe, and calves born to night-blind dams were weak and died within one week. Sheep were not affected since they are better able to store vitamin A, and camels and goats obtained sufficient vitamin A from perennial plants.

Babesiosis. The project zone is hyperendemic for bovine babesiosis. Calves become infected as soon as they acquire tick infestations and are constantly reinfected throughout their lives. They acquire an initial immunity through the colostrum, and later they develop their own immunity. As long as they are constantly reinfected, the immunity is active and consequently the infection is held at a low level with no clinical signs. However, if

exposure to infection is reduced, as on Ibecetene Ranch where a program of tick control has been undertaken, the immunity is lost and clinical illness and mortality occur. If tick control cannot adequately be practised on the ranches, it can hardly be expected to work under field conditions, and results could be counter-productive. No survey information from Niger is available but in northern Nigeria, the prevalence of Babesia bovis is reported to be 10 percent and that of B. bigemina less than 1 percent (Leeflang and Ilemobade 1977).

Blackleg. Blackleg has a reputation for being one of the most common diseases in the Sahel. It occurs in cattle throughout the project zone and all herders were aware of its importance. During this study, no pattern of occurrence was noted although herders reported that when blackleg affects a herd in an epidemic, as it did around Bermu in 1976, it is the most important cause of mortality in calves. When it occurs in a more endemic fashion, all ages of cattle may be affected; this suggests that some cases are due to clostridia other than Clostridium chauvaei, the specific agent of blackleg.

Botulism. Botulism is well-known in the Sahel but is apparently not recognized by Livestock Service field agents in Niger; however, it undoubtedly occurs there and the herders are familiar with it. The intoxication produces a progressive flaccid paralysis with high mortality due to the neurotoxins of type C and type D Clostridium botulinum. One case was reported by herders during the survey which could not be confirmed but, if true, was certainly a case of water-borne botulism, similar to those described elsewhere in the Sahel (Gidel et al. 1974, Provost et al. 1975; Doutre and Touré 1978).

Bovine pleuropneumonia. This disease was reported to occur in some locations in the departments of Tahoua and Maradi where the Livestock Service carries out vaccination in conjunction with the annual rinderpest campaign. During the project study, no animals were encountered which showed signs of this disease; therefore, it appeared to be well-controlled. Even without vaccination, the incidence would be low in the arid project zone because of rapid destruction of the organisms (Mycoplasma mycoides mycoides) by drying (Blood et al. 1979).

Brucellosis. Brucellosis occurs widely in African livestock and it may reasonably be assumed to occur in the project zone. Previous surveys carried out at the veterinary laboratory in Niamey indicated a prevalence of 15 to 30 percent in cows although these results were not from the project zone. One study reported that the prevalence of brucellosis in the vicinity of Niamey was 20 percent in cattle, 45 percent in goats and 25 percent in sheep. The survey was done in an agropaatoral zone and tests on the inhabitants gave an incidence of 30 to 40 percent positive reactors in herders and 5 to 6 percent in farmers (Gidel et al. 1974).

Although no teats were done in the present study to verify brucellosis as a cause of abortion in the zone, there were clinical indications of a high prevalence rate. Late-term abortions were observed in cattle being carsd for by hired FulBe herders, and many WoDaaBe herders told of a continuing pattern of abortions in their herds, especially involving first-calf heifers but not associated with difficult parturition.

There was evidence from the project zone that brucellosis occurred in goats. WoDaaBe do not drink goat's milk because they say that it will give them fevers. In contrast, the Twareg do not believe this. A possible explanation for this difference is that since the Twareg consume a lot of goat's milk as children, they acquire milk-borne caprine brucellosis early in life and become immune. On the other hand, WoDaaBe subsist mainly from their cattle and do not regularly drink goat'a milk; thus they do not become immune to caprine brucellosis and could acquire severe infections as adults. They could easily become aware of the relationship between goat milk and febrile illness transmitted through it.

Caseous lymphadenitis. This is an infection of small ruminants with Corynebacterium pseudotuberculosis (C. ovis). Although it is usually reported to be more common in sheep, in the project zone it occured just as often in goats[1].

---

1. It is also common for both ahesp and goats in Nigeria (Addo and Eid 1978).

Subcutaneous abscesses are formed but the animals remain productive until the organisms spread through the body, eventually causing pneumonia and abscesses in the liver and internal lymph nodes. When this happens, the animals become debilitated and unproductive[1]. Caseous lymphadenitis was particularly prevalent around villages which had sedentary flocks of sheep and goats (e.g. Bermu) and where the area was permanently contaminated; in such areas, the prevalence reached 10 percent. The Twareg did not know what to do about infected animals, but FulBe herders recognized when infections became generalized and removed severely affected animals from their herds by selling them.

Contagious ecthyma. This was only observed in goats, although sheep are also susceptible. It was not widespread and was only seen in WoDaaBe herds in the southern part of the project zone. It has been reported to be widespread in sheep and goats in Nigeria (Obi and Gibbs 1978) but this does not appear to be the case in Niger, at least at present.

The economic effects are difficult to estimate. Contagious ecthyma occurred in herds which had other health problems and in which the animals were in poor condition, but the contagious ecthyma itself was not a major factor in determining the poor health status of these herds.

Enterotoxemia. Enterotoxemia occurred in sheep in the project zone. The incidence was not determined but herders claimed it to be high. They knew the neurological form of the disease caused by Clostridium perfringens type D (Macadam and Zwart 1957). They were familiar with the signs, which

---

1. Staphylococcal abscesses, which mimic the early stages of caseous lymphadenitis (Pegram 1973), may also occur in the project zone.

include frothing at the mouth, inability to stand, convulsions and rapid death. The only cases observed or reported concerned animals grazing new grass early in the rainy season, or in animals being fed millet bran[1].

Foot and mouth disease. Foot and mouth disease occurred throughout the zone. Cattle were clinically affected but other cloven-footed animals, including wild ungulates, are also susceptible and probably harbor the disease.

Two affected cattle herds were observed, both of them FulBe herds from the agropastoral zone being grazed in the north, one near Gadabeji, the other near Agadez. A well-documented outbreak had also occurred on the North Dakoro Ranch. It is uncommon to find so much foot and mouth in Sahelian cattle herds. The high incidence of the disease in Niger may result from the north-south movement of herds in and out of Nigeria, a country where the disease is widespread.

Mandibular abscesses. Abscesses commonly occurred in camels and were seen during the dry season. They were a sequella to an acute respiratory infection which occurred at the beginning of the dry season and which caused fever, listlessness and loss of appetite. The animals recovered after several days but the mandibular lymph nodes became affected and progressively increased in size until they burst and drained a creamy yellow pus through the skin. There were subcutaneous sinus tracta and satellite abscesses along the mandible or in the intermandibular space. The lesions healed spontaneously after 6 to 9 months and mortality occurred only if the lymph nodes failed to burst and drain.

---

1. Diseases due to C. perfringens types B and C have also been reported in Africa (Sterne 1981; Blood et al. 1979) and may occur in the project zone. Enterotoxemia due to C. perfringens types C and D also affects camels (Ipatenko 1973); it may occur in the project zone but was not observed during the present study.

Some Twareg herders lance the affected nodes in order to speed recovery. In general, this was a herd rather than an individual animal problem, and the incidence was about 10 percent in affected herds. Most affected herds were in the Marandet area and were using the cement troughs at the wells there (see salmonellosis below for further information); however, affected herds were occasionally encountered in other parts of the project zone.

This clinical syndrome has not been described in the literature. It resembles the disease "strangles" in horses which is due to Streptococcus equi. There is a good possibility that the camel disease is also a streptococcal infection. Other syndromes involving streptococcal infections of the skin and subcutis of camels have been reported (Edelsten and Pegram 1974) but these were not secondary to acute respiratory infections.

Nodular worm disease. Oesophagostomum columbianum caused serious disease in sheep and goats in the southern part of the project zone, south of a line between Abalak and Aderbissinat. All herds were probably affected, and the type of production system had no noticeable influence on infections.

Disease is caused by larval worms embedded in the wall of the large intestine. Debility and diarrhea were the main features of the infection and affected animals were unproductive and unmarketable. Infection may heighten the effects of malnutrition, causing animals to die of starvation during the dry season (Carmichael 1972). This is one of the most serious diseases in the project zone, and was recognized as such by FulBe, WoDaaBe and Twareg herders, all of whom were willing to purchase anthelmintic treatment (levamisole).

Pododermatitis. This disease, sometimes called foot rot, occurred in sheep which were being watered at boreholes during the dry season. Water had spilled onto the ground, producing mud around the drinking troughs. Sheep which were forced to walk repeatedly in the mud became lame. Only the Twareg were concerned enough about the condition to consider it a problem.

Pox virus infections. Goatpox was observed in Twareg flocks around Agadez and sheeppox occurred in the agropastoral zone. Both diseases occurred at

Aderbissinat. The goatpox was milder than the sheeppox and did not cause mortality. The sheeppox appeared to exacerbate the enzootic pneumonias and this caused some losses which could probably have been prevented by an injection of long-acting oxytetracycline. Highly virulent strains of sheeppox, such as those reported from Nigeria (Asagba and Nawathe 1981), were not encountered.

Pulmonary disease in sheep and goats. Pneumonia and pleuropneumonia were the most important causes of morbidity and mortality in sheep and goats. Flock mortality had been especially high during the cool winter season and at the beginning of the rainy season when malnourished animals were chilled and stressed.

Fourteen sheep and goats were autopsied during the present study and all had some degree of pneumonia; those which were malnourished always had severe lung lesions. Consolidation of the ventral portions of the lungs occurred in 30 percent of the cases. Several animals had abscesses in the lungs and one had an entire lobe destroyed by abscessation. Four animals had adhesions between the lungs and the chest wall which were the result of prior episodes of pleuropneumonia.

Examinations of individual animals and herds revealed that all flocks of sheep and goats were affected. Nasal discharge was always evidence of pneumonia. Upper respiratory infections were not observed but a chronic tracheitis was noted in most animals necropsied; this may have been due to the production of exudate from the lungs or inhalation of sand, or both. Animals that were listless were usually also febrile (104-106°F) but those having only a nasal discharge had normal body temperatures. Occasionally, diarrhea occurred in the more severely affected animals. Coughing was usually reported by the herders but was not obvious during herd examinations. Very sick animals stumbled when they walked; before death they lay down and were unable to get up.

Animals over two weeks of age were affected; other than this, there was no evidence that morbidity or mortality were greater in any particular age group.

Bacteriologic examinations were not performed in the present study, but previous reports indicated that about 50 percent of the pneumonias may have been due to various serotypes of Pasteurella haemolytica biotype A and about 30 percent to various strains of Mycoplasma (Pegram 1979; Ola Ojo 1976). The remaining cases were probably due to a variety of other organisms but contagious caprine pleuropneumonia was probably not a component of this disease complex (Goni and Onoviran 1973; Okoh and Kaldas 1980).

Rickettsial diseases. Bovine anaplasmosis was the only rickettsial disease diagnosed in the study; there was no evidence of heartwater (Caudria ruminantium) nor of the Amblyomma ticks that transmit it. Tropical theileriosis (Theileria annulata) was not found either, which is consistent with the findings of a 10 year observation period on blood-borne infections in northern Nigeria (Leeflang and Ilemobade 1977).

Anaplasma marginale infections in cattle were probably common but remained subclinical. Obi (1978) detected a prevalence of 34 percent in FulBe cattle in Nigeria which had been trekked in from the north and Leeflang and Ilemobade (1977) also reported A. marginale infections to be common in northern Nigeria.

During the project study, clinical infections occurred during both rainy and dry seasons, only in mature cows. In these animals, the disease was debilitating and they lost weight rapidly. Even with the high infection rate, the incidence of clinical cases was probably no more than 1 to 2 percent per year.

There is a possibility that some rickettsial case may be due to tick-borne fever (Erlichia spp.), transmitted by Hyalomma ticks but these were also effectively treated with oxytetracycline (Robertson 1976).

Rinderpest. Rinderpest must be considered the most important disease in the project zone, as it provides the main economic rationale for the Livestock Service field operation. Since the majority of animals have not

been exposed to natural rinderpest virus for many years, withdrawal of vaccination would result in a highly susceptible population which could be devastated by an epidemic.

There is, at present, a disease occurring in the zone which causes oral erosions, diarrhea, low morbidity and a mortality rate of about 70 percent; it was only observed near Ibecetene. During the present study, there was no way to determine whether this was rinderpest (possibly modulated by prior vaccination) or mucosal disease. It occurred in animals of 2 to 3 years of age. In any case, scattered cases of rinderpest are confirmed from time to time in both Niger and Chad, and in the absence of vaccination, the disease would be certain to recur.

Salmonellosis. This disease is an intestinal infection caused by a number of strains of *Salmonella* spp. and is spread through fecal contamination of water and forage. Infections can occur in many animals, including all classes of livestock, and in young wild animals, but chronic carrier states are common and complicate attempts to control infection, especially under pastoral conditions.

Camels are known to harbor salmonellae (Ambwani and Jatkar 1973). Camel calf mortality due to salmonellosis has been verified under pastoral conditions in Ethiopia (Sandford 1981) and Somalia.

Unconfirmed but probable outbreaks of salmonellosis were observed in camels in the area of Marandet. The herders reported mortality to be 80 percent in affected young camels during the dry season and in the rainy season camel herds were observed which had suffered 100 percent mortality of calf and yearling camels.

During the rainy season, many adult camels were observed in mediocre body condition, and were probably mild chronic carriers. They were in herds which had experienced high mortality of young animals during the previous dry season.

Transmission of salmonellosis around Marandet could be due to the use of cement watering troughs. These troughs are large and porous and do not dry out during their period of use in the dry season. The sides of the troughs are not high enough to prevent fecal contamination and they are difficult to clean.

Twareg herders near Aderbissinat reported that they once saw a FulBe herder washing out one of the cement troughs. When asked why, he replied that, in the evenings, crows and jackals came to drink at the troughs, contaminated the water and transmitted the disease to his livestock. This may have been a reference to salmonellosis which has indeed been shown to be carried by jackals and hyenas in northest Nigeria (Britt 1979).

Septicemic pasteurellosis. This disease of cattle, sometimes called hemorrhagic septicemia, is due to type E *Pasteurella multicida* (Perreau 1973). It is thought to be common in the Sahel and is believed by Livestock Service agents to be common in the project zone. It was not, however, observed during this study, probably because it is a disease of humid ecosystems where it occurs at the beginning of the rainy season. There is some confusion in Niger about the nature of this disease; it is referred to only as "pasteurellose" in French and no distinction is made between this disease and pulmonic pasteurellosis, or shipping fever, caused by *Pasteurella hemolytica*. Neither disease appears to be common in the project zone.

Small ruminant pest (PPR). This disease was observed in the northern half of the project zone where the clinical disease occurred only in goats. In affected herds, the morbidity rate could not be determined but it was obviously high. The mortality rate was probably 90 percent in affected animals. In Nigeria, pest is considered the most important obstacle to goat production (Nduaka and Ihemalandu 1973) and it may be equally important in Niger.

This disease had a particularly significant influence on production in the Agadez region where losses have been occurring for 3 years.

Streptothricosis. Streptothricosis, a skin infection of cattle, was only observed in WoDaaBe herds near Bermu during the dry season. The cases were very mild and of no serious economic consequence, but herders were nevertheless concerned enough to pay for treatment for the affected animals.

Wounds. The most economically important wounds were pack sores on the backs of camels used for transportation by WoDaaBe, agropastoral FulBe and Hawsa. During the rainy season, the wounds were invariably infected and secondary myiasis was common.

Parasitic infections

External infestations

Biting flies. There are no serious dry season problems in any class of livestock in the project zone. Tabanids infest camels and occasionally other hosts, but they are not numerous. Their numbers decrease during the rainy season and adult flies disappear in August, to reappear probably around January. They mechanically transmit trypanosomiasis to camels, but since this disease is uncommon in the zone, the tabanids cannot be considered economically important.

Hornflies of the genus Lyperosia are numerous on livestock only during the rainy season. They are particularly prominent on the flanks of cattle and camels, where they bite and cause annoyance. Their presence may inhibit the healing of wounds on sheep and camels, and they may mechanically transmit protozoa and rickettsia; despite this, control measures would not be economically rewarding.

Lice. These were only observed on sheep during the dry season in the southern agropastoral zone. Infestations were of no obvious importance.

Mites. Psoroptic mange occurs in sheep, and to a lesser extent in goats, throughout the zone but is most common and severe in the southern half. All flocks are affected to some degree and no seasonality in the degree of infestations was observed.

Ticks. These infested all species of livestock but cattle were most heavily parasitized; donkeys were the least affected and sheep, goats and camels were intermediately affected. During the dry season, their distribution was more generalized, but only in camels did infestations become more severe.

Specimens collected were identified as *Hyalomma* spp., which may transmit *Anaplasma*, *Babesia* and *Coxiela burneti* (the Q fever agent) (Capponi et al. 1970; Hausmesser and Pontrel 1973). No *Amblyomma* spp., the vectors of heartwater, were found.

Several cases of anaplasmosis were diagnosed in mature Bororo cows, and there was often evidence of mild babesiosis in calves (generalized lymphadenopathy and slight jaundice); however, losses due to babesiosis were only occurring at the Ibecetene Ranch. Outside the ranch, animals developed non-sterile immunity, or pre-munity.

Internal parasites

A survey was undertaken in Dakoro arrondissement in which fecal samples were collected from cattle, sheep and goats for microscopic examination.

Young susceptible animals were sampled whenever possible, and observations were made on the appearance of mucous membranes, body condition, obvious pathology, fecal consistency and body temperature. A total of 67 cattle, 67 sheep and 51 goats were examined.

A laboratory was established at project headquarters in Maradi where semi-quantitative fecal flotation examinations were performed. Two grams of feces were suspended in 12 cc of Sheather's sugar solution, and the miniscus was transferred to a microscope slide for identification and grading of

parasite eggs into density categories. Coccidial occysts were counted and graded in the same manner.

The results gave no indications of heavy parasite infections in any class of livestock, and there were no significant changes in fecal egg output during the course of the survey.

The occurrence of strongle parasitism should be considered normal, and undoubtedly all animals were infected to some degree. Given the low plane of nutrition, the normal worm burdens may have had significant effects, but the only way to test this would be to carry out trials to determine whether there is any response to anthelmintic treatment. No heavy coccidial infections were ever encountered and there was no correlations between fecal egg or occyst output and body condition. Occasionally, cestode eggs were observed, but these were of no pathologic significance.

Nodular worm infections, which were determined by clinical examination and necropsy to be a common cause of debility in sheep and goats, were not detected by the survey because it is the larval stages which cause disease, and these do not produce eggs. Liver fluke infections (fascioliasis) do not occur anywhere near the project zone (Tager-Kagan 1978). Necropsies performed on sheep and goats during both the dry and rainy seasons revealed only light, insignificant infections with the pathogenic stomach worm Haemonchus contortus.

DISEASE PATTERNS: ECONOMIC IMPORTANCE, THE ROLE OF NUTRITION AND HERDER ATTITUDES

During the short period in which the animal disease study was undertaken, at least 24 diseases and diseaae complexes were observed in various classes of livestock in the project zone. Disease is clearly a constraint to livestock production. In the following table an attempt is made to rank diseases occurring in the project zone, based on estimates of cost of control, mortality, lost production and public health problems.

1. Diseases of greatest economic importance:

Anaplasmosis,	Nodular worm disease,
Avitaminosis A,	Pneumonias in sheep,
Blackleg and malignant edema,	PPR,
Bovine pleuropneumonia,	Protein/caloric inanition in sheep,
Brucellosis,	Rinderpest,
Enterotoxemia,	Salmonellosis,
Foot and mouth disease,	Sheeppox.

2. Diseases of lesser economic importance:

Babesiosis,	Pododermatitis,
Contagious ecthyma,	Strangles in donkeys,
Goatpox,	Streptothricosis,
Labial papillonmas in goats,	Wounds.
Pneumonias of goats,	

3. Diseases of uncertain economic importance:

Anthrax,	Psoroptic mange,
Caseous lymphadenitis,	Sarcoptic mange of camels,
Mandibular abscesses of camels,	Septicemic pasteurellosis.

Reducing the incidence and prevalence of these diseases would provide one of the most rapid ways to increase livestock production. Improved herd health would allow the animals to use available forage more efficiently, and could be achieved through interventions which would not disrupt existing

pastoral production systems. Herders would be better able to meet their own production goals.

During the course of this study, all species of livestock in the zone were not found to be equally susceptible to disease. Sheep were most susceptible, probably because available food is never wholly adequate for their maintenance and production. Chronic food shortage caused sheep to suffer excessively from the pneumonias which they harbored. Camels were the next most delicate species but there was a high variability of health status between camel herds. Nutrition undoubtedly played a role when camels were forced to leave superior browsing habitats and eat only grass; however, specific diseases such as salmonellosis and mandibular abscesses affected them especially severely when they shared unsanitary drinking facilities with other classes of livestock. In general, cattle were more resistant to disease and in particular were less liable to suffer from chronic debilitating infections; nutrition was the main influence on cattle production and Bororo cattle were particularly affected by low nutritional status at the end of the dry season. Flocks of goats appeared to be especially robust unless they were kept around villages where there was a buildup of contaminating bacteria and parasites, in which case they suffered the same chronic debilitating diseases as sheep. Donkeys seemed to be the hardiest animals kept in the zone and appeared to receive adequate nutrition until the very end of the dry season, when some of them lost a large amount of weight.

There was a definite seasonality in the occurrence of infectious diseases and the most severe effects were often seen at the end of the dry season when the quantity and quality of food was minimal. It would be a mistake, however to overemphasize the role of nutrition as an influence on the severity and occurrence of infectious diseases. There were other factors during the dry season which influenced infectious diseases: unsanitary well water and unsanitary watering troughs were major problems. Other contributing factors were the localized crowding of herds and the onset of the birth season which produced an added demand for better husbandry.

Many factors contribute to the development of disease in the herds, including cultural traits, animal reproduction, nutrition and habitat. The best example observed during the study was small ruminant losses from enzootic pneumonias and pleuropneumonias. When sheep are allowed to undergo a second cycle of breeding in November or December, they gave birth to lambs at the end of the dry season. The added nutritional stress of this pregnancy comes at a time when the animals can least afford it. As a consequence, extreme malnutrition makes the animals more susceptible to pulmonary disease and heavy losses result. Twareg herders are aware of this inter-relationship and avoid the losses by controlling breeding in the flock. WoDaaBe herders do not control sheep breeding and consequently their flocks consistently suffer greater losses. During the study, only one group of WoDaaBe was encountered which practiced breeding control; these were herders who maintained close contact with Twareg herders in the same region.

Goats suffered much less from the same types of pulmonary disease, apparently because they were able to obtain more satisfactory year-round nutrition. Breeding control is unnecessary for this species, since considerable peaking in parturitions takes place naturally. Goats only suffered from pneumonias when they were in strong competition for browse with camels, as in the vicinity of Marandet.

Most herders in all ethnic groups in the zone have a good understanding of animal health and its effects on animal productivity. The Twareg debate among themselves about animal health and they sometimes perform necropsies on their animals to learn the cause of death.

3.4 GRAZING AND ANIMAL-PLANT RELATIONSHIPS

Although a decade or more of mapping plant communities and general research on animal nutrition had increased knowledge about the ecology of Niger's pastoral zone, at the start of the NRL project there was little detailed understanding of plant-animal relationships and in particular how both animal production and the plants themselves responded to different degrees of grazing pressure. This information is essential to an evaluation of the technical options available to planners to improve the productivity of Sahelian pastoralism, and can guide attention to technically feasible interventions in range management. Such investigation is thus an important companion to project research on the social organization of grazing, on socially and economically feasible systems of resource management, and on ways to improve animal health and production generally.

With these objectives in mind, grazing trials (experiments in fenced pastures under closely monitored, controlled conditions) were established at two government ranches in the southern part of the project zone. These grazing trials were the main means for identifying factors affecting livestock weight gain and nutritional status at various times throughout the year, and quantifying the effect of grazing on the vegetation. The grazing trials provided a means to simulate the wide range of situations that occur in the open rangelands and to monitor under controlled conditions the complex changes that occur as a result. Many variables were still present but fewer than are found in most studies in the Sahel.

PROJECT ZONE GRASSLANDS

Using information collected during two low altitude aerial surveys in the project zone in May and October of 1981, Milligan (1982a) divided the zone into six ecological land systems based primarily on geomorphology, topography, vegetation structure and soil appearance. These six land systems were further grouped into four major categories: (1) Wooded Sahel

Previous Page Blank

Savanna, (2) Sand-dune Grassland, (3) Runoff and Floodplains, and (4) Mountains, Hills and Rocky Outcrops. The distribution of these four land systems is shown in figure 3.4.1.

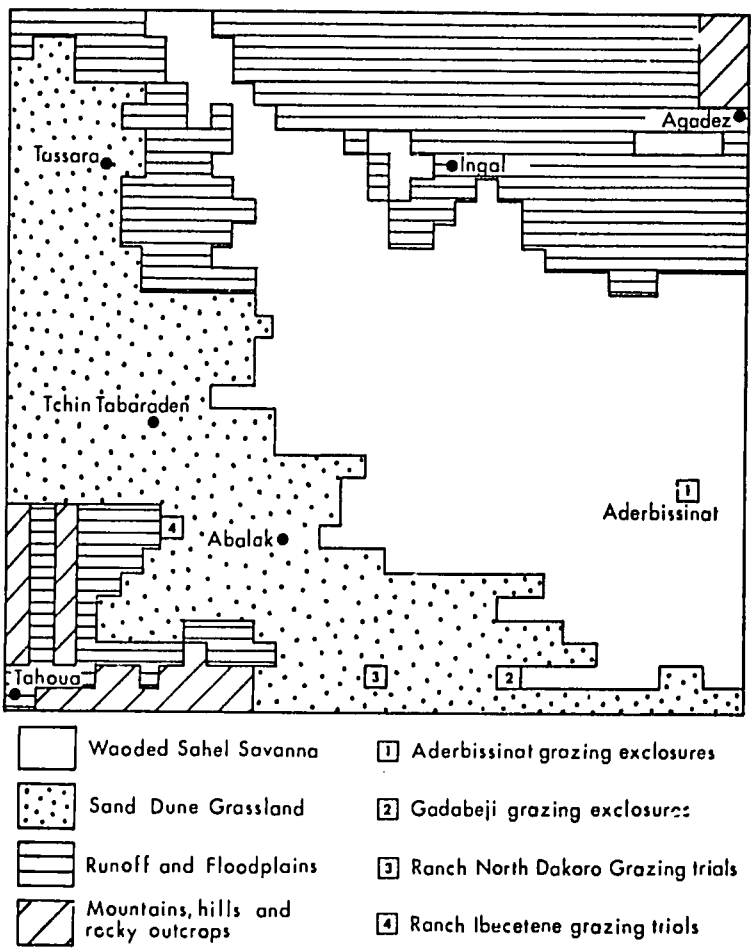


Figure 3.4.1 Ecological land systems and range research sites in the project zone

The Wooded Sahel Savanna is found along a diagonal gradient running from the southeast to the northwest of the project zone. A large portion in the southeast has prominent drainage lines in which the majority of trees are found. Scattered throughout the central and southeastern portion of this gradient are areas of gently rolling hills with a stabilized sand dune structure. Here there are no major drainages and trees are mostly found in seasonal pools although upland areas may also have trees. Moving northwest along the gradient the land becomes relatively flat with no major drainage lines and a sparse but uniform tree cover.

The Sand-dune Grasslands occupy the majority of the western portion of the study area (south and west of the Wooded Sahel Savanna). This area consists of stabilized sand dunes with sparse tree cover in the northwest increasing to the south and east.

The Runoff and Floodplain areas are found primarily in the northeast portion of the study area in the Ighazer flood plain and also north and southeast of Tassara and around Tahoua. These are generally flat areas or sloping from hilly land with virtually no tree cover.

A small portion of the project zone is occupied by mountains, hills and rocky outcrops. These areas of exposed rock have a variable tree cover and are concentrated in two major areas: in the Ayr mountains in the northeast corner of the zone; and in the Tahoua hills area in the southwest corner of the zone.

In addition to the land systems classification, Milligan (1982a) also identified nine major rangeland pasture types in the project zone using a rough pasture map of the pastoral zone (Rippstein and Peyre de Fabrègues 1972) and superimposing the aerial survey grid patterns over this map. Based on these classifications, over eighty percent of the zone can be classified into four major pasture types. The first and largest type, occupying 29 percent of the entire project zone, is the Panicum turgidum pasture located in the northern half to northern third of the zone. Panicum turgidum is a heavily branched perennial grass considered to be very

palatable to camels, sheep and goats when young. However, Maliki (1981) states that "there is not a great demand for this on the part of the cattle. It gives a bad taste to the milk". The northern Panicum turgidum pastures in the zone are used almost exclusively in the rainy season months of July and August.

A second pasture, that which is dominated by the tree species Sclerocarya birrea, occupies approximately 25 percent of the project zone. In the extreme south, Sclerocarya birrea is accompanied by Combretum glutinosum. Further north, in the central portions of the zone, Sclerocarya birrea is sometimes found together with Guiera senegalensis. All three of these species are browsed at some time by animals. Cows especially like the fruits of Sclerocarya birrea while camels browse the leaves and fruits. Combretum glutinosum is not very palatable to cattle (Maliki 1981), although they will graze the new leaf resprouts in March and April. Guiera senegalensis is good pasture for camels (Maliki 1981) and sheep and goats eat the fruit of this tree (Bartha 1970).

A third pasture type, accounting for approximately 19 percent of the project zone, is concentrated primarily in the east central portion of the zone. This complex is dominated by the tree Commiphora africana which has an average grazing value and is especially liked by camels (Maliki 1981).

The last major pasture type is a grassland found in the west central portion of the zone around Tchin Tabaraden. This type, accounting for approximately 12 percent of the study area is dominated by the annual grasses Aristida mutabilis and A. funiculata.

RANGE RESEARCH SITES

The project range research was concentrated in the southern half of the project zone with the majority of research confined to grazing trials and associated auxiliary studies at the Ibecetene Ranch approximately 85 km north of Tahoua and the North Dakoro ranch approximately 60 km northwest of Dakoro. In addition to the work on the ranches, ten grazing exclosures, one hectare or less in size, were constructed in the areas around Aderbissinat (5 exclosures) and Gadabeji (5 exclosures). The sites of these activities are shown in figure 3.4.1.

Grazing exclosures

The Aderbissinat exclosure sites were located west of Aderbissinat at distances varying from 4-35 km at an average elevation of 470 meters. This area lies within the Wooded Sahel Savanna land system and is classed into the Commiphora africana pasture type by Milligan (1982a). Other tree species in the area include Acacia radiana, A. laeta and Balanites aegyptica. Characteristic of this zone are large hardpan areas. These soils are fairly impermeable to water and lack significant amounts of vegetation. The major annual grasses in the area include Cenchrus biflorus, Tragus beteroniansus and Chloris virgata, with Gisekia pharmacioides and Tribulus terrestris as the dominant forb species. Perennial grasses are not abundant in the area.

The Aderbissinat area is visited by many herds on their way to northern pastures at the beginning of the rainy season and serves as a rainy season pasture for other herds. As a result, this area has fairly heavy grazing pressure during the rainy season. It is used during the dry season mainly by camels, sheep and goats.

The Gadabeji area, located approximately 90 km southwest of Aderbissinat, lies in the southeast corner of the zone at an average elevation of 430 meters. The area is located in the transition zone between the Wooded Sahel Savanna and the Sand-dune Grassland land systems, and is classed into the Combretum glutinosum and Sclerocarya birrea pasture type by Milligan (1982a). The tree species Acacia radiana and Balanites aegyptica are also fairly abundant in the area. Dominant annual grass species in the Gadabeji area include Cenchrus biflorus, Tragus beteroniansus and Aristida mutabilis. Perennial grasses are fairly abundant in the area with Aristida pallida and Cyperus conglomerata as the most dominant perennials. Major forb species include Calotropis procera, Alysocarpus ovalifolius and Cassia mimosoides.

The Gadabeji area is used primarily as dry season pasture and is normally lightly stocked during the rainy season as most animals have left for northern pastures. It is located on a transhumant route and usually receives grazing for a short-period early in the rainy season as the herds pass through on their way to northern pastures.

Ranches

The two government ranches or Multiplication Centers, Ibecetene and North Dakoro, where the majority of the project range research was conducted, were established in 1976 and 1978 respectively, as part of the government's drought recovery program. The ranches were intended to provide a source of quality animals for the herdsmen in the zone and to serve as extension centers for demonstrations, training and information.

North Dakoro ranch

The North Dakoro ranch is 28,800 hectares in size and is located approximately 50 km west of Gadabeji in the Sand-dune Grassland land system. The ranch supports about 3,000 head of cattle year-round with water supplied by two boreholes 12 km apart. This range occupies the same pasture type as Gadabeji (Combretum glutinosum, Sclerocarya birrea), and in overall species composition and topography the sites are very similar. Average elevation of the ranch is approximately 450 meters with gently rolling hills of a stabilized sand-dune structure. Grass cover is fairly uniform with Cenchrus biflorus, Schoenefeldia gracilis and Aristida mutabilis as the dominant annual grasses. Over 58 percent of the total ranch area in 1982 consisted of pasture with Cenchrus biflorus as the most dominant grass and with Aristida mutabilis or Schoenefeldia gracilis as the subdominant species. Thirty percent of the area was dominated by Aristida mutabilis and ten percent by Schoenefeldia gracilis.

Although not nearly as abundant as the annuals, perennial grasses are also found scattered throughout the ranch with Aristida pallida and Cyperus conglomerata as the most dominant perennial grasses. Dominant forb species include Calotropis procera, Chrosophora brocchiana, Indigophera sp. and Alysocarpus ovalifolia. Tree density is fairly high with open treeless terrain ranging from 11 to 25 percent. In addition to Sclerocarya birrea, the major tree species include Acacia laeta, Acacia albida and Balanites aegyptiaca.

Ibecetene ranch

The Ibecetene ranch occupies an area of 42,085 hectares and lies just east of the hills located near the town of Kao in the southwestern part of the project zone. The ranch supports 3,500 head of cattle and is organized like North Dakoro ranch with two boreholes located 12 km apart providing the water supply. The average elevation in the hills to the west of the ranch is 600 meters while the average elevation of the ranch itself is 475 meters. Much of the western half of the ranch is runoff and flood plains with the remainder of the ranch, extending northward, classified as an undulating stabilized sand-dune grassland. The percent cover of open treeless terrain ranges from 51-100 percent, with most trees concentrated in temporary pools or depressions.

The major grass species on the Ibecetene ranch are Cenchrus biflorus and Aristida mutabilis with Schoenefeldia gracilis as a subdominant species. Chrosophora brocchiana and Calotropis procera are the dominant forb species. Major perennial grass species at Ibecetene include Cyperus conglomerata, Aristida pallida and Andropogon gayanus, although perennial grasses are not very abundant and tend to be concentrated primarily in temporary pools.

A detailed survey of the vegetation communities on the Ibecetene ranch was made in November 1982 with vegetation communities delineated and percent biomass, vegetation height and percent ground cover estimated for each community. Results show that nearly two-thirds of the ranch is composed of two pasture types; Aristida mutabilis/Schoenefeldia gracilis and Cenchrus biflorus/Aristida mutabilis, each occurring on 30 percent of the area. Differences between the two types were in both the height of the vegetation and the percent ground cover. The Aristida mutabilis/Schoenefeldia gracilis pastures are 30-40 cm in height while the Cenchrus biflorus/Aristida mutabilis pastures range from 40-70 cm high. The average ground cover in the Aristida mutabilis/Schoenefeldia gracilis type is greater than 90 percent while that of the Cenchrus biflorus/Aristida mutabilis type is lower at 50-70 percent. The range of biomass produced in the Aristida mutabilis/Schoenefeldia gracilis is 900-1,200 kg/ha which is close to the 1,500 kg/ha reported in the Sud-Tamesna area (IEMVT 1970). The production

range for the Cenchrus biflorus/Aristida mutabilis pastures is lower (700-1,000 kg/ha). Although the average height of the Cenchrus biflorus/Aristida mutabilis pastures is greater, the lower percent ground cover reduces the amount of biomass found in these areas.

A large portion of the remaining area (26 percent) is composed of two pasture types dominated by Cenchrus biflorus. The average vegetation height is 400-100 cm while the average ground cover is 40-60 percent. The biomass for these types ranged from 500-800 kg/ha. The other pasture type containing Cenchrus biflorus covering 10 percent of the ranch also has Chrosophora brocchiana or Calotropis procera in varying situations. This type has a very low percent ground cover (0-10 percent), vegetation height of 70-100 cm, and a biomass range of 100-300 kg/ha. In the areas where Cenchrus biflorus is limited, biomass production is below 100 kg/ha. Some areas are completely covered by Chrosophora brocchiana and Calotropis procera and are essentially void of grass cover. These areas were larger in 1982 than in 1981.

The last two pasture types, mixed vegetation and temporary pool vegetation, occur over 4 and 2 percent of the ranch area respectively. The mixed vegetation type is concentrated along the western edge of the ranch, an area of runoff and flood plains caused by water drainage from the rocky, hilly area round Kao. Cymbopogon spp., Aristida spp. and Tribulus terrestris occur in these pastures as well as the species dominant in other pastures. The temporary pool vegetation type in the low lying areas over the remainder of the ranch where water drains occurs or collects for brief periods during the rainy season. Typical species include Panicum spp., Aristida funiculata and Tephrosia spp.

The vegetation in both these areas is tall (30-150 cm) and average ground cover is between 40 and 90 percent. The biomass present ranges from 1,000 to more than 2,000 kg/ha.

Grazing trials

Grazing trials were established on the Ibecetene and North Dakoro ranches in June 1980. Each grazing trial consisted of a set of six adjacent pastures encompassing approximately 170 hectares near the second well at each of the two ranches. Figure 3.4.2 shows the layout. Of the six pastures, three were grazed exclusively in the rainy season and three were reserved for dry season grazing. The three rainy season pastures were 14 hectares, 28 hectares and 42 hectares at Ibecetene and 14 hectares, 28 hectares and 47 hectares at North Dakoro. These pastures were stocked with the same number of animals in any given season resulting in the three separate grazing intensities: heavy, moderate and light respectively.

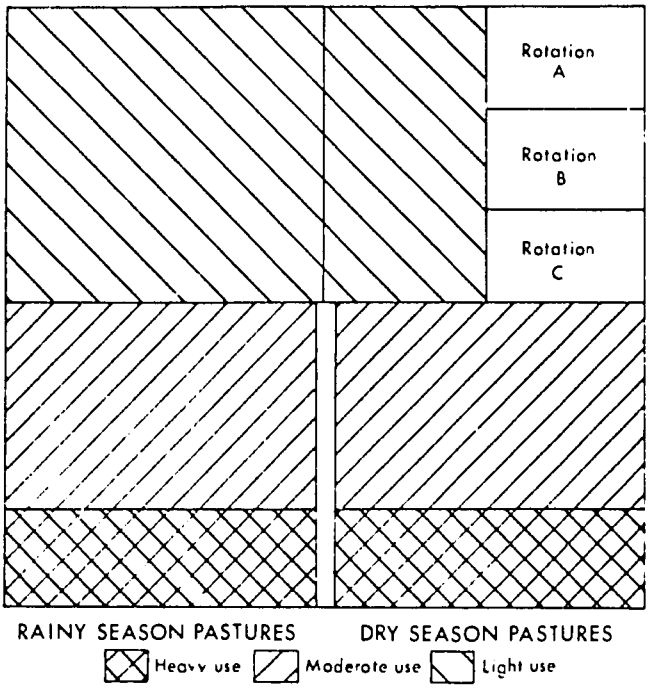


Figure 3.4.2 Layout of project grazing trials

Initially, the dry season pastures at each ranch were identical to the rainy season pastures. However, in December 1981 the dry season light use pasture was subdivided into one 21 hectare pasture and three 7 hectare pastures at Ibecetene and one 23 hectare pasture and three 8 hectare pastures at North Dakoro to incorporate a dry season rotation system into the trials.

Species composition

The North Dakoro grazing trials were established in a Cenchrus biflorue/ Schoenefeldia gracilis grassland community. Species compoaition in both the dry and rainy season grazing trial paatures, expressed for the dominant species as percent of total is provided in table 3.4.1 from 1979 through 1982.

The effects of season and intensity of grazing in this annual plant community were masked by the effects of variation in the annual precipitation patterns. For example Aristida mutabilis increased in all pastures in 1981 and then decreased again in 1982. It appears (also from the exclosure composition data) that this grass is favored by substantial early rains followed by a period of moisture stress. This species also was favored by dry season use over rainy season use. Other species such as Cenchrus biflorus and Fimbristylis exilis were favored by rainy season grazing over dry season grazing. Fimbristylis exilis and Tragus beteroniansus, both small annuals with short life cycles, vary dramatically with the yearly precipitation patterns.

The Ibecetene grazing trials were established in a Aristida mutabilis/ Cenchrus biflorus grassland community. Species composition in both the dry and rainy season pastures from 1979 to 1982 are shown in table 3.4.2. Aristida mutabilis has steadily decreased since 1979 in all pastures and Cenchrus biflorus has steadily increased. This phenomenon does not appear to be related to season of use, intensity of use or precipitation, but rather seems to be related to plant succession after a fire which occurred in 1978. Fimbristylis exilis, Tragus beteroniansus, and Schoenefeldia gracilis varied with annual precipitation patterns.

Table 3.4.1 Plant species composition, North Dakoro grazing trials, 1978-1982

(1) Dry season species composition (percent of total)

	1979[1]			1980			1981			1982		
	H	M	L[2]	H	M	L	H	M	L	H	M	L
Aristida mutabilis	0.7	1.6	-	-	-	0.7	4.4	8.9	8.8	2.4	2.5	0.8
Brachiaria xantholeuca	8.4	10.2	5.3	11.4	11.4	2.1	4.4	2.6	2.5	19.0	17.3	8.3
Cenchrus biflorus	61.3	63.3	64.9	48.0	49.6	54.3	60.9	52.2	60.0	48.6	36.1	47.7
Fimbristylis exilis	2.1	3.9	2.3	17.7	15.2	18.6	-	0.6	1.2	10.4	8.0	8.0
Schoenefeldia gracilis	11.3	10.2	19.8	16.0	14.5	12.1	15.6	31.8	23.1	2.4	17.5	20.1
Tragus beteroniansus[3]	2.1	7.8	2.3	2.9	6.1	7.9	11.3	2.6	1.2	10.4	7.8	4.8
Forbs	-	-	-	-	-	-	-	-	-	5.0	1.3	1.6

(2) Rainy season species composition (percent of total)

Aristida mutabilis	1.9	-	1.4	5.2	1.8	1.9	12.3	12.4	18.5	5.1	-	4.9
Brachiaria xantholeuca	1.9	6.5	5.7	11.7	11.6	6.5	3.4	6.2	4.1	11.7	10.2	9.0
Cenchrus biflorus	36.5	31.2	36.4	24.4	25.3	28.4	31.4	41.6	45.1	23.6	25.8	25.4
Fimbristylis exilis	10.9	5.3	1.4	9.9	9.1	5.4	-	-	-	3.1	6.2	7.3
Schoenefeldia gracilis	14.1	21.8	20.7	15.7	18.2	20.7	11.5	18.2	20.5	9.1	11.1	14.5
Tragus beteroniansus[3]	26.3	30.6	30.0	17.3	19.6	21.5	16.9	13.9	9.2	22.2	18.2	17.8
Forbs	-	-	-	2.3	3.9	1.9	-	3.0	-	2.0	2.1	3.0

Notes: See page 172

Table 3.4.2 Plant species composition, Ibecetene grazing trials, 1978-1982

(1) Dry season species composition (percent of total)

	1979[1]			1980			1981			1982		
	H	M	L	H	M	L	H	M	L	H	M	L
Aristida mutabilis	51.5	56.4	57.0	26.0	13.6	25.9	19.7	19.4	27.5	9.0	9.1	7.7
Brachiaria xantholeuca	19.0	12.9	1.5	-	7.6	5.8	-	-	5.3	-	3.5	4.4
Cenchrus biflorus	9.8	20.2	25.9	17.9	21.2	28.8	23.0	34.2	26.0	23.3	31.1	25.3
Fimbristylis exilis	12.3	0.8	9.6	4.0	0.6	2.4	3.3	5.6	3.0	2.4	18.7	18.7
Schoenefeldia gracilis	3.1	1.6	2.2	12.1	38.0	2.4	5.7	4.6	6.1	-	4.0	7.7
Tragus beteroniansus	3.7	2.4	0.7	19.6	20.1	16.5	22.1	13.9	23.7	3.1	16.3	6.6
Forbs	0.6	1.6	-	-	11.4	5.9	-	-	-	4.2	-	3.9

(2) Rainy season species composition (percent of total)

Aristida mutabilis	59.7	56.0	38.6	23.1	26.1	26.8	3.5	16.6	26.0	18.8	8.8	7.8
Brachiaria xantholeuca	3.2	3.0	2.0	4.7	4.4	9.3	4.6	5.8	8.8	1.0	-	1.3
Cenchrus biflorus	19.4	29.8	46.5	16.0	13.3	26.8	48.0	40.0	22.2	20.8	36.3	29.9
Fimbristylis exilis	12.9	1.5	2.0	11.3	11.1	6.7	-	2.9	7.3	33.7	28.6	18.2
Schoenefeldia gracilis	1.6	1.5	6.9	2.8	0.9	1.5	0.6	-	-	1.0	-	1.3
Tragus beteroniansus	1.6	3.7	-	21.7	21.7	17.8	27.1	22.4	26.0	17.8	13.2	11.7
Forbs	-	0.8	-	-	-	-	4.2	3.4	-	-	-	-

Note: see page 172

PRIMARY PRODUCTIVITY

Rainfall-primary production relationships

Primary production in the project zone is extremely variable due in part to the extreme variability in rainfall patterns between years and within years. This variability was discussed in relation to the pastoral zone as a whole in chapter 2.1. Discussion here concentrates on the effect of this rainfall variability on plant growth.

Annual precipitation at the four range research sites ranged from 108 mm (Aderbissinat 1980) to 244 mm (North Dakoro 1982) in the three years when reseach was carried out. Figure 3.4.3 shows the distribution of the annual rains at each of the four sites. There does not appear to be any pattern in overall rainfall distribution at the monitored sites. For example in 1981 at North Dakoro there were heavy rains early in the rainy season followed by a considerable period with no measurable precipitation. The same phenomenon occurred that year at Gadabeji. Ibecetene had very regular rains throughout the 1981 rainy season while the majority of the rains at Aderbissinat came during a short two week period in the middle of the season.

The rains are just as variable in one place from year to year. At North Dakoro in 1980 the rains were fairly evenly distributed throughout the months of June-September. In 1981 a higher amount of rain fell in June followed by small rains in July and fairly regular rains in August and September. The 1982 rains began extremely late in the season with over 45 percent of the total rains falling in a three day period in early August.

Notes to tables 3.4.1 and 3.4.2.

1. In 1979 fences were not completed at the time the areas were sampled. Thus there can be no difference due to intensity or season of grazing as all areas were commonly grazed.

2. Heavy (H), medium (M), and light (L) grazing intensity.

3. Tragus beteroniansus in the dry season pastures always exceeded the rainy season pastures even in 1979 when there was no difference in grazing. It seems to be correlated to old cattle trails which crossed the dry season pastures.

The relationship between total annual rainfall, biomass production and efficiency of rainfall (expressed as kg/ha of biomass per millimetre of rain) for three years (1980-1982) at North Dakoro, Ibecetene and Aderbissinat and for two years (1981-1982) at Gadabeji is shown in table 3.4.3. It appears as though the relationship between total biomass produced (kg/ha) and total annual precipitation relates more to the distribution of the yearly rains than to total rainfall. In the years 1981 and 1982 at Gadabeji precipitation was 159 mm and 150 mm respectively but total biomass varied from 188 kg/ha to 1,132 kg/ha. At the other extreme a precipitation difference of 43 mm at Aderbissinat resulted in only a 71 kg/ha difference in forage production. At North Dakoro, virtually the same total annual rainfall in three years (238 mm, 236 mm and 244 mm in 1980-1982 respectively) produced extremely different amounts of biomass (1,500 kg/ha, 750 kg/ha and 1,200 kg/ha). The most efficient rainfall (producing 7.5 kg/ha/mm) occurred at Gadabeji in 1982 where 150 mm of rain produced a biomass of 1,132 kg/ha. Gadabeji also had the least efficient rainfall (1.2 kg/ha/mm in 1981), where 159 mm resulted in only 188 kg/ha total dry matter production.

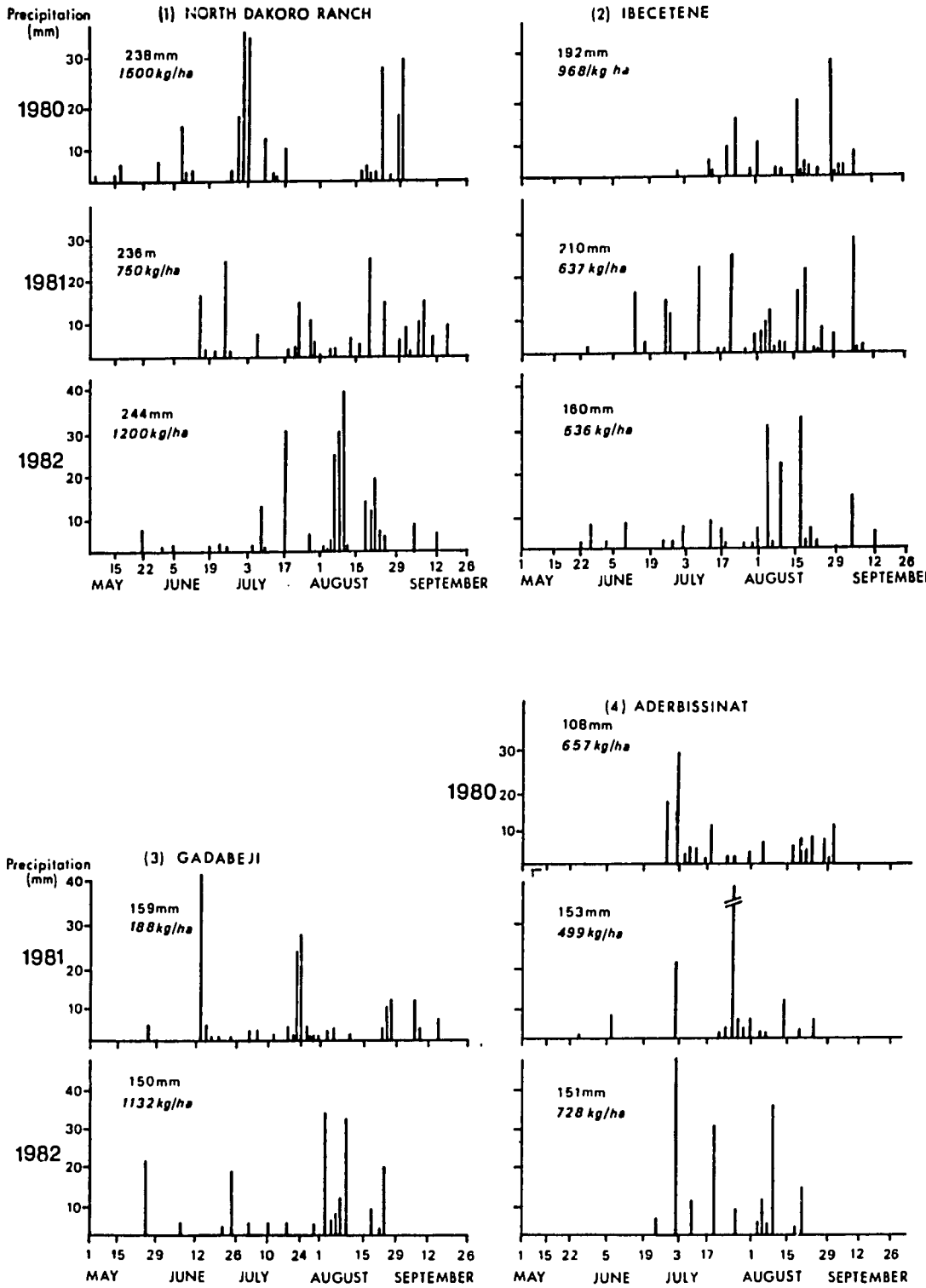


Figure 3.4.3 Distribution of annual rainfall at four range research sites in project zone

Table 3.4.3 Precipitation, production and efficiency (expressed as kg/ha biomass produced per mm of rain) of yearly rains at four research sites, 1980-1982

Year	(1) Ibecetene			(2) North Dakoro		
	mm	kg/ha	efficiency	mm	kg/ha	efficiency
1980	192	968	5.0	238	1500	6.3
1981	210	637	3.0	236	750	3.2
1982	160	586	3.7	244	1200	4.9

Year	(3) Gadabeji			(4) Aderbissinat		
	mm	kg/ha	efficiency	mm	kg/ha	efficiency
1980	-	1173	-	108	657	6.1
1981	159	188	1.2	153	499	3.3
1982	150	1132	7.5	151	728	4.8

The distribution of the annual rains at each site and shower size varied considerably from year to year and from site to site. At Gadabeji and North Dakoro, where the topography and plant composition are very similar, there appears to be a positive correlation between the efficiency of the rains and the occurrence of showers of 10 to 20 mm, as figure 3.4.4 shows.

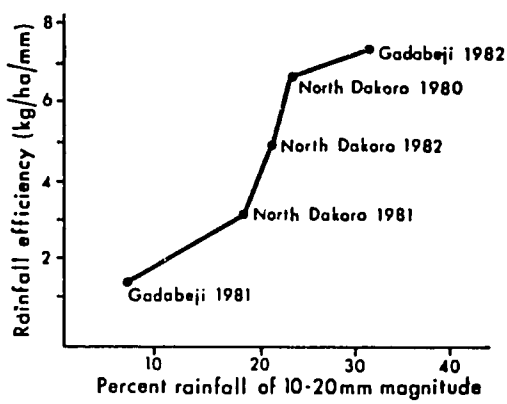


Figure 3.4.4 Relationship between the efficiency of annual rains and percentage of 10 to 20 mm showers at North Dakoro and Gadabeji, 1980-1982

Influences of grazing on primary production

Although precipitation is a major factor determining potential forage production, other factors, especially the time and intensity of grazing, can greatly affect the actual forage production of an area in a given rainy season.[1] Results obtained from the grazing trials, clipping plot experiments and grazing exclosures indicate that grazing or clipping the grass in an area during the rainy season can stimulate vegetative growth and thereby increase overall biomass production. Data from the rainy season grazing trials at both Ibecetene and North Dakoro was used to determine the effects of different grazing pressures on forage production,

The formula for estimating plant growth is as follows:

$$\text{Herbage growth (kg/ha)} = VE - VB + \left(\frac{.03 \times AW \times A \times D}{P}\right)$$

Where:

VE = Standing biomass at the end of the period in kg/ha of herbaceous dry matter.

VB = Standing biomass at the beginning of the period in kg/ha of herbaceous dry matter.

AW = Average individual animal weight during the period in kg. This is the average of the weights at beginning and end of the period.

A = Number of animals in the herd.

D = Number of days in the grazing period.

P = Pasture size in hectares.

0.3 = The percentage of the body weight that animals normally consume on a daily basis.

---

1. Soil fertility, especially in nitrogen and phosphorus, is a major influence on differences in plant production at different sites (Penning de Vries and Djitèye 1982). The project did no measurements of this. However this effect is strongest when annual rainfall exceeds 300 mm; as figure 3.4.3 shows, rainfall at project range research sites was less than this in all cases.

Vegetation growth under each of the grazing intensities in different periods during the 1981 and 1982 Ibecetene rainy season trials and for the 1981 Dakoro rainy season trials are given in tables 3.4.4 and 3.4.5.

In 1981 at Ibecetene, total vegetation production was 699 kg/ha for the heavy use rainy season pasture, 570 kg/ha for the moderate and 523 kg/ha for the light use rainy season pasture. Basically the same situation occurred at Ibecetene in 1982 with total production in the heavy use rainy season pasture being over two times that of the light use pasture (655 kg/ha and 306 kg/ha respectively).

The 1981 Dakoro results (table 3.4.5) also show that the greatest total production (689 kg/ha) was in the heavy use pasture, followed again by the moderate and light use pastures (672 kg/ha and 662 kg/ha respectively).

Table 3.4.4 Vegetation growth at Ibecetene rainy season grazing trials, 1981-1982

Grazing intensity	Plant growth (air dry kg/ha) in period: [1] 1 1981	1 1982	2 1981	2 1982	3 1981	3 1982	4 1981	4 1982	5 1981	5 1982	Total for rainy season 1981	Total for rainy season 1982
Heavy	209	-	300	4	80	415	86	154	24	82	699	655
Moderate	122	-	418	10	3	550	21	19	6	-136	570	443
Light	78	-	364	21	68	539	34	-143	-21	-141	523	306
Precipitation	67.8		32.0	102.1	56.8	56.4	32.4	1.0	0.0	0.0	189.0	159.5

Note:

1. Period

Period	1981	1982
1	Prior to 13 July	-
2	13 July to 7 Aug	Prior to 10 Aug
3	8 Aug to 30 Aug	11 Aug to 20 Sept
4	31 Aug to 12 Oct	21 Sept to 16 Oct
5	13 Oct to 2 Nov	17 Oct to 16 Nov

Table 3.4.5 Vegetation growth at North Dakoro rainy season grazing trials, 1981

Grazing intensity	Plant growth (air dry kg/ha) Prior to 2 July	3 July to 27 July	28 July to 31 Aug	1 Sept to 10 Oct	2 Oct to 1 Nov	Total rainy season
Heavy	151	311	44	183	-38	689
Moderate	138	197	226	111	-87	672
Light	137	241	283	1	-124	662
Precipitation	94.2	25.1	71.5	44.9	0	235.7

From 6 July to 3 October 1981 a clipping plot experiment was conducted at North Dakoro. Rainfall was 234.4 mm. The results confirmed the vegetative growth patterns found in the rainy season trials. Plots clipped weekly had a total seasonal production of 939 kg/ha whereas production for the unclipped plots was 764 kg/ha as table 3.4.6 shows. Weekly clippings also led to greater production than two or three week clippings.

Table 3.4.6 Dry matter production at North Dakoro under four intensities of clipping

Clipping interval	Dry matter production (kg/ha)
1 week	939
2 weeks	797
3 weeks	708
Clipped only at end of season	764

The Gadabeji and Aderbissinat exclosure sites also showed differences in biomass production between the grazed exterior areas and the ungrazed interior. In 1980 and 1982 at Gadabeji standing herbage on exterior transects was slightly greater than on interior transects at several exclosures. At Aderbissinat several exclosures in 1981 also had greater production outside the exclosures.

The above data indicate that heavy grazing pressure during the vegetative growth period results in an increased biomass production. However, grazing too early in the season, when the plants are just germinating, may have detrimental effects. During the 1982 dry season at Ibecetene, four heifers in the heavy and moderate use pastures and two heifers in the light use pasture were held in the dry season trials until August 10, when the heifers were removed; these pastures were not grazed for the remainder of the rainy season. Thus the dry season pastures were exposed to grazing while the plants were just germinating. Standing herbage

estimates of the dry season pastures at the end of the growing season showed lower amounts of forage produced in the heavy use pasture during the 1982 rainy season. Statistical analysis showed that forage in the heavy use was significantly different from the moderate use pasture at the 95 percent level of probability. Thus it appears as though heavy grazing early in the rainy season, while the plants were germinating, was detrimental to plant production in the 1982 rainy season at Ibecetene.

Soil moisture-primary production relationships

The amount of rainfall that permeates the soil surface to become available to growing plants is as or more important than the total amount of rainfall. The amount of available soil moisture as well as the total length of time this moisture is available to growing plants plays a key role in germination, seedling survival and biomass production.

Influences of grazing on soil moisture

Results from the Ibecetene and North Dakoro grazing trials show that the time and intensity of grazing has a marked effect on the buildup of soil moisture. Pastures grazed in separate seasons show differences in the accumulation and depletion of soil moisture. At both Ibecetene and Dakoro, moisture penetrated less deeply and soil moisture depleted faster after the rains had ended in pastures not grazed during the rainy season than in those which were grazed during the rainy season. Figures 3.4.5 and 3.4.6 illustrate this.

The soil moisture on the ungrazed dry season pastures was nearly exhausted in the two week period following the last of the September rains, so that by the first week in October they contained only trace amounts of available soil moisture at the 60 to 90 cm level. The one exception to this was the dry season heavy use parcel at Ibecetene where 50 percent of available soil moisture was retained in the 30 to 240 cm depths until production of 37 kg/ha and as a result would be more representative of a grazed than an ungrazed pasture.

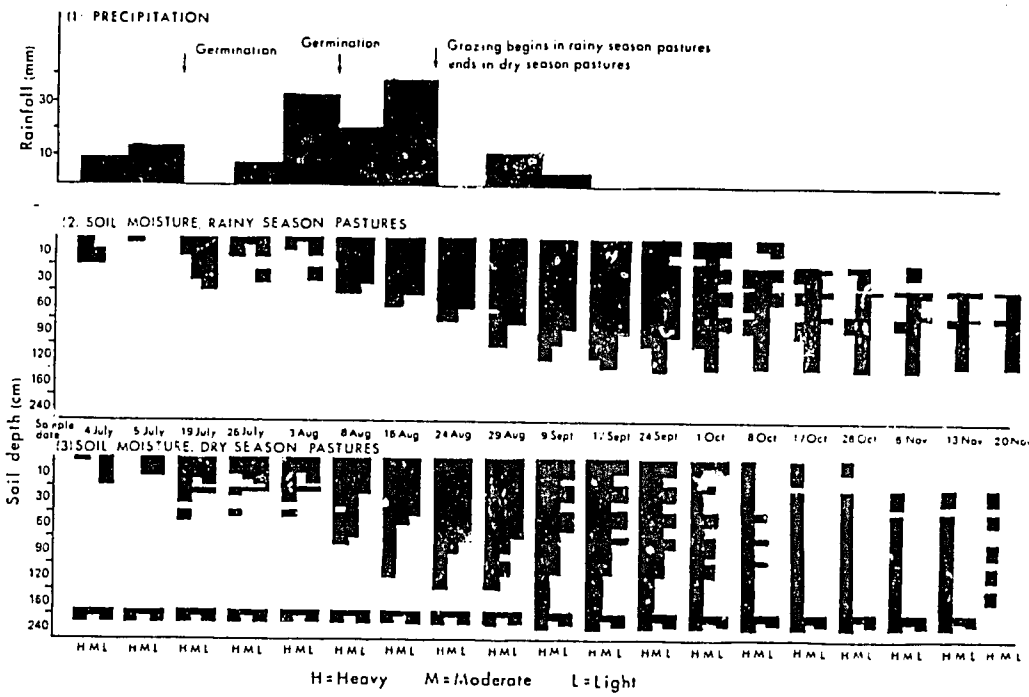


Figure 3.4.5 Soil moisture profiles and distribution of rainfall, Ibecetene, 1982

The pastures grazed in rainy season trials, in contrast to the dry season pastures, still contained a considerable amount of soil moisture for nearly two months after the final rains. Thus rainy season grazing appears to preserve soil moisture through a reduction in the amount of plant cover and canopy which therefore reduces the amount of water loss due to transpiration by the vegetation.

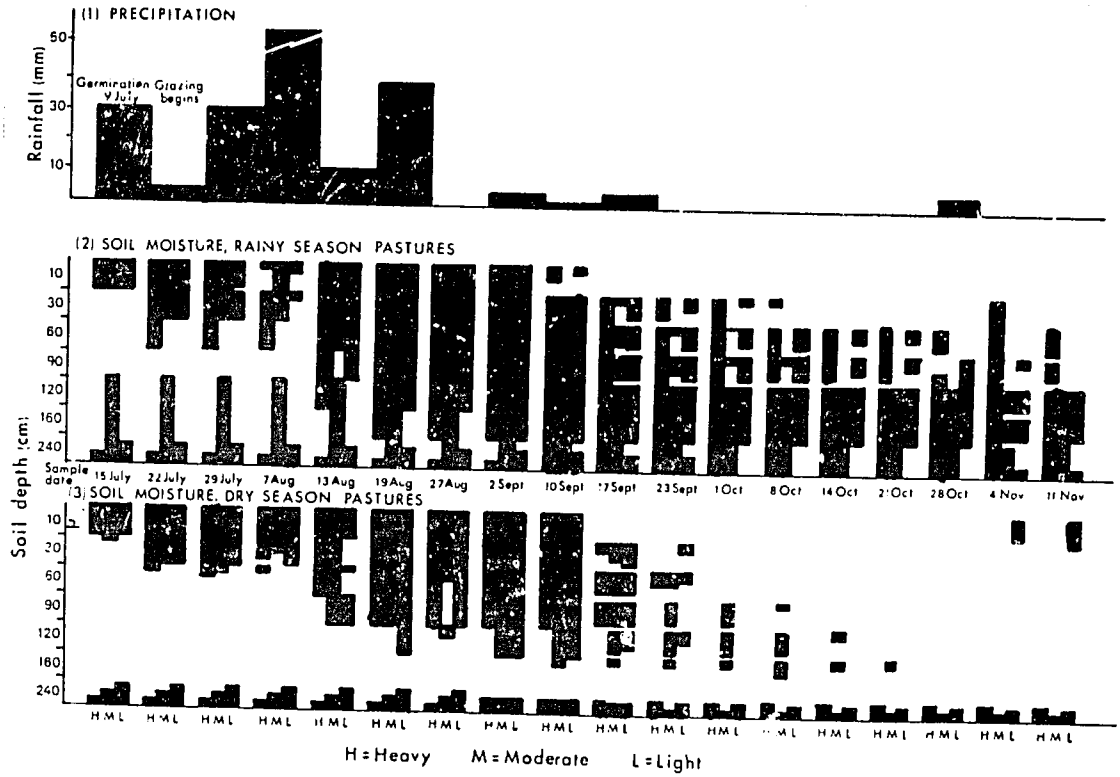


Figure 3.4.6 Soil moisture profiles and distribution of rainfall, North Dakoro, 1982

Figure 3.4.7 shows this relationship between the amount of standing herbage and percent available moisture in the upper 90 cm (where the majority of annual plant roots are found) two weeks after the rains ended. This relationship indicates that greater amounts of standing herbage leave little soil moisture at the end of the rainy season, while lesser amounts of standing herbage result in some soil moisture being present at the end of the growth period.

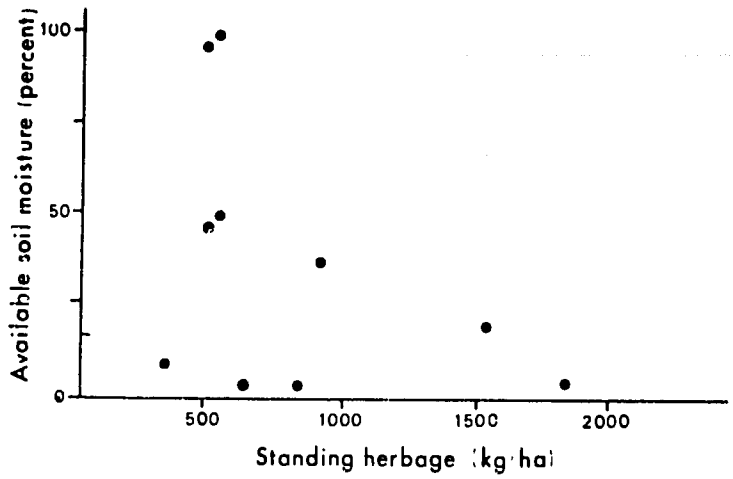


Figure 3.4.7 Available soil moisture in the top 90 cm of soil and standing herbage two weeks after the end of the rains, October 1982

Rainy season pastures under the three different intensities of grazing also exhibit different soil moisture profiles, as figures 3.4.5 and 3.4.6 show. These differences are again related to the amount of standing herbage present. The soil moisture in the light use pastures, under less intense grazing pressures and thus with higher amounts of standing herbage left ungrazed, was depleted faster than the heavy and moderate use pastures. In these latter pastures the rate of depletion was slower, resulting in a retention of soil moisture until after the majority of plant growth was finished, thus creating a soil moisture reserve.

This was particularly evident at the North Dakoro trials where the heavy use pasture contained a higher percent available moisture than either the moderate or light use pastures at the 30 - 240 cm depths until the end of November. At Ibecetene the moderate use pasture contained the highest

percent available moisture (100 percent at the 30 - 120 cm depths; sample date 17 October) for the longest period. However, by early November there was still some soil moisture in the heavy use pasture and large amounts in the moderate use pasture, while the light use pasture was almost dry. This situation continued until the third week of December.

This soil moisture reserve is used by perennial grasses, shrubs and trees during the dry season, thus providing a protein and vitamin A source to animals at the time when protein is needed to increase the digestibility of the low quality forage that livestock feed upon at this time of the year.

Percent dry matter

Throughout the rainy season and early dry season, percent dry matter (pdm) of the grass forage appears to be related, at least in part, to the time and intensity of grazing pressure.

During the late rainy season in 1981 and 1982 at both Dakoro and Ibecetene, the heavy use rainy season pasture was lower in pdm than either the moderate or light use pastures as table 3.4.7 shows. The moderate use was only slightly lower than the light use pasture in all years. These differences between pastures were not apparent in 1980 when grazing did not begin until late in the season.

These differences between the pastures also occurred throughout the course of the rainy season. Results for the 1980, 1981 and 1982 trials at North Dakoro are presented graphically in figure 3.4.8. In each year the pdm of the vegetation was similar in all pastures for the first two months of the trials. At this point, however, differences between the pastures become apparent. This point of divergence depends on the occurrence of the final rains each year. In 1981 and 1982 the pdm of the vegetation reached 100 percent in all pastures two months after most of the rains were over. In 1980, when grazing began late, this change basically took place after one month. In addition, within this two month period in 1981 and 1982, the rate of increase in the pdm for the heavy use pasture was slower than either the moderate or light use pastures.

Table 3.4.7 Percent dry matter in rainy season pastures at North Dakoro and Ibecetene grazing trials, 1980-1982

	Percent dry matter									
	North Dakoro Rainy season pastures						Ibecetene Rainy season pastures			
1980	Jul 28	Aug 27	Sept 26	Oct 28	Nov 29	Jan 2	Aug 2	Sept 2	Oct 2	
Heavy	25	44	63	97	100	100	32	43	100	
Moderate	24	40	56	93	100	100	27	41	100	
Light	28	39	57	98	100	100	33	44	100	
1981	Jul 2	Jul 27	Aug 31	Oct 1	Nov 2		Jul 13	Aug 7	Aug 30	Oct 12
Heavy	26	35	43	46	100		20	29	29	100
Moderate	24	30	54	66	100		22	31	34	100
Light	26	30	42	67	100		19	33	37	100
1982	Jul 14	Aug 13	Sep 17	Oct 12	Nov 11	Dec 15	Aug 10	Sep 20	Oct 17	Nov 16
Heavy	30	24	57	77	100	100	54	24	55	100
Moderate	28	25	51	85	100	100	50	34	85	100
Light	36	21	52	87	100	100	53	42	87	100

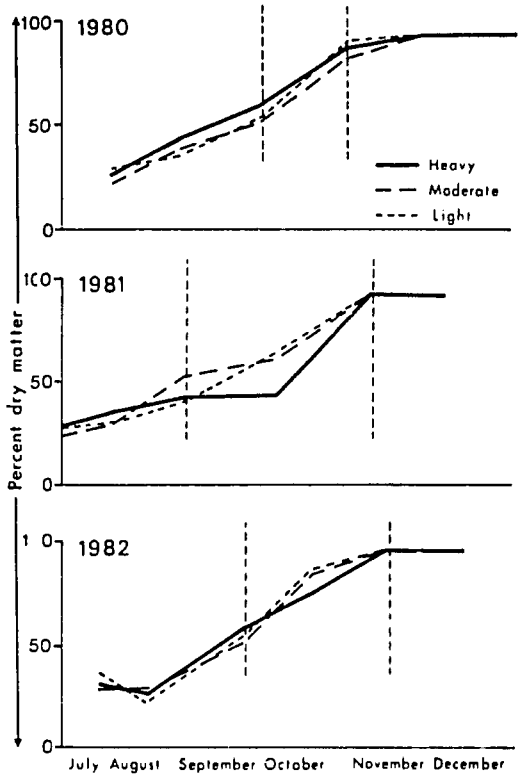


Figure 3.4.8 Rate of change in percent dry matter in North Dakoro grazing trials, rainy season, 1980-1982

At any given time the pdm of the vegetation is determined to a large degree by the amount of available moisture in the soil, with an inverse relationship between percent dry matter and the percent available soil moisture in the 0-90 cm soil depths, as figure 3.4.9 shows.

Apart from the initial period at the beginning of the rainy season when soil moisture is critical to germination and seedling survival, the available soil moisture present is particularly important (in terms of the vegetation quality and a soil moisture reserve) during the period following the end of the rains.

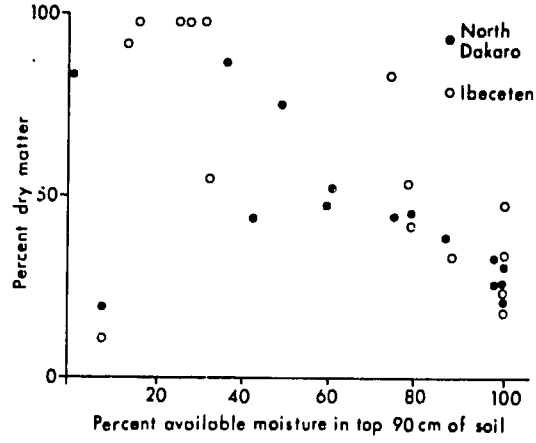


Figure 3.4.9 Average percent available soil moisture in top 90 cm of soil and percent dry matter, Ibecetene and North Dakoro grazing trials, 1982

Preliminary results from soil moisture studies in 1982 indicate that if a heavy and constant pressure is applied throughout the rainy season, a soil moisture reserve is created. This means that grass forage at the end of the rainy season will have a lower pdm and thus greater amounts of digestible crude protein and nitrogen.

Dry matter disappearance

With the exception of trees and perennial grasses and forbs, the total amount of forage production becomes fixed by the end of the rainy season. It is this amount of forage production that is available to animals throughout the dry season. Aside from grazing, there are two other factors which contribute to dry matter disappearance. These are natural decomposition and fire.

Natural decomoposition

Results from six studies conducted within the grazing trial system at North Dakoro Ranch show that pastures left ungrazed during the rainy season have low rates of forage loss from decomposition during the cold and hot season when animals are prohibited from entering the area; studies number 1 and 2 in table 3.4.8 show this. Large losses due to trampling by animals will occur where they pass through any particular area.

Pastures grazed during the rainy season have higher rates of forage loss from decomposition, possibly related to low vegetation density which makes the remaining vegetation more susceptible to destruction by wind or blowing sand (see studies number 3-5). Late rains may accelerate decomposition and cause an increased rate of disappearance, while early rains may eliminate a large portion of litter which constitutes the majority of available late dry season forage. The high disappearance rate in studies number 3-5 in table 3.4.8 was due to the effect of the early rains on the remaining standing vegetation and litter.

Other studies conducted in the Sahel (Penning de Vries and Djitèye 1982) support these conclusions. They found minimal (less than 15 percent) losses of biomass during the cold and hot seasons (October-May) and the majority of vegetation losses (in areas excluded from grazing and fire) occurring primarily during two relatively short periods. The first occurs at the end of the rainy season, immediately after plant maturation. At this time, as much as 20 percent of the total biomass can be lost due to the heavy loss of seeds caused by wind as well as ants. Late rains at this time may also result in considerable biomass losses.

The second and perhaps more important losses occur and the very end of the dry season (in May and June), where remaining biomass is subject to strong winds and intense, early rains. Losses due to termites, which become extremely active during this time, are also considerable.

Table 3.4.8 Results from six decomposition studies conducted at North Dakoro Ranch, 1980-1982

Study number	Previous treatment (pasture)	Date begun	Duration of study (months)	Initial standing biomass (kg/ha)	Lost (kg/ha)	Disappearance rate (percent)	Monthly disappearance rate (percent)
1	Exclosure	mid-November 1980	6.0	1493	102	7	1.2
2	Light use dry season	mid-November 1980	1.5	1632	25	1.5	1
3	Heavy use rainy season	November 1981	8.5	97	31	66	8
4	Moderate use rainy season	November 1981	8.5	269	64	24	3
5	Light use rainy season	November 1981	8.5	354	124	35	4
6	Light use	mid-January 1980	4.0	736	309	41	10

Fire

Fire results in a 100 percent loss of available dry forage in an area. The majority of fires occurring in the project zone are caused by man and occur primarily in the cold season months of October to February. At this time there is an abundance of dry grass in the bush as well as an increase in the number of small cooking fires used by herders for heat and cooking. Fire not only completely removes dry season forage but also creates large barren areas which are very vulnerable to erosion by winds and early rains.

The percent of total biomass lost each year to fire is very variable due, in part, to variable rainfall as well as to variations in overall plant density. Penning de Vries and Djitèye (1982) report that it takes a minimum of 1,000 kg/ha of dry matter to support a fire, and this amount of biomass is often not reached in the project area.

Conflicting data have been obtained as to the benefits and detriments of fire on forage production. Results from a study at the Ibecetene Ranch during the 1981 rainy season showed that initial forage production of annual grasses in the early rainy season was substantially greater in an area burned the previous October than in an adjacent non-burned area (414 kg/ha, 748 kg/ha and 894 kg/ha dry matter production on the burned areas on 17, 25 and 31 July respectively, and 202 kg/ha, 516 kg/ha and 600 kg/ha production on the non-burned areas for the same sample dates). However, a burn study conducted at the North Dakoro Ranch during the 1982 rainy season, in an area of annual grasses burned the previous September, showed that initial forage production inside and outside the burned area were very similar. Dry matter production in the burn on 18 and 25 July was 77 kg/ha and 291 kg/ha respectively, while production in the adjacent non-burned area was 98 kg/ha and 292 kg/ha.

No quantitative data exist on the effect of fire on perennial grasses and forbs in the project zone, but qualitative observations of two areas burned during the 1981 dry season at North Dakoro Ranch showed new green perennial regrowth (primarily the grass species Aristida pallida and Cyperus conglomerata) in the burned areas during the following late dry and early rainy season. According to Penning de Vries and Djitèye (1982), this perennial regrowth in a burned area is higher in both quantity produced and quality (measured in terms of percent nitrogen) than that in an unburned area. These increased amounts of better quality feed are also more accessible to animals because the taller, less palatable rank growth is removed.

SECONDARY PRODUCTIVITY: THE PLANT-ANIMAL RELATIONSHIP

Stocking rate

Stocking rate may be defined as the number of hectares per Tropical Livestock Unit (TLU), with each TLU representing 250 kg of live animal weight. What the stocking rate actually refers to is the ratio of forage production to animal food requirements. As animal liveweights differ, the TLU number is derived from the combined kg of liveweight divided by 250.

Stocking rates vary greatly throughout the zone. In the aerial surveys of May and October 1981, Millian (1982a) found stocking rates ranging from 92 ha/TLU (in a small area in the extreme northeast corner of the zone around Agadez in May) to 6 ha/TLU (in a small area in the southwest of the zone just north of Tahoua in October). These figures are extremes. Overall stocking rates for the zone were found to be approximately 20 ha/TLU in May 1981 and 15 ha/TLU in October 1981 with average annual stocking rates being lower in the northwest (45 ha/TLU) and increasing in the central (16 ha/TLU) and southeast (14 ha/TLU) portions of the zone.

Stocking rates in the areas where the project grazing research was conducted ranged from 16 ha/TLU in the area surrounding the Ibecetene Ranch to 13 ha/TLU around Aderbissinat, and 12 ha/TLU in the Gadabeji and North Dakoro Ranch area. The stocking rate of the Ibecetene Ranch is approximately 15 ha/TLU while at the North Dakoro Ranch it is somewhat higher, at 13 ha/TLU.

Calculations for the stocking rates of the grazing trials were based on the vegetative production (kg/ha) in the trials rather than using exclusively the number of hectares in each pasture and placing the desired number of TLU in the pasture. A twenty hectare area with a vegetative production of 1,500 kg/ha could, in theory, support twice as many animals as the same size area with only 750 kg of vegetation produced per hectare, providing the quality of the vegetation in the two areas is similar.

At both grazing trial sites, stocking rates differed from year to year due to the fact that initial amounts of available vegetation were different at the start of the trials. For the rainy season, grazing trial stocking rates were determined each year by the initial standing herbage in each pasture, particularly the heavy use, and the expected biomass production. In the dry season trials, since the amount of vegetative biomass is "fixed" at the start of the dry season and no further production is expected, a formula based on the vegetation per hectare, number of hectares, average animal weight, rate of daily consumption and desired length of trials (days)

was used to calculate the number of animals that would remove nearly 100 percent of the vegetation in the heavy use pasture.

In this way the stocking rate in the heavy use pasture was at its greatest without endangering the health of the test animals. This maximum stocking of animals for a certain period of time was done for several reasons. The first was to allow the effects of heavy grazing on the vegetation to become apparent in a short period of time in order to observe the consequences of a constantly intense level of grazing pressure. As the trials were originally only scheduled to run for two and a half years these results were necessary for a complete analysis of the animal-vegetation relationship. The second reason was to ensure that gain per individual in the heavy use pasture was adversely affected to the point that gain per hectare in the heavy use pasture was less than the gain per hectare in the moderate use pasture. This is important in the construction of livestock production curves used below to analyze the results of three different intensities of grazing. The final reason was to ensure that the three resulting intensities of grazing would be similar to the wide range of grazing conditions that occur in the pastoral zone.

Rainy season grazing trials

Rainy season grazing trials were conducted in 1980, 1981 and 1982. In all three years the trials began at Dakoro in July. At Ibecetene the 1980 and 1982 trials began in August and the 1981 trials in July. Starting times depended on the first rains and germination. However, in 1980 delays prevented starting the trials until late in the season.

Vegetation quality

Differences in animal weight gains in all rainy season pastures as a result of trial starting dates and initial amounts of available vegetation are given in tables 3.4.9 and 3.4.10. In 1980 the trials started after the vegetation was already established and was reaching maturity. As a result, seasonal gain per individual and average daily gain per individual were much lower than in 1981 and 1982, when the trials began early with newly germinated grasses. At Ibecetene the gain per individual averaged between

the pastures in 1980 was approximately 4 kg as compared to 52 and 59 kg respectively in 1981 and 1982. At Dakoro the 1980 gain per individual averaged between the pastures in 1980 was only 1 kg as compared tc 66 and 62 kg respectively in 1981 and 1982. This was largely due to the lower quality of the vegetation in 1980, which was already mature when the grazing trials started.

Differences in the rate of individual animal gain also became apparent as the standing herbage increased. Table 3.4.11 shows that when the standing herbage was above 500 kg/ha at Ibecetene and above 400 kg/ha at Dakoro there was a decrease in the average individual daily gain. Though the differences are not as great at Dakoro, the decrease is still evident.

The reduction in individual daily gain reflects a change in forage quality, and weight gain at any time is the most direct indication of forage quality. Any effect of accelerated initial compensatory gain was reduced since the animals had already been grazing on newly germinated grasses before being placed in the trials.

Grazing pressure

The high quality of the earlier phenological plant stages is one important factor in maximizing animal weight gains during the rainy season. The other equally important factor is grazing intensity. Differences in grazing intensity were found to be important, particularly in early rainy season grazing at Dakoro in 1982. At this time, the initial standing herbage in all pastures was under 30 kg/ha and daily animal gains were 0.66 kg, 0.98 kg, and 0.93 kg for the heavy, moderate, and light use pastures, with stocking rates of 1.5, 2.8 and 5.2 ha/TLU respectively. These figures show that daily gains in the heavy use pasture at this time were reduced by 31 percent.

Table 3.4.9 Summary vegetation and animal weight data, North Dakoro rainy season grazing trials, 1980-1982

Period	Pasture	Initial heifer weight (kg)	Initial standing herbage (kg/ha)	Final standing herbage (kg/ha)	Gain per individual (kg)	Gain per individual per day (kg)	Body weight change (%)	Gain per hectare (kg)	Stocking rate (ha/TLU)
Jul 28-Dec 29, 1980 (153 days)	Heavy	238	1350	53	- 3	-0.02	- 1	- 7.0	0.7
	Moderate	239	994	328	+ 3	+0.02	+ 1	+ 3.0	1.4
	Light	236	993	758	+ 4	+0.03	+ 2	+ 1.0	2.4
Jul 2-Nov 2, 1981 (123 days)	Heavy	132	151	47	+51	+0.42	+39	+61.3	1.3
	Moderate	126	138	269	+73	+0.59	+58	+45.4	3.3
	Light	117	136	354	+74	+0.60	+63	27.6	5.6
Jul 14-Nov 13, 1982 (121 days)	Heavy	129	29	194	+52	+0.43	+40	62.2	1.5
	Moderate	140	30	378	+65	+0.54	+46	38.4	2.8
	Light	130	27	551	+69	+0.57	+53	23.4	5.2

Differences in the monthly weights for the entire rainy season in all the pastures due to different stocking rates were also apparent. With moderate intensity rainy season grazing, the total gain per individual animal was often comparable to the light use pasture. However, in several cases these gains were greater in the moderate use than either the heavy or light use pasture. In each year the moderate use pasture animals also had greater gains per hectare than the light use pasture. In addition the amount of standing herbage was higher under moderate and heavy use, exceeding the light use after the first or second month of grazing.

Table 3.4.10 Summary vegetation and animal weight data, Ibecetene rainy season grazing trials, 1980-1982

Period	Pasture	Initial heifer weight (kg)	Initial standing herbage (kg/ha)	Final standing herbage (kg/ha)	Gain per individual (kg)	Gain per individual per day (kg)	Body weight change (%)	Gain per hectare (kg)	Stocking rate (ha/TLU)
Aug 2-Nov 26, 1980 (116 days)	Heavy	215	573	14	- 1	-0.01	- 0.4	- 0.3	0.9
	Moderate	212	558	196	+ 6	+0.05	+ 3	+ 5.7	1.8
	Light	207	522	273	+ 7	+0.06	+ 3	+ 3.9	2.7
Jul 13-Oct 30, 1981 (111 days)	Heavy	90	209	88	+38	+0.34	+42	+57.7	1.5
	Moderate	94	122	204	+54	+0.49	+57	+41.2	3.0
	Light	90	78	204	+64	+0.58	+71	+32.5	4.6
Aug 10-Nov 16 1982 (98 days)	Heavy	151	4	198	+36	+0.37	+24	+12.8	2.2
	Moderate	153	10	188	+74	+0.76	+48	+21.0	4.4
	Light	151	21	172	+68	+0.69	+45	+14.8	6.6

At Dakoro it appears that moderate intensity grazing may have occurred during the first month of grazing in the heavy use pasture in 1981 and 1982. This was due to the pastures being under stocked with animals during these years. In 1981 and 1982, when the trials began and the vegetation was young, rainy season gain per individual in the moderate and light use pastures for the entire season was very similar (1981, 73 and 74 kg; 1982, 65 and 69 kg - see table 3.4.9) indicating that the moderate use pasture may have simulated light use intensity grazing by maximizing gain per individual. Thus only minor increases in gain per individual were obtained at Dakoro when the stocking rates were lighter than 3.3 and 2.8 ha/TLU and the amount of residual standing herbage was greater than 269 and 378 kg/ha.

Table 3.4.11 Variation in average heifer rate of gain under increasing standing herbage at Ibecetene and North Dakoro grazing trials, 1981-1982

	Individual daily gain (kg/day) with standing herbage of:			
	Ibecetene		North Dakoro	
	<500 kg/ha	>500 kg/ha	<300 kg/ha	>400 kg/ha
1981	1.28	0.48	0.91	0.73[1]
1982	1.44	0.38	0.96	0.75

Note:

1. Daily rates of gain in the heavy use pastures were much lower than in the moderate use and light use pastures and were not included in these averages. The reduced rate of gain in the heavy use pasture was due to extremely heavy stocking rates too early in the rainy season, which caused the animal weight changes to be very responsive to periods of inadequate rainfall.

Also at Dakoro early in the 1981 rainy season trials the heavy use pasture had large amounts of standing herbage after the first month of grazing. This was similar to the moderate use pasture at Ibecetene. In 1981 the standing herbage remaining after the first month of grazing in the heavy use pasture was only 9 percent less than the standing herbage in the light use pasture. This occurred even though the heavy use pasture (1.6 ha/TLU) was stocked 3.5 times more heavily than the light use pasture. For this same period the weight gains in the heavy use pasture were 92 percent of the weight gains in the light use pasture.

At Ibecetene for the years when the vegetation was exposed to grazing pressure during the earlier stages of growth (1981 and 1982), the moderate use pasture had 19 percent more standing herbage than the light use pasture after the first or second month of grazing. This occurred despite the fact that the moderate use pasture was stocked 1.5 times more heavily than the

light use pasture. For these years this increased amount of standing herbage occurred in the moderate use pasture when the stocking rates were 3.0 and 4.4 ha/TLU in 1981 and 1982 respectively. Animal weight gains in the moderate use pasture for the same periods were 89 and 96 percent of the animal gains in the light use pasture.

Varying benefits can be obtained from different intensities of rainy season grazing. Indications are that plant production can be increased with minimal sacrifice of animal gains during the early growing season. At Ibecetene this occurred in the range of approximately 3.5 ha/TLU while at Dakoro similar results occurred under heavier stocking rates (1.6 ha/TLU).

Finally, the percent of body weight gained seems to be affected by the variation between years in the initial average heifer weights. However, in general, rainy season weight gains for growing heifers averaged in the range of 40 to 60 percent of the body weight.

Dry season grazing trials

Dry season grazing trials were conducted in 1981 and 1982 at Ibecetene and North Dakoro. The first year trials began in December while in 1982 the trials began one month later, at the end of January.

Tables 3.4.12 and 3.4.13 summarize the data generated by two years of dry season trials at Ibecetene and North Dakoro. In the 1982 trials the amount of litter present in the pastures was measured for the first time after the previous year's experience indicated that it was an important forage resource throughout the dry season. Also during the 1982 trials the animal-vegetation relationship was studied in a deferred grazing system described below.

Table 3.4.12 Summary vegetation and animal weight data, Ibecetene dry season grazing trials, 1980-1982

Period	Pasture	Initial heifer weight (kg)	Initial standing herbage (kg/ha)	Final standing herbage (kg/ha)	Final litter (kg/ha)	Gain per individual (kg)	Gain per individual per day (kg)	Body weight change (%)	Gain per individual per hectare (kg)	Stocking rate (ha/TLU)
Dec-May, 1981 (185 days)	Heavy	147	700	10	-	+ 1	+0.005	+ 1	+ 0.3	2.16
	Moderate	154	864	100	-	+ 9	+0.05	+ 6	+ 3.1	4.13
	Light	152	942	128	-	+14	+0.08	+ 9	+ 3.1	6.27
Feb-May, 1982 (127 days)	Heavy	192	595	23	163	-19	-0.14	-10	-16.3	1.52
	Moderate	192	641	54	337	- 1	-0.01	- 0.5	- 0.5	3.04
	Light	188	795	68	202	+ 1	+0.01	+ 0.5	+ 0.2	4.65

Table 3.4.13 Summary vegetation and animal weight data, North Dakoro dry season grazing trials, 1981-1982

Period	Pasture	Initial heifer weight (kg)	Initial standing herbage (kg/ha)	Final standing herbage (kg/ha)	Final litter (kg/ha)	Gain per individual (kg)	Gain per individual per day (kg)	Body weight change (%)	Gain per individual per hectare (kg)	Stocking rate (ha/TLU)
Dec 31 -May 25 1981 (145 days)	Heavy	150	1202	35	-	-11	-0.07	- 7	-14.1	1.2
	Moderate	148	1661	179	-	- 7	-0.05	- 5	- 3.7	2.4
	Light	154	1482	271	-	- 7	-0.05	- 5	- 2.3	3.9
Jan 23 -May 24 1982 (121 days)[1]	Heavy	187	628	3	156	-15	-0.13	-15	-19.0	1.9
	Moderate	203	575	22	288	- 5	-0.04	-12	-10.8	3.6
	Light	183	663	136	274	- 5	-0.04	-17	- 7.6	6.9

Note:

1. The last 31 days in 1982 have not been included as changes in animal weights were primarily caused by early rains.

Animal performance

Animal body weight changes for all intensities of grazing at Ibecetene differed between years. As table 3.4.12 shows, in 1981 daily gains in all pastures were positive. In 1982 the daily gains in the heavy and moderate use pastures were negative (-0.14 and -0.01 kg). The light use pasture had only a minimal positive daily gain (+0.01 kg). The large losses of 1982 were due to heavier stocking rates in this year. Also, greater initial gains were made in the first month in 1981 on greater amounts of available vegetation. This enabled the animals to finish the 1981 season with weight gains in all pastures.

At Dakoro, as table 3.4.13 shows, animal daily gain was negative in both 1981 and 1982, with the losses being comparable despite differences in initial standing herbage in 1982.

The amount of available vegetation per Tropical Livestock Unit (TLU) is another important factor affecting individual animal gain. By calculating available forage per Tropical Livestock Unit day one can begin to predict animal losses or gains at various stocking rates. Available standing herbage (kg) per TLU day is plotted against daily gain per individual in figures 3.4.10 and 3.4.11 for Ibecetene and Dakoro. Initially, there was a gradual reduction in daily gain per individual with decreasing available forage (kg) per TLU day. However, with less than 10 kg of available forage, daily gain per individual decreased dramatically at both Ibecetene and Dakoro. Thus it appears that stocking rates which allow for less than 8-10 kg of forage per TLU day would adversely effect animal weight changes.

Livestock production curves

Livestock production curves, produced by plotting gain per individual and gain per hectare against the total amount of standing herbage remaining after grazing were used in analyzing the livestock-vegetation relationship in the grazing trials. The curves are shown in figure 3.4.12. The shape of the gain-per-individual curve reflects the fact that with abundant vegetation individual animal gain reaches a maximum and then remains constant (zone A in figure 3.4.12). However, when the amount of available vegetation is sufficiently reduced, individual animal weight gain begins to

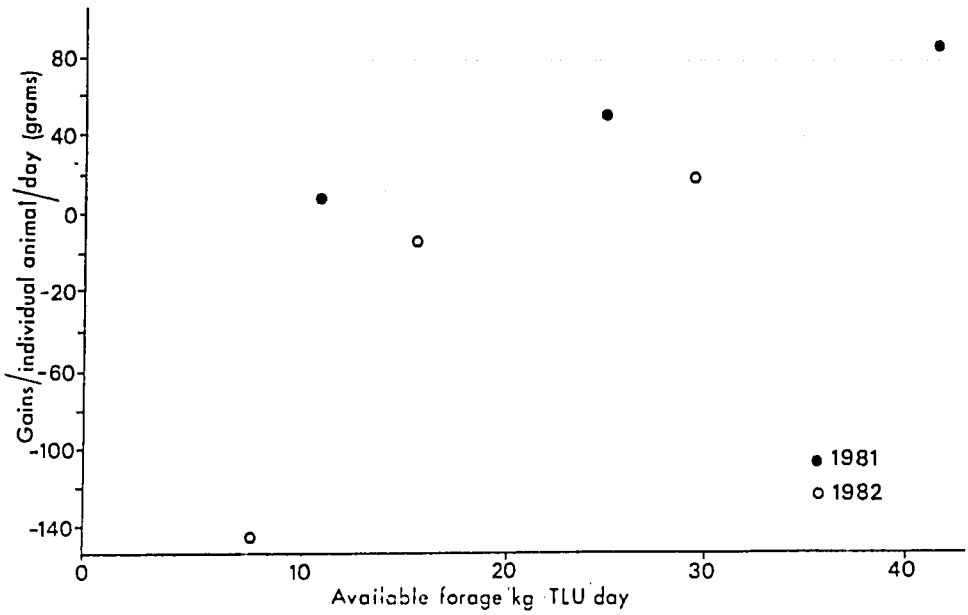


Figure 3.4.10 Dry season daily animal weight gains related to available forage, Ibecetene, 1981-1982

decline (zone B in figure 3.4.12). The gain-per-hectare curve shows that increase in total animal gain per unit area is obtained with increased grazing intensity up to a certain point. Once this level of grazing intensity is exceeded the total animal gain produced per hectare of grazing land begins to decline, due to the rapidly declining production of each animal.

In a situation where a perfect production factor market prevails, and land and animals can be bought and sold easily (which of course is not the case of the Sahelian pastoral economy), production would be optimized by grazing to the point where the two production lines cross.

Figure 3.4.12 shows graphically the results for the 1981 and 1982 trials at Ibecetene. The range of 250-350 kg/ha of remaining standing herbage (zone A) is where the gain per individual was maximized both years. Taking into consideration gain per hectare, the crossover point was in the range of 200 kg/ha of standing herbage remaining after grazing both years. Gain per individual and gain per hectare numbers are not shown in figure 3.4.12 as animal gain varies yearly. This is in part due to yearly variation in climate, variation in initial standing herbage, and variation in initial

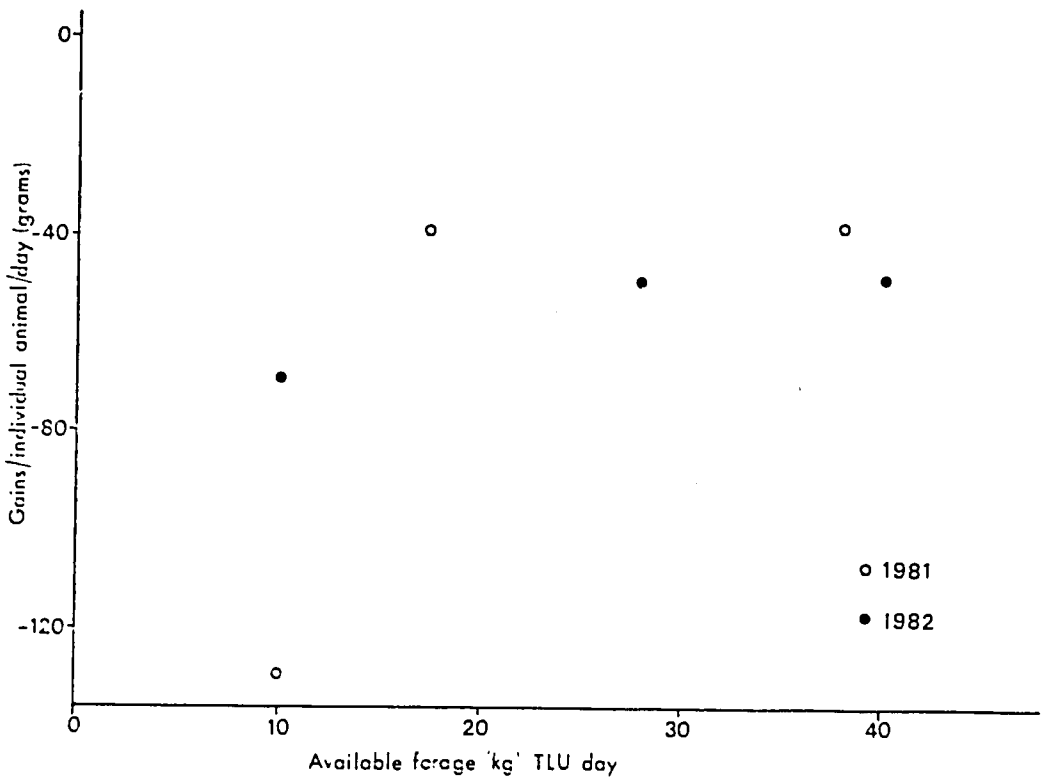


Figure 3.4.11 Dry season daily animal weight gains related to available forage, North Dakoro, 1981-1982

heifer weights. The curves generated in both 1981 and 1982 had maximum gain per individual in the same range of standing herbage and the intersection between gain per individual and gain per hectare occurred around 200 kg/ha of standing herbage.

At the Dakoro grazing trials, which are representative of southern pastures dominated by Cenchrus biflorus, the crossover point in 1981 was near 350 kg/ha of standing herbage remaining after grazing. In 1982 large weight losses in the first month of trials prevented the construction of the curves at any date throughout the trials.

Deferred grazing

The 1982 dry season grazing trials, in addition to investigating the animal-plant relationship in three different intensities of grazing, also investigated this relationship in a deferred grazing system. This was done to determine if and for how long the early higher quality dry forage can be maintained by keeping the vegetation ungrazed.

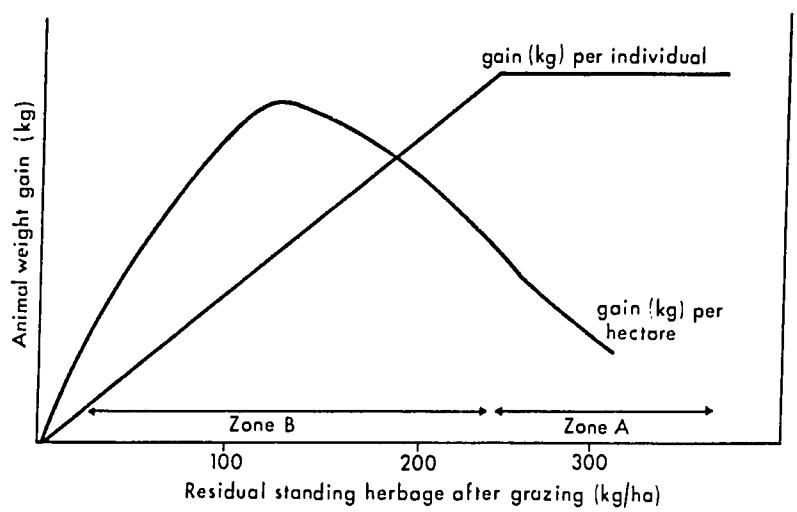


Figure 3.4.12 Livestock production curves, Ibecetene, dry season, 1981-1982

The heifers were placed in the first of the three separate parcels used in this system in February. Thus, these grazing trials were performed primarily during the hot season. The animals were kept in a particular parcel until weight losses occurred. At this time, they were placed in the next parcel that had previously been ungrazed.

At Ibecetene in the first month (March) the animals gained an average of 10 kgs. The following month (April), the animals were held in the first parcel (light grazing rotation A - see figure 3.4.2) and five new heifers put in light grazing B. The animals in light grazing A lost an average of 6 kg and the light grazing B heifers lost 8 kg. During the same period animals in all other pastures lost 6-13 kg. This seems to indicate the possibility of a climatic stress period as the cold season ends and the hot season begins. At this point animals were placed in a new parcel, light grazing C, and the five heifers from light grazing B were removed. The following month (May) the animals gained an average of 13 kg and after three months the average net gain was 17 kg. Then in June, as the early rains began, the animals lost an average of 16 kg. Thus up until the early rains, which drastically lowered forage quantity and quality, the deferred grazing system (stocking rate 5.9 ha/TLU) had gained 17 kg. During the same time period the light use heifers (stocking rate 4.65 ha/TLU), which had been grazed 36 days before the rotation system started, only maintained their weights. This was significantly different at the 95 percent level of probability. The corresponding confidence limits were 24 to 16 kg of additional gain under deferred grazing.

At Dakoro in the first month (March) the animals in the deferred grazing system lost an average of 14 kg which was believed to be due to faulty watering. In the following two months, April and May, the average gains were 6 and 12 kg respectively, so that after the first 3 months the net weight change was a gain of 4 kg. In the final month (June) the animals lost approximately 16 kg which was again due to reduced forage availability and quality as a result of early rains.

Comparisons between the light use (stocking rate 6.9 ha/TLU) and the deferred grazing system (stocking rate 6.5 ha/TLU) for the months of April and May at Dakoro show 8.6 kg additional gain under deferred grazing. This was significantly different at the 95 percent probability level and had a corresponding confidence limit of ±7.6 kg around a mean of 8.6 kg. However, grazing began 31 days earlier in the light use pasture.

The results of the deferred grazing experiments showed that forage quality was preserved and animal gain obtained during the late dry season under deferred grazing at both Ibecetene and Dakoro. These weight gains could be important in improving the animal's physical and nutritional condition before the critical dry-to-rainy season transition period begins.

Seasonal patterns

By combining the results for the 1981 rainy season and the following 1982 dry season grazing trials at Ibecetene and Dakoro the general pattern of animal weight changes during the year can be seen.

Ibecetene

Figure 3.4.13 is constructed from Ibecetene grazing trial data. During the rainy season in the first month of grazing the rate of weight gain is greater than during the second month. This reflects a reduction in forage quality as the plants reach maturity.

For the period from 2 November 1981 till 21 January 1982 there were no animals in the trials. A new set of uniform test heifers were then used in the dry season trials. The dry season animal weight gain curves for both 1981 and 1982 at Ibecetene had a similar general shape. During both years there was a period of weight gain when the previously ungrazed pastures were first made available to the animals. This was followed by a decrease in the rate of weight gain, then a drop in animal weights occurring in late March and early April. This was followed by a period of small gains in weight or weight maintenance and a final drop in the animals' weight which appears to be related to the effects of early rainfall on the availability and quality of forage, and the extended 1982 dry season and corresponding late germination at the start of the following rains.

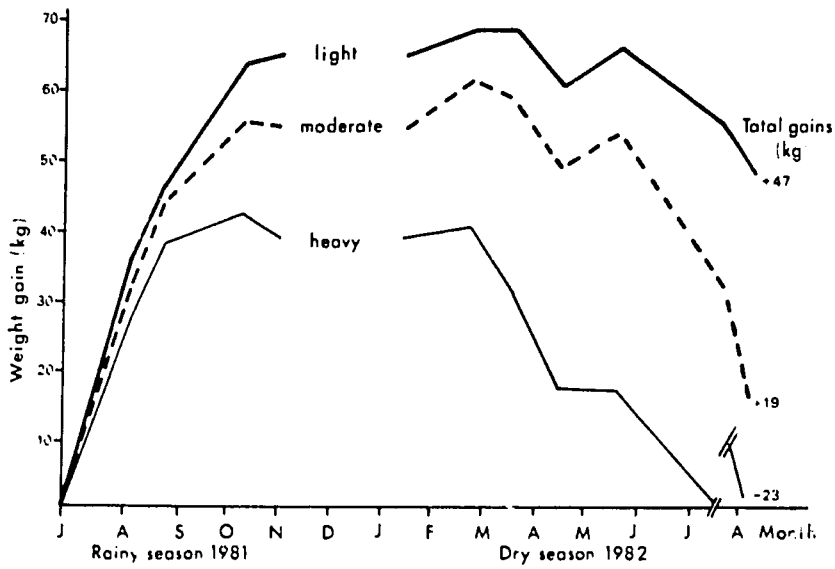


Figure 3.4.13 Annual heifer weight gains, Ibecetene, 1981-1982

The heavy use parcel stocking rate was 1.5 ha/TLU in the rainy season and 2.9 ha/TLU in the dry season.[1] Amounts of standing herbage remaining after grazing in the heavy use parcels were 88 and 19 kg/ha in the rainy and dry season pastures respectively; these produced a mean net loss of 23 kg per heifer.

The moderate use parcel was stocked at 3.0 ha/TLU in the rainy season and 5.5 ha/TLU in the dry season. Standing herbage remaining after grazing was 204 and 42 kg/ha respectively for the rainy season and dry season. In this pasture there was an overall mean increase in body weight of 19 kg.

---

1. Stocking rates given here differ from earlier which, to facilitate comparisons between years, do not include animals in the 1982 dry season trial from 29 June to 10 August. Stocking rates used here include the final dry season period.

The light use parcel was stocked at 4.6 ha/TLU in the rainy season and 8.6 ha/TLU in the dry season. Standing herbage remaining after grazing was 204 and 57 kg/ha respectively for the rainy and dry season. The net result was a gain of 47 kg per heifer.

These weights are a result of measurements on two different sets of test heifers and there was a period of 49 days without weights being measured. During this time some weight losses probably occurred, so the overall annual gains are correspondingly inflated. It should be noted also that during the trials the heifers were watered daily in both the rainy and dry season.

In 1982 two heifers from each dry season pasture were put directly into the 1982 rainy season trials at Ibecetene and results similar to those discussed above were obtained. Each pair of heifers remained under the same grazing pressure in the rainy season trials as in the dry season trials. The average weight of the heifers is shown in figure 3.4.14 as it changes throughout the year. Heifers in the light use pasture, stocked at 4.65 ha/TLU during the dry season and 6.6 ha/TLU during the rainy season, produced a net annual gain of 57 kg. Heifers in the moderate use pasture, stocked at 3.04 ha/TLU during the dry season and 4.4 ha/TLU during the rainy season, gained 20 kg over the year. The heifers in the heavy use pastures, stocked at 1.52 and 2.2 ha/TLU for the dry and rainy seasons respectively, lost 21 kg over the year.

These annual weight gains are not only comparable to those in figure 3.4.13 but also to the average gain of the two separate sets of test heifers used in the 1982 dry and rainy season trials, as shown in table 3.4.14.

Table 3.4.14 Average individual heifer weight gain, Ibecetene, dry and rainy season trials, 1982

Grazing pressure	Dry season[1] gain (kg)	Wet season gain (kg)	Annual gain (kg)
Heavy	-59	22	-37
Moderate	-35	66	+31
Light	-17	67	+50

Note:
1. 1982 dry season weight gains include weight changes that occurred from June 29 to August 10 which were not included in other data concerning the Ibecetene 1982 dry season because animal weights were primarily affected by rainfall and not by vegetation.

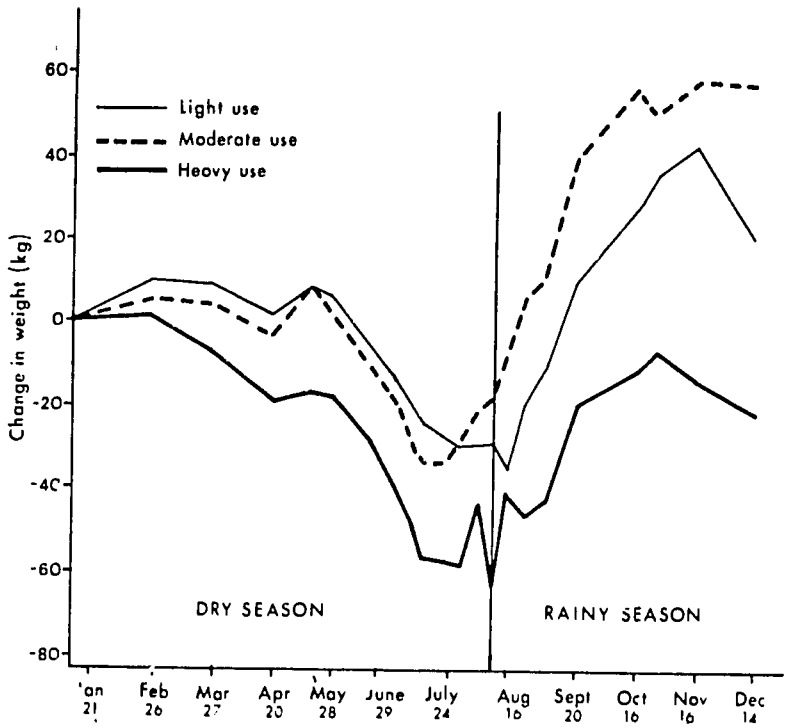


Figure 3.4.14 Heifer weight changes over one year at different grazing intensities, Ibecetene, January to December 1982

Figure 3.4.14 also shows that under these conditions, differences in animal weights caused by varying grazing pressures during the dry season were not nullified by rainy season compensatory gain.

Dakoro

The North Dakoro grazing trial results are shown in figure 3.4.15. Again the difference in rates of weight gain between the first and second month of grazing is apparent. The difference is not as evident as in the Ibecetene data, but a general decrease in forage quality as the grasses mature is still evident. During the North Dakoro 1981 rainy season trials, the parcels were understocked and the animals were removed prematurely. It seems likely that both moderate and light use parcels had been subjected to

the equivalent of light intensity grazing, while in the heavy use parcel the animal weight changes were more like those under a moderate intensity of grazing pressure. This implied that a rainy season stocking rate lighter than 3.3 ha/TLU and leaving more than 296 kg/ha of standing herbage yielded minimal increases in animal weight gain.

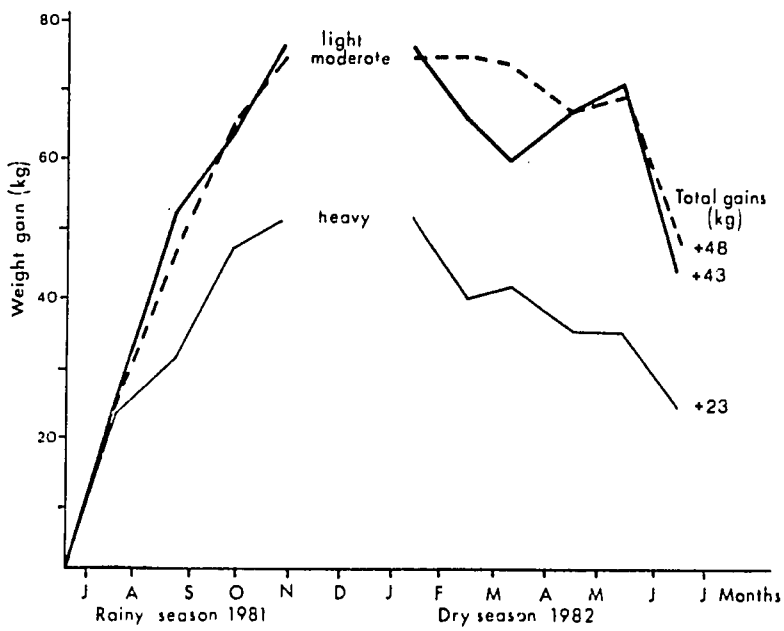


Figure 3.4.15 Annual heifer weight gains, North Dakoro, 1981-1982

No animal weight change data exist for the 82 day period between the end of the rainy season trials and the beginning of the dry season trials. With the exception of the light use pasture, the 1982 North Dakoro dry season trials have the same general pattern of animal weight changes during the first two months as the Ibecetene trial. The sharp decrease in animal weight changes in February to April in the light use pasture may have been the result of faulty watering by the herder.

Weight losses in the heavy and moderate use pasture during late March and early April were similar to those at Ibecetene. This tends to support the possibility of stress in the cold-to-hot season transition period in which weight losses occur due to changes in weather. During the final month, weight losses in all pastures were probably the result of early rain and its effects on the availability and quality of the forage. This suggests another transition period in which animal weight losses again occur as a result of changes in weather.

Heavy intensity grazing during the rainy season (1.6 ha/TLU) and dry season (1.9 ha/TLU) produced 23 kg of net weight gain, and left 47 and 3 kg/ha of remaining standing herbage in the rainy and dry season pastures respectively. Stocking rates in the moderate use pasture during the rainy season (3.3 ha/TLU) and dry season (36 ha/TLU) produced a net weight gain of 48 kg, while leaving 296 and 22 kg/ha respectively of standing herbage. Light intensity grazing had stocking rates of 5.6 ha/TLU during the rainy season and 6.9 ha/TLU during the dry season, with 354 and 136 kg/ha of standing herbage remaining in the pasture at the end of each season's trial. The net weight gain was 43 kg which was slightly less than that in the moderate use pasture. This was probably due to the watering problem in the dry season light use pasture already mentioned.

Transition periods

The period at the end of the cold season and the beginning of the hot season (late March to April) appears to be a high stress period for livestock. During this period at Ibecetene, 10-12 kg losses were recorded in 1981 and 13-8 kg losses in 1982. This was followed in both years by a period of small weight gains.

At the Dakoro trials the 1982 data show a similar trend. In the month of April, weight losses of 6-7 kg occurred in the heavy and moderate use pastures. In the light use pasture and deferred grazing system, weight gains occurred in April. However, this appears to be related to a corrected watering schedule.

The dry season to rainy transition is another important stress period for livestock. This is the time between the first substantial rains and the subsequent growth of new grass to a height which makes it available to the

animals. Livestock have previously been forced to graze only dead dry forage for 9 months, and their weights are at an annual low. By the end of the dry season, most of the remaining available forage is in the form of litter (plant material lying on the ground). All of the remaining standing vegetation is strong, coarse, low quality stem material with the finer higher quality grass parts and seeds found on the ground, knocked down by animal trampling and wind.

The arrival of the first substantial rain coats and mixes the litter with the surface soil. This removes litter as a source of forage or greatly reduces its quality by stimulating decomposition and leaching of plant nutrients. At Ibecetene, this phenomenon was documented at the end of both the 1981 and 1982 dry season, and at North Dakoro it was noticeable in 1982.

At Ibecetene in 1981 heifers in the moderate and light use pastures lost 6-7 kg in the final month of the dry season trials. This appears to be directly related to 15 mm of rain which fell three days before the final weighting date. In the last month of the 1982 trials, heifers in all pastures, including the deferred system, lost 16-19 kg. This was largely because of 7 mm of rain which fell 18 days before the final weighing date. At Dakoro in 1982 weight losses of 13-26 kg were recorded in June in all pastures, again including the deferred grazing system. This was related to early rains, particularly 6.1 mm which fell in late May 1982.

Early grazing on newly germinated vegetation also can contribute to animal weight losses in this transition season. The newly germinated grass can be a low quality forage due to its high water content, which dilutes plant nutrients and protein. Premature grazing of young plants can completely remove the plants from the soil. This has a double disadvantage: first, complete removal of individual plants means that subsequent rainy season growth must come from the germination of new plants, and second, when animals eat soil attached to the plant roots their health is affected and their weight reduced.

Thus the combined effect of the early rains on litter and the quality of the newly germinated grasses make this period especially critical for animals. If a supplemental feed could be made available to the animals at this time, the large weight losses which occur might be reduced.

3.5 SEASONAL CHANGES IN NUTRITIVE VALUES OF RANGELANDS

The quality of feed available to animals in the project zone is measured through the nutritive value of the vegetation; this is particularly influenced by the seasons. With the onset of the first rains in June or July, the herbaceous stratum begins to grow, and after the heavy rains in August, vegetation cover reaches a peak. Towards the end of September, the end of the rains result in a rapid drying of the herbaceous biomass although some plants remain green until December. During the long dry season, there is a spontaneous and severe degradation of this grass vegetation. The ligneous stratum puts on leaves and fruits which remain fresher and are browsed by cattle during the dry season. Plants are thus strongly influenced by the seasons and their phenological cycle reflects major changes in their environment. While annual and perennial grasses show cyclical physiological changes often detrimental to livestock, ligneous and non-graminaceous plants provide a stabilizing and compensatory natural feed supplement. This section summarises results of project research on these seasonal changes in the nutritive value of pastoral zone rangelands.

Grasses

Data on dry matter, crude and digestible protein, and vitamin A for some of the commonest grass species in the pastoral zone are shown in table 3.5.1. As soon as the rains stop, green matter dries up quickly and, by mid-December, has lost 72 percent of its water content. With rapid evapotranspiration, digestible protein and vitamin A are also reduced. In seven of the 10 species studied, digestible protein was negligible in the dry seasons. *Pennisetum pedicellatum* is exceptional in that its raw protein was above 20 percent, and preserves a relatively high rate of digestible nitrogenous matter (DNM) at the

---

1. See Louis *et al*. (1983) for complete results.

Table 3.5.1 Protein and vitamin A values of common grasses of the pastoral zone[1]

Species (Annual or perennial)	Season[2]	Dry Matter (%)	Crude Protein (%)	Digestible Protein[3] (%)	DNM[4] (g/kg)	Vitamin A (IU/kg)[5]
Aristida mutabilis (A)	Rains	32.5	8.87	4.72	47.2	7600
	Dry	90.3	2.25	0.00	00.0	ND
Cenchrus biflorus (A)	Rains	25.1	7.31	3.26	32.6	5400
	Dry	88.0	2.62	0.00	00.0	ND
Cenchrus preiurii (A)	Rains	22.4	5.62	1.70	17.0	7800
	Dry	95.0	3.50	0.00	00.0	ND
Cyperus conglomeratus (P)	Rains	34.9	14.12	9.59	95.9	9200
	Dry	84.7	2.9	0.00	00.0	-
Dactyloctenium aegyptium (A)	Rains	26.7	11.18	6.86	68.6	4600
	Dry	92.0	4.37	0.54	5.4	ND
Eragrostis tremula (A)	Rains	45.6	5.12	1.23	12.3	5400
	Dry	82.0	2.43	0.00	00.0	ND
Panicum turgidum (P)	Rains	34.8	7.87	3.78	37.9	3800
	Dry	40.0	5.93	1.99	19.9	3200
Pennisetum pedicellatum (A)	Rains	29.2	21.12	16.10	161.0	12700
	Dry	90.4	7.81	3.73	37.3	5400
Schonefeldia gracilis (A)	Rains	33.2	8.62	4.48	44.8	5400
	Dry	91.5	2.43	0.00	00.0	ND
Tragus berteronianus (A)	Rains	30.5	6.06	2.10	21.09	6200

Notes:
1. Whole plants (leaves, stems, flowers, seeds).
2. Rains = August; Dry = mid-December.
3. Digestible protein calculated according to Demarquilly (Boudet and Rivière 1968).
4. DNM = Digestible Nitrogenous Matter.
5. ND = Non detectable, amount less than 2000 IU/kg.

beginning of the dry season (37.5 g/kg). Though this is only 23.1 percent of its rainy season DNM, this annual grass has the highest level of vitamin A (12,700 IU/kg), of which it only loses 57.5 percent when dry. The protein and vitamin A values of Panicum turgidum (a perennial) during the dry season are also high. Its dry matter (DM) in the dry season was only 40 percent, while that of the other species studied was 82-95 percent; this means that Panicum turgidum was partly fresh while most other species were dry. Its digestible protein and vitamin A content only dropped in the dry season by 47.5 and 15.8 percent respectively.

In general, during the rainy season, the protein content of these species is acceptable under local soil conditions, with an average of 9.58 percent (± 1.46). When the grasses dried up, protein content was reduced to 3.80 percent (± 0.60). Vitamin A content is low even in green grass (on average 6,810 ± 780 IU/kg); while it can rise above 100,000 IU/kg in tropical grass species.

Data on gross energy (GE) and net energy (NE) and cellulose and lignin are shown in table 3.5.2. Gross energy does not change from wet to dry season. However, net energy, calculated on the basis of fodder unit values taken from the literature (see Louis 1983: 13), drops considerably in the dry season (1,139 ± 63 versus 751 ± 84 kcal/kg). The NE/GE ratio tends to approach 0.40 as digestible energy and net energy rise. The difference between the average rainy season ratio (0.30 ± 0.04), and that of the dry season (0.19 ± 0.02), illustrates the poor energy value of the dry straw. This situation may be due to the rapid lignification of the annual grasses, an increase in cellulose and a decrease in hemicellulose content.

Table 3.5.3 shows the results of analysis of five major elements. Calcium (Ca) is more than adequate (on average 0.40 percent ± 0.04) and its level is hardly affected by the grass drying up. This is also true of magnesium (Mg) and potassium (K).

Table 3.5.2 Energy, cellulose and lignin values of common grasses of the pastoral zone

Species	Season	Gross Energy (GE) (kcal/kg)	Net Energy (NE) (kcal/kg)	NE/GE	Cellulose (%)	Lignin (%)
Aristida mutabilis	Rains	3918	1051	0.26	25.6	-
	Dry	4126	658	0.16	39.3	3.5
Cenchrus biflorus	Rains	3766	1072	0.28	25.8	-
	Dry	3850	733	0.19	36.3	6.4
Cenchrus preiurii	Rains	3783	1504	0.40	33.4	-
	Dry	3857	883	0.23	35.4	4.6
Cyperus conglomeratus	Rains	3725	1297	0.35	21.0	-
	Dry	3725	1165	0.31	35.9	-
Dactyloctenium aegyptium	Rains	3766	1184	0.31	21.2	-
	Dry	3819	-	-	29.4	5.8
Eragrostis tremula	Rains	3843	1222	0.32	23.3	-
	Dry	4316	846	0.20	38.3	6.1
Panicum turgidum	Rains	3965	1297	0.33	26.3	-
	Dry	3933	846	0.21	33.0	6.4
Pennisetum pedicellatum	Rains	3490	733	0.21	23.6	-
	Dry	3440	282	0.08	29.8	3.8
Schonefeldia gracilis	Rains	3873	977	0.25	31.7	-
	Dry	3992	601	0.15	38.8	3.8
Tragus berteronianus	Rains	3725	1053	0.28	22.3	

Table 3.5.3 Nutritive values (major elements) of common grasses of the pastoral zone

Species	Season	CA (%)	P (%)	Mg (%)	Na[1] (%)	K (%)	Ca/P
Aristida mutabilis	Rains	0.24	0.22	0.20	ND	0.90	1.1
	Dry	0.24	0.10	0.19	ND	0.42	2.4
Cenchrus biflorus	Rains	0.40	0.24	0.24	0.01	3.60	1.7
	Dry	0.48	0.09	0.34	ND	2.62	5.3
Cenchrus preiurii	Rains	0.24	0.23	0.24	ND	2.90	1.0
	Dry	0.40	0.13	0.34	0.01	2.45	3.1
Cyperus conglomeratus	Rains	0.48	0.28	0.20	0.01	2.90	1.7
	Dry	0.54	0.10	0.18	-	1.14	5.4
Dactyloctenium aegyptium	Rains	0.48	0.24	0.50	ND	3.02	2.0
	Dry	0.64	0.10	0.34	0.01	2.45	6.1
Eragrostis tremula	Rains	0.40	0.30	0.24	ND	1.30	1.3
	Dry	0.24	0.05	0.14	ND	0.78	4.8
Panicum turgidum	Rains	0.40	0.17	0.20	ND	1.70	2.3
	Dry	0.80	0.15	0.38	0.03	0.87	5.3
Pennisetum pedicellatum	Rains	0.80	0.33	0.10	ND	4.60	2.4
	Dry	0.64	0.13	0.19	0.05	5.38	4.9
Schonefeldia gracilis	Rains	0.32	0.19	0.20	ND	2.20	1.7
	Dry	1.00	0.10	0.80	ND	1.18	10.0
Tragus berteronianus	Rains	0.32	0.16	0.20	0.01	2.20	2.0

Note: 1. ND = Non detectable

Sodium (Na) content of the grasses is extremely low, and can scarcely be measured by the atomic absorption method. When sodium is measureable, it does not exceed 0.05 percent which is quite well below the level required by cattle: 0.08 percent on a DM basis. Phosphorous (P) concentration in grass is affected by the dry season. During the rains, phosphorous varied from 0 30 to 0.16 percent (0.23 percent ± 0.01 on average) which, to the animals, is an adequate amount. However, at the beginning of the dry season, phosphorous rapidly decreases and is only 17.56 percent of rainy season values. In the dry season, phosphorus levels vary between 0.05 and 0.15 percent (on average 0.10 percent ± 0.009), which is quite inadequate to meet the ruminant phosphorus requirements. Furthermore, the calcium-phosphorous (Ca/P) ratio may affect assimilation of phosphorous. The Ca/P ratio should be in the range 1 to 1.7. The ratio has been calculated for all species studied. In the rainy season, it causes no problems (1.0 - 2.4) with an average of 1.72 ± 0.14. On the other hand, during the dry season, a calcium surplus and phosphorous deficiency make the ratio unsatisfactory: it varied from 2.4 to 10.0, with an average of 5.28 ± 0.67. This is damaging to good phosphorous nutrition in ruminants in general and cattle in particular.

Non-graminaceous and Ligneous species

Protein and vitamin A concentrations of these species are given in table 3.5.4. The species which were studied are rich sources of digestible protein for livestock during the dry season. The level of digestible nitrogenous matter (DNM) varies from 57.7 g/kg (for *Chrozophora brocchiana*) to 195.8 g/kg (for *Maerus crassifolia*). On average, these species can supply 104.9 ± 10.01 g/kg DNM, which is three to four times the DNM level needed to satisfy cattle maintenance requirements under pastoral conditions. Four species are above this average: these are *Maerua crassifolia*, *Boscia senegalensis*, *Balanites aegyptiaca* and *Bauhinia rufescens*.

In general, vitamin A levels are higher in non-graminaceous herbages or ligneous plants than in herbaceous graminaceae species: on average 13,054 IU/kg versus 6,810 IU/kg. However, vitamin A was not evenly distributed in the species studied. A wide variation was observed in vitamin A content, with a variation coefficient of 24.5 percent. Although the species studied

Table 3.5.4 Protein and vitamin A values of some non-graminaceous, shrub and tree species in the pastoral zone

Species[1]	DM[2] (%)	CP (%)	DP (%)	DNM[2] g/kg	Vitamin A IU/Kg
Acacia raddiana	42.1	14.00	9.49	94.8	11600
Balanites aegyptiaca	41.0	15.87	11.22	112.2	28000
Bauhinia rufescens	35.3	15.18	10.58	105.8	33600
Boscia senegalensis	58.9	16.82	12.10	121.0	3800
Calotropis procera	12.4	14.62	10.06	100.6	9200
Chrozophora brocchiana	42.0	10.00	5.77	57.7	7800
Leptadenia hastata	27.7	14.12	9.59	95.9	4600
Maerua crassifolia	44.5	24.87	19.58	195.8	5400
Prosopis juliflora	34.5	14.37	9.83	98.3	28000
Psoralea plicata	25.8	11.75	7.39	73.9	4600
Ziziphus mauritaniaca	50.2	14.38	9.84	98.4	7000

Note: 1. Most species sampled during dry season. Samples were composed of green leaves and buds.
2. DM = Dry matter; CP = Crude protein; DP = Digestible protein; DNM = Digestible Nitrogenous matter.

are not very rich in vitamin A, they are excellent sources of this vitamin in the long dry season when gr-inaceous herbages lose almost their entire stock of this nutrient.

Values for energy, cellulose and lignin are shown in table 3.5.5. Net energy values indicate that the species studied are excellent sources of digestible energy during dry periods compared to the grasses under study (table 3.5.2). On average, these ligneous plants contain 1,436 ± 154 kcal/kg at times (December) when grass pastures only provide half that amount, or 751 kcal/kg. Their NE/GE ratios are relatively high, and the average value of 0.36 ± 0.01 underlines their superior energy value in the dry season. This desirable characteristic is a function of low cellulose and lignin contents.

Concentration of a few major elemente are given in table 3.5.6. The levels of calcium are high compared to the needs of animals, and also to the calcium content in the rangelands of the area. An average calcium concentration of 2.14 ± 0.45 percent for example, is 10 times the Ca percentage required in cattle feeding. In case of Ca deficiency in grasses, shrubs and trees can compensate.

The species mentioned above also constitute a good source of phosphorous (0.20 ± 0.2 percent). Balanites aegyptiaca (0.12 percent) and Boscia senegalensis (0.08 percent) are less rich in P. The extremely high Ca/P ratio (Ca/P = 12.4 ± 2.13) is caused by an increase in calcium. Magnesium (0.37 ± 0.05 percent) and potassium (1.76 ± 0.36 percent) levels are considered normal for the pastoral zone. In general, sodium content is low, below 0.01 percent. Exceptionally, Calotropis procera contains 0.11 percent and Leptadenia hastata 0.03 percent.

Discussion

The rapid ageing of annual plants during the dry season generates a mobilization of the nutritive elements. This mobilization is advantageous in the rainy season, and unfavourable during the dry season. The most unstable substances among those chemically determined are cellulose, lignin, protein, phosphorous and vitamin A. As grasses dry, concentrations of cell wall

Table 3.5.5 Energy, cellulose and lignin values of non-graminaceous, shrub and tree species in the pastoral zone

Species	GE[1] (kcal/kg)	NE (kcal/kg)	NE/GE	Cellulose (%)	Lignin (%)
Acacia raddiana	4752	1767	0.37	5.5	4.4
Balanites aegyptiaca	4164	1504	0.36	7.9	8.3
Bauhinia rufescens	4251	1598	0.37	12.5	6.8
Boscia senegalensis	4517	1692	0.37	16.3	10.2
Calotropis procera	3564	-	-	10.2	5.2
Chrozophora brocchiana	4044	-	-	15.1	4.0
Leptadenia hastata	4063	-	-	10.1	4.5
Maerua crassifolia	3606	1692	0.46	8.2	5.4
Prosopis juliflora	4400	1297	0.29	11.5	12.5
Psoralea plicata	4257	-	-	23.2	6.4
Ziziphus mauritaniaca	4410	1504	0.34	10.7	5.5

Note: 1. GE = Gross Energy; NE = Net Energy.

constituents such as cellulose and lignin increase, while those of protein, phosphorous and vitamin A decrease.

During the dry season, livestock suffer from under-nutrition and malnutrition because the consumable ration rapidly becomes deficient in protein, digestible energy, phosphorous and vitamin A. In terms of these four key nutrients alone, the dry litter and standing dry herbage cannot meet the needs of the animals. Consumption of leaves and fruits from green trees and shrubs contributes to meeting needs for these nutrients. When dry season pastures have been eaten down, the animals should be able to satisfy all their nutritional requirements from the ligneous stratum or non-graminaceous herbage, but production by these plants is too low to satisfy their need for dry matter. Hence, their energy requirement for maintenance are met by a degradation of body tissues, resulting in deterioration in the physical condition of the animals and loss of weight.

Table 3.5.6 Nutritive values (major elements) of some non-graminaceous, shrub and tree species in the pastoral zone

Species	Ca (%)	P (%)	Ca/P	Mg (%)	Na[1] (%)	K (%)
Acacia raddiana	0.96	0.19	5.0	0.14	0.01	0.91
Balanites aegyptiaca	3.44	0.12	28.6	0.53	0.01	2.01
Bauhinia rufescens	3.20	0.19	16.8	0.14	0.01	0.91
Boscia senegalensis	0.96	0.08	12.0	0.53	ND	0.60
Calotropis procera	3.40	0.26	13.1	0.34	0.11	4.40
Chrozophora brocchiana	1.68	0.27	6.2	0.38	ND	0.60
Leptadenia hastata	2.40	0.17	14.1	0.34	0.03	2.76
Maerua crassifolia	1.60	0.14	11.4	0.82	ND	3.30
Prosopis juliflora	3.28	0.17	19.3	0.43	ND	1.02
Psoralea plicata	1.04	0.46	2.2	0.24	0.01	2.14
Ziziphus mauritaniaca	1.60	0.20	8.0	0.24	ND	0.80

Note: 1. ND = Non detectable

4.1 PEOPLE AND PRODUCTION SYSTEMS

The project area is mainly inhabited by Twareg and WoDaaBe pastoralists; they practise nomadic livestock-raising, spending the dry season concentrated near permanent water points and dispersing during the rainy season, when surface water is abundant and pasture is good. Fulfulde- and Tamasheq-speaking agropastoralists make up a second part of the population; these groups practise agriculture and livestock-raising in various combinations, usually with part of the family transhuming north with animals during the rainy season while the rest of the family remains behind to tend the fields. A third part consists of sedentary, often Hausa, farmers who grow millet and other crops, especially in the extreme southern parts of the zone where there is enough rain to permit regular agriculture. Some of these farmers also keep animals.

These three strata of the zone's population were researched by the project socioeconomic team between 1980 and 1982, with emphasis on the two major pastoral groups, the Twareg and WoDaaBe. A third and smaller part of the zone's pastoral population, Arabic-speaking herders, was not studied. The results of the research are reported in this chapter, which provides a historical, cultural, and social background to the Twareg, WoDaaBe, and some agropastoral and agricultural groups, and an economic analysis of their production systems. This section summarizes the size and distribution of these populations within the project zone.

SOURCES OF INFORMATION

Data on the size and distribution of any pastoral population are scarce and often of questionable reliability. The dispersed and mobile nature of nomadic camps makes census-taking difficult. Three main sources of information are available on the size, distribution and ethnic composition of the project zone's population: administrative censuses, aerial surveys carried out by the International Livestock Centre for Africa (ILCA) on behalf of the project and project field research.

Administrative censuses have been taken in Niger since the colonial period though they are of limited accuracy. In the pastoral zone, census

problems include the use, for registration of individuals, of administrative categories which correspond poorly to existing social groups (eg the "tribe"), irregular intervals between up-dating of the census, herders' efforts to avoid enumeration or to report incorrect information (since the census was used to establish tax rates), the difficulty of contacting a significant proportion of the population during a brief period (and the resulting practice of recording second-hand information), and imprecise registration of non-economically active people. Consequently pastoral populations are usually underestimated, and it is not possible to get an accurate sense of the population's dynamics or geographic distribution from the census figures.

The ILCA aerial survey as well as information gathered by individual socioeconomic researchers provide alternate sources of data which, combined with the census figures, can be used to construct a general picture of the project zone's population. The aerial survey team counted the number of dwellings in the project area according to their location and type. As surveys were flown at three different times (May and October 1981, and September 1982), seasonal differences in the number and distribution of dwellings were reflected in the survey's results. Two assumptions were used to arrive at estimates of the human population's size and ethnic composition. First, dwelling type was used as the indicator of the ethnicity of the occupants; open scrub crescents were considered to be inhabited by WoDaaBe or nomadic FulBe, while leather and mat tents were considered to be inhabited by Twareg. While dwelling types do normally indicate the ethnicity of the occupant, this is not invariably true. However, the error introduced by this is probably small.

The second set of assumptions, derived from field research, concerns the mean number of people per dwelling. In the case of the Twareg, a detailed breakdown of 83 households participating in the production economics study, gave a figure of 4.5 ($\pm$ 1.7) people per dwelling, which was probably a slight underestimate since very small children were not all counted; there was no significant difference between the Twareg inhabiting leather tents in the west of the zone and those inhabiting mat huts in the east and north. The Twareg families belonging to the six pilot herders' associations created by the project in the Abalak area (about 120 families) had however an average size of 6 people per family; this may somewhat overstate the mean number of people per

tent since in some cases a "family" member of an association included people living in more than one tent. As a compromise between these two figures, an estimate of 5 people per Twareg dwelling is used here to calculate the Twareg population (including the "sedentary" category) from the air survey count of dwellings.

The case of the WoDaaBe and FulBe is more complicated. The air survey counted the small brushwood crescents (suudu, pl. cuuDi) built by WoDaaBe and nomadic FulBe as their main form of dwelling.[1] There are several potential sources of error: not all WoDaaBe or nomadic FulBe build such crescents at all their camp sites, and some may make no camp at all that is visible from the air; crescents are sometimes placed among the trees and are not easily visible; camps are very small and scattered, leading to the likelihood of underestimation in a sample survey with a low sampling fraction (8.6 per cent). These problems would be expected to lead to an underestimate of the total number of occupied WoDaaBe and FulBe crescents, although probably not by a very significant amount. A further difficulty is that there is no way of distinguishing WoDaaBe from FulBe crescents from the air.[2]

To convert the number of occupied crescents to the number of people requires an estimate of the number of people per crescent, and further problems arise here. As discussed in the following chapter, WoDaaBe (and also FulBe) women build their crescent for the first time at a particular moment in the domestic cycle: in theory this takes place when they return to their husband after a period of two years' residence with their parents following the birth of their first child. In polygamous marriages, each wife builds her own crescent. Each crescent does not therefore indicate a nuclear family unit, but a wife with her children, together with a varying number of other people: a husband, shared perhaps with co-wives who have crescents of their own, other wives who have not yet constructed their own crescent, dependent unmarried or married children.

---

1. Both groups occasionally put up small huts or shelters inside the crescent in the rainy season, and a few families have adopted leather Twareg tents, but the number of either of these is insignificant.

2. The main difference between the two is the height of the table on which calebashes and other utensils are placed.

The only detailed information available is from the WoDaaBe socioeconomic sample of 19 families (140 people), which had 23 crescents, with a mean population per crescent of 6.0 (± 2.6) people. There is no information available on the mean number of people per crescent in FulBe camps, and anyway no way of distinguishing FulBe from WoDaaBe crescents. In the following calculations a figure of 6 people per occupied crescent is used.

Results of air surveys of the project zone population

The three air surveys took place in the late dry season (May 1981), the transition between the rainy and cold seasons (October 1981), and the late rainy season (September 1982). The methodology and full results are described in Milligan (1982a, 1982b, 1982c).

Table 4.1.1 shows the number of camps and dwellings recorded by the air surveys, and table 4.1.2 uses these figures to estimate the population of the project zone. The "sedentary" category refers to the dispersed mat or thatch huts characteristic of the mixed agropastoral, especially Twareg and Buzu, economy of the south west corner of the project zone between Tahoua, Abalak and Kao; mat and leather tents refer respectively to the chief dwelling type of the Kel Ayr and Kel Dinnik Twareg, with a small number of Arab herders in the north west of the zone also using leather tents. The figures in tables 4.1.1 and 4.1.2 do not include towns, villages or mud huts more characteristic of the pioneer Hawsa farming front along the southern edge of the project zone.

Table 4.1.1 Pastoral and agropastoral camps in the project zone [1]

	Total number of camps[2]			Mean number of dwellings/camp		
	May 1981	October 1981	September 1982	May 1981	October 1981	September 1982
1. Twareg:						
- mat tents	2,231 (12)	1,443 (15)	1,638 (16)	4.6	3.9	4.0
- leather tents	2,494 (14)	2,660 (17)	1,682 (21)	4.8	3.8	4.3
- sedentary	2,056 (29)	1,240 (35)	1,705 (29)	6.3	11.3	11.1
2. WoDaaBe/FulBe	2,253 (20)	2,863 (19)	1,490 (20)	2.5	2.2	2.8
3. Arabs[3]	-	135 (59)	-	-	6.5	-

Source: Project air survey (Milligan 1982 a, b, c)

Note:

1. Excludes villages, towns and mud huts.
2. Coefficient of variation (standard deviation in percent) in parentheses.
3. The October 1981 survey was the only one in which an attempt was made to distinguish the leather tents inhabited by Arab herders from Twareg ones.

Table 4.1.2 Estimated project zone pastoral and agropastoral population

	Total number of dwellings[1]			Estimated total population[2]			
	May 1981	October 1981	September 1982	May 1981	October 1981	September 1982	Mean[1]
1. Twareg							
- mat tents	10,215 (17)	5,681 (20)	6,550 (19)	51,075	28,405	32,750	37,410 (26)
- leather tents	12,031 (18)	10,144 (18)	7,201 (24)	60,155	50,720	36,005	48,960 (20)[3]
- sedentary	12,950 (29)	13,977 (38)	19,001 (31)	64,750	69,885	95,005	76,547 (17)
2. WoDaaBe/FulBe	5,709 (21)	6,244 (20)	6,954 (25)	34,254	37,464	41,724	37,814 (8)
3. Arabs	-	879 (74)	-	-	4,395	-	4,395
Total	40,905	36,925	39,706	210,234	190,869	205,484	202,196 (4)

Source: Project air survey (Milligan 1982 a, b, c)

Notes:

1. Coefficient of variation in brackets
2. For assumptions used to calculate number of inhabitants/dwelliing see text.
3. Mean is too high due to inclusion of Arabs in this category in May and September surveys. See text for discussion.

Table 4.1.1 shows a small increase in average camp size for pastoral Twareg during the dry season as compared to the wet. Sedentary settlements nearly double in size during the wet season when farming takes place. WoDaaBe Fulbe camps show a small increase in average size in the wet season.

Table 4.1.2 shows estimated pastoral and agropastoral populations (excluding large villages) in the zone to be about 202,000 as an average of the three surveys. There is rather little variation between the overall seasonal totals, but the sub-totals vary considerably between surveys. Kel Ayr pastoral Twareg, inhabiting mat tents, decrease substantially (by 44 per cent) between dry and wet season; this is discussed below. Kel Dinnik pastoral Twareg, inhabiting leather tents, vary substantially between seasons, as do the "sedentary" agropastoral Twareg populations of the Tahoua area. However, if these two groups are considered to overlap, with some groups living in "sedentary" thatch huts during the cropping season, and reverting to leather tents after the harvest, the overall population is much less variable between seasons.

The only survey during which an attempt was made to distinguish Arab pastoralists' leather tents from those of the Twareg was in October 1981, and gave an estimate of about 4,400 people, mainly in the Tassara area in the north west of the project zone. If, as seems likely, the same population is resident year round in the zone (although possibly some camps move north out of the zone in the rainy season), the estimates for leather tent inhabitants in the May and September surveys include approximately the same number of Arab-speaking herders. In this case, the combined population of leather tent-dwelling pastoral Twareg, "sedentary" hut-dwelling agropastoral Twareg and leather tent-dwelling pastoral Arabs varies little between seasons, as table 4.1.3 shows, with a substantial shift from leather tents to thatch huts during the agricultural season.

Table 4.1.3 Kel Dinnik pastoral and agropastoral Twareg and Arab populations in the project zone

Dwelling	Inferred occupants	Estimated population May 1981	October 1981	September 1982
Leather tents	Twareg and Arabs	60,155	55,115	36,005
"Sedentary" huts	Twareg	64,750	69,885	95,005
		124,905	125,000	131,010
Mean population (± SD%)			126,972 (2)	

Source: Project air survey

The WoDaaBe/FulBe population also varies seasonally, with a 22 per cent increase in September over May, due principally to the FulBe from the south who enter the project zone during the rains.

For pastoral development purposes, dry season areas are the key development focus because of the regularity with which nomadic groups return there, because pasture shortage then is a limiting factor, and because of the possibility of pasture control through control of water; these areas also correspond most closely to the administrative divisions of the pastoral population. The dry season (May 1981) population estimates from the air survey for the project zone are shown in table 4.1.4.

Table 4.1.4 Air survey estimates of project zone dry season population

Dwelling/ethnic category	Estimated dry season population	Percent of total zone population
Twareg/Arabs		
- Mat tents	51,075	24
- Leather tents	60,155	29
- "Sedentary"	64,750	31
WoDaaBe/FulBe	34,254	16
Total	210,234	100

Source: Project air survey

Overall dry season population density in the project zone can be calculated from the aerial survey data at about 2.2 people per square kilometer for the Twareg and 0.4 people per square kilometer for the WoDaaBe/FulBe,[1] though densities vary substantially from place to place. Highest densities are found in the south-western part of the zone, below the 16th parallel; this is the area of concentration of sedentary camps of Tamasheq-speakers, largely former Twareg slaves and Kel Gress Twareg, and also the main location of cultivated fields. The eastern part of the zone, from

1. The area covered by the air survey was 81,500 km^2

south to north and extending into the central region, is of medium population density. Lowest densities are found in the north. Maps 24 to 39 in the Pastoral Atlas of Central Niger illustrate the distribution of different ethnic groups and population densities in the project zone.

TWAREG

The Twareg population in the project zone consists of three major traditional groupings: the Iwllemeden Kel Dinnik, the Kel Ayr, and the Kel Gress. Figure 4.1.1 shows the general geographical situation of these confederations.

The Kel Dinnik are found in the west of the zone occupying dry season areas roughly between Tahoua, Tassara, In Waggeur, and Mayata, with Tchin Tabaraden as the main area of population concentration. In the rainy season, these groups move northward to the salt cure region near Ingal. Formerly the eastern division of a larger Iwllemeden confederation, the Kel Dinnik are now administered from Tchin Tabaraden and are divided into seven groupements, six of which are mainly in the project zone. These groupements which contain between one and thirty tribes, or between 500 and 18,000 people, have varying degrees of correspondance to the Kel Dinnik tribes' pre-colonial political structure and distribution, but are mainly the product of the French colonial administration's efforts to control and manipulate the Kel Dinnik into administratively and politically manageable units.[1]

---

1. Bernus (1981: 106-107 and 347-356) describes the history and composition of the groupements.

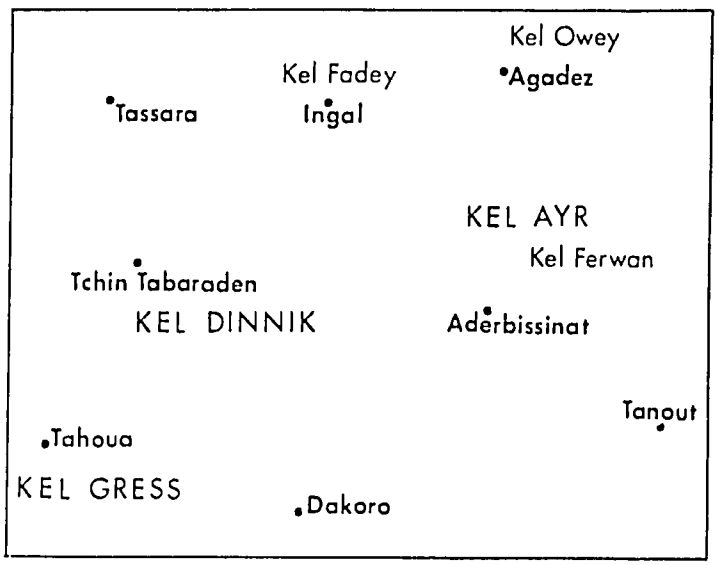


Figure 4.1.1 Distribution of Twareg confederations in project zone

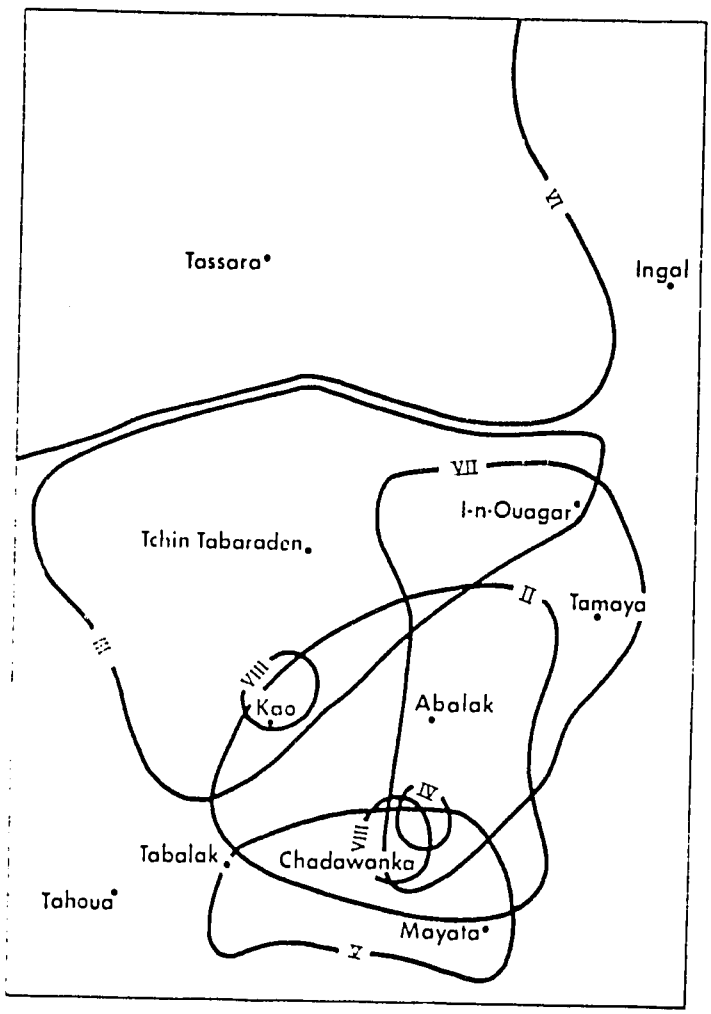
Bernus (1981) has documented the general dry season areas inhabited by the tribes within these groupements, and these are mapped in simplified form from Bernus and from project fieldwork in figure 4.1.2. The Arab herding population of the Tassara area is also classified as a groupement (number VI) and is also shown on figure 4.1.2.

The 1977 census information on the breakdown of the Kel Dinnik population by administrative group is shown in table 4.1.5. These figures have been increased to allow for growth between 1977 and 1981 at 1.8 percent annually.[1] Estimated in this way the Kel Dinnik population mainly living within the project zone is 60,700 people, with an additional 9,000 Arabs in the Tassara area, some of whom spend a good proportion of the year within the project zone. Assuming (a) that the "leather tent" air survey category corresponds to the Kel Dinnik Twareg and Arab herding population,[2] (b) that only 4,000 of the 9,000 Arabs are in the project zone, and (c) that a small proportion of the Kel Dinnik live in the dry season in thatch huts, then the estimated Kel Dinnik population in the project zone in 1981 from the adjusted census records is 58,000 to 60,000 people, which fits closely with the 1981 dry season air survey estimated population of 60,155 people. This suggests that the administrative census figures are in fact of the right order of magnitude as far as the pastoral Kel Dinnik in the project zone are concerned.

---

1. A demographic survey carried out in the project zone in the early 1960s (INSEE/SEDES 1966) calculated an annual population growth rate of 1.1 percent for nomadic Twareg and 2.4 for their pastoral ex-slaves, and a demographic survey of Twareg in Mali in 1981 found 1.8 percent annual growth (Hill, Randall and Sullivan 1982).

2. There are probably also a small number of what Bernus (1981:320) calls the pre-Saharan ungrouped Twareg who live north of the Ighazer plain and west of the Ayr mountains who enter the project zone in the wet season.



gure 4.1.2 Dry season distribution of Twareg Kel Dinnik groupements in the Tchin Tabaraden area

Table 4.1.5 Breakdown of the Kel Dinnik Twareg and Arab population of the project zone by administrative groupement: official 1977 census and 1981 projection

Groupement	Number of tribes	Number of people: 1977 census	Number of people: 1981 projection
Twareg:			
II	26	16,143	17,337
III	30	18,235	19,584
IV	1	543	583
V	19	7,605	8,168
VII	13	10,455	11,228
VIII	5	3,496	3,755
(sub total)	94	56,477	60,655
Arabs:			
VI	5	8,370	8,989
Total	99	64,847	69,644

Note : 1977 census figures from Bernus (1981); 1981 projection based on assumption of 1.8 percent annual growth from 1977 (see text for details).

The second major group of Twareg in the project zone are the Kel Ayr, who live in the east and north of the area between Aderbissinat, Ingal and Agadez. Their major confederations are the Kel Ferwan, Kel Fadey and the Kel Owey, though the third is primarily located outside the project zone proper in the Ayr mountains. The Kel Fadey occupy the plains around Ingal and the plateaux immediately south during the dry season and move to the salt cure region during the rains. The 1977 census records a total of 3,435 people for the 11 Kel Fadey tribes (Bernus 1981). The Kel Ferwan are found in the east between Aderbissinat and Agadez, with northern and southern concentrations in the dry season and a great deal of variation in the extent and direction of rainy season movements. Figure 4.1.3 shows the dry season areas. The 1977 census records a total of 8,236 people in the 17 Kel Ferwan tribes which are

administratively registered at Agadez. In addition to the Kel Fadey and the Kel Ferwan, there are about 7,000 Kel Ayr Twareg, administratively attached to the Sultanate of Agadez, who occupy dry season areas north of the project zone, who are found in the Tadarest during the rainy season. This give an administrative total of 18,671 Kel Ayr Twareg in the project zone in the rains, or about 20,000 if population growth since 1977 is allowed for. The Kel Ayr correspond in part to the air survey category "mat tents" for which a population of 51,075 people was estimated in May 1981, although the September 1982 and October 1981 air survey estimates were much less, respectively 32,750 and 28,405 people.

Some of the discrepancy between these totals is due to the various other Twareg herding populations in the zone who inhabit mat tents: Igdalen, Kel Tadele and other Twareg in the north and northwest of the zone, who probably make up around 4,000 people; and an unknown number of Kel Gress pastoralists from the south of the project zone, who migrate north during the rains and the salt cure (Bernus 1981: 318-331). However these people are not enough to account for the differences between the administratively censused Kel Ayr population in the project zone, and the number of mat tents estimated by the May 1981 air survey.

It is difficult to reconcile these discrepancies. One possible explanation is a substantial dry season immigration of Kel Ayr populations who spend the rest of the year outside the zone. However, this cannot explain the very great differences in the population estimates from the air survey and the administrative census. One or the other, or both, must be wrong: either the administrative census seriously underestimates the Kel Ayr population of the project zone, or the air survey category "mat tent" includes a substantial population other than the Kel Ayr. It is not possible to resolve this discrepancy without further field work in the areas concerned.

The Kel Gress are the third main Twareg group inhabiting the project zone. They have a mainly agropastoral economy, and occupy the southern part of the zone where millet cultivation is less risky. The Kel Gress confederation as a whole was estimated to contain 65,000 people in 1967, with a high rate of population growth (Bonte 1975). If population growth was 2.5

per cent a year, the 1981 Kel Gress population would be about 92,000 people. Along with former Twareg (especially Kel Dinnik) slaves also practising an agropastoral economy, the Kel Gress are censused as part of the "village" administrative structure, rather than the "tribal" structure into which pastoral Twareg are put.

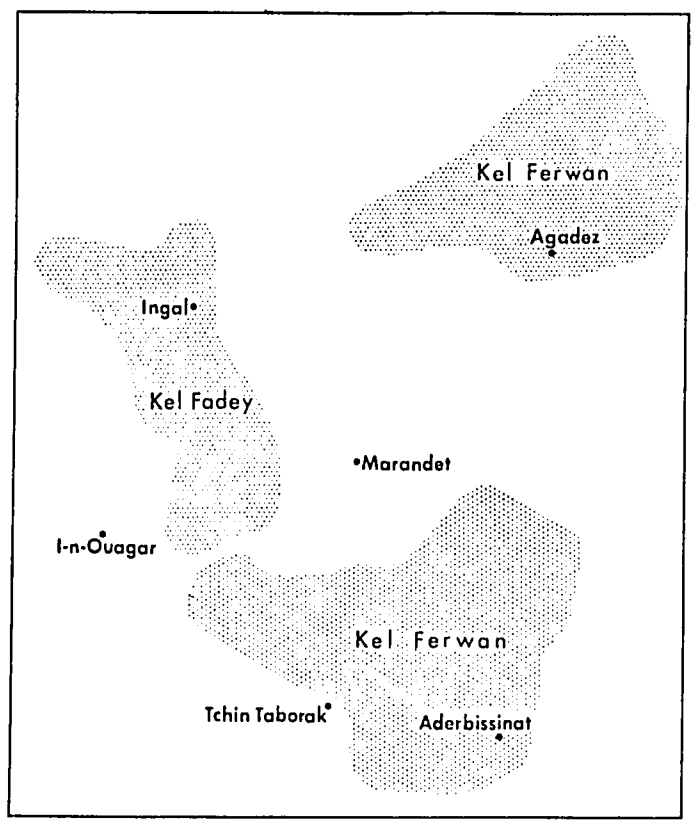


Figure 4.1.3 Dry season concentration areas of Kel Ferwan and Kel Fadey Twareg

In 1977 it may be estimated that according to official records there were about 79,000 Tamasheq-speakers in the Tahoua department who were not censused as part of the nomadic "tribal" structure.[1] Only some of these inhabit the project zone. The air survey estimated population of 64,750 sedentary Twareg in May 1981 is probably composed principally of these Kel Gress, and of agropastoral Kel Dinnik, especially former slaves.

WODAABE

WoDaaBe are found in three main sectors of the project zone, with approximately one third of the total in each: (1) in the west between Tassara, Ingal, Abalak, and Kao; (2) in the center, between Ingal, Abalak, and Gadabeji; and (3) in the east, between Ingal, Agadez, Tanout, and Gadabeji (see maps 24, 31 and 37 in the Pastoral Atlas of Central Niger). In each of these sectors there are considerable population movements. Although patterns vary significantly, north-south movement is most common. Thus, during the dry season, 65-70 percent of the WoDaaBe population is concentrated in the southern part of the three sectors, but in the rainy season almost the entire WoDaaBe population migrates to the area around the 16th parallel or between the 15th and 17th parallels. Within the three main WoDaaBe sectors, eight main areas of dry season concentration have been identified. These are listed in table 4.1.6.

---

1. The Statistical Yearbook, 1978-79 (p. 43) records 172,232 Tamasheq-speakers in the Tahoua department as a whole in 1977, and the official census figures for nomadic Twareg in the department in the same year was 93,361

Table 4.1.6 Dry season WoDaaBe concentrations

Zone	Location	Relative density
A	Northeast and east of Tchin Tabaraden	Heavy
B	Between Abalak, Chadawanka, Intawila, Bermo, and north of Abouhaya	Heavy
C	South of line running between Tamaya and Aderbissinat	Heavy
D	Northwest of Kao (Durum)	Medium
E	Northeast of Tofemanir	Medium
F	Southeast of Marandet	Medium
G	Around Ingal	Medium
H	Northwest of Tchirozerine and Aghaghen	Medium

Administratively, the zone's WoDaaBe population is attached to several departments and arrondissements: the ninth administrative grouping of Tchin Tabaraden, the FulBe chieftaincy of Madaoua and Dakoro, the WoDaaBe chieftaincy of Tanout, and the Sultanate of Agadez. The WoDaaBe population of the zone is divided into the two maximal lineages: the Degereeji, around 17,500 people, and the Alijam, around 15,500 people. Each of these is further subdivided into several primary lineages (lenyol s., leYYi pl.); the breakdown of the population in terms of the maximal and primary lineages is shown in table 4.1.7. It appears from project estimates that only about one third of the WoDaaBe in the zone are accounted for in the administrative census.

Table 4.1.7 Estimated WoDaaBe population in project zone

Lenyol	Number of chiefs	Administrative census	Project estimate
DEGEREEJI			
Jiijiiru	26	2,300	3,500-4,000
Gojanko'en	13	2,500	6,000-6,500
Kasawasawa	18	1,000	2,500
Suudu Suka'el	7	350	1,000
Njapto'en	8	1,700	4,000
ALIJAM			
BiBBe Dennke	2	185	600
Bii Nga'en	6	400	1,000
Yaamanko'en	20	1,370	3,500
Bii Korony'en	30		5,000-6,000
Alamoyo	3	150	250
TOTAL	157	11,755	31,850-33,850

Source: Maliki (1981a).

Population movements have extensively intermingled the two maximal lineages, resulting in a reorganisation of traditional relations and affiliations. As a result it is not possible to state simply the geographical locations of the major lineage divisions of the WoDaaBe population. This reflects the fact that the different primary lineages are in the process of reconstituting their internal cohesion; this phenomenon is particularly evident in the case of the Jiijiiru Hamboore, who have very fluid relations with other fractions of their primary lineages located further east outside the project zone proper, and is also true of the Kasawasawa of Tanout and those of Dakoro, and the Yaamanko'en of northern Tahoua department and Tanout.

The most geographically cohesive groups are the Gojanko'en, who live in the region between Tchin Tabaraden, Abalak and Chadawanka, and the Bii Korony'en who live in the region between Dakaro, Abalak, and Tofemanir.

FULBE

A substantial number of pastoral FulBe live permanently in the project zone, and others, generally agropastoralists, migrate into the zone with their herds in the rainy season from permanent villages and cultivation hamlets south and west of the project zone. Administratively, the FulBe clans or primary lineages of central Niger are attached to the FulBe groupement chiefs of Tahoua, Madaoua, Dakoro and Tanout.

There are three sectors of pastoral FulBe concentration within the project zone, which are shown in figure 4.1.4 and in map 25 of the Pastoral Atlas of Central Niger: (1) a region between Tamaske, Tahoua, Kao, Tchin Tabaraden, Telemces and Taza, in the Tahoua department; (2) the area between Chadawanka, Tabotaki, Tamaske and Korofane, also in the Tahoua department; (3) an area north and east of Dakoro, reaching as far north as Gadabeji and east beyond Belbegi. Two of the 13 FulBe clans which use the first sector in the wet season, and 5 of the 11 in the second sector, live within the project zone year round, as do about 8 clans in the third sector.[1] During the rainy season, the number of FulBe within the project zone increases as people who spend the dry season south of the zone move north with their herds. While the degree of transhumance varies among these southern Fulbe groups, the majority are agropastoralists; young people bring the cattle and sheep to the wet season pastures to avoid crop damage and also, especially in the case of sheep, to avoid diseases - such as pneumonia and ticks - the FulBe believe to be encouraged by the increased humidity in the south during the rains. During this transhumance a large number of herders practise an intensive form of herding (called biggal in Fulfulde) without the support of a camp, having left the rest of the family behind in the farming villages in the south. Transhumance routes followed by these southern FulBe in the Tahoua department in the rainy season are shown in figure 4.1.5.

---

1. These clans are respectively: the FereBBe and Ba'en in the first area, the Tsaygumanko'en, Kufayanko'en, Birdaaji, Saalamanko'en and Tsinkitanko'en in the second area; in the third area the most important clans are the Tunkuranko'en, JawBe, FereBBe, MalYinko'en, Jappanko'en, KatsinanKo'en, Buubuanko'en and WeweBBe.

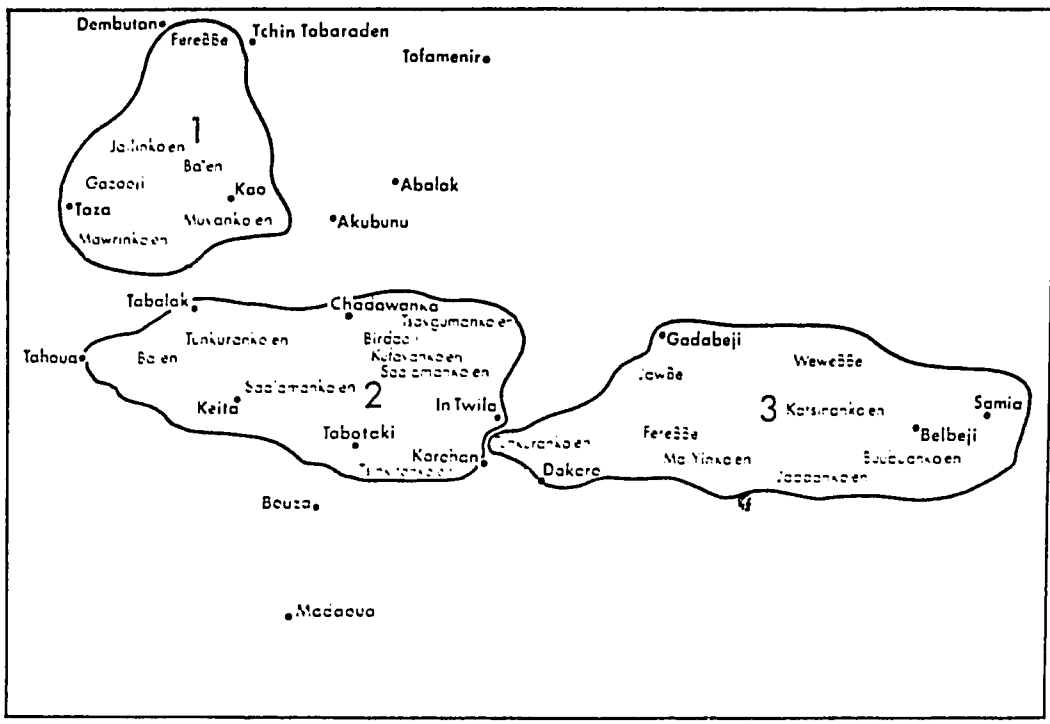


Figure 4.1.4 Sectors of pastoral FulBe concentration in the project zone

Table 4.1.8 gives project estimates of the numbers of pastoral FulBe who live permanently in the project zone, and of the number of additional FulBe cattle herds which move into the project zone during the rains, the majority of the latter accompanied only by one or two herders.[1]

1. In terms of the air survey categories, the pastoral FulBe who live permanently in the project zone generally build brushwood crescents very like those of the WoDaaBe, while the herdsmen from the agropastoral zone to the south who come into the zone in the rains generally build no shelter of any kind.

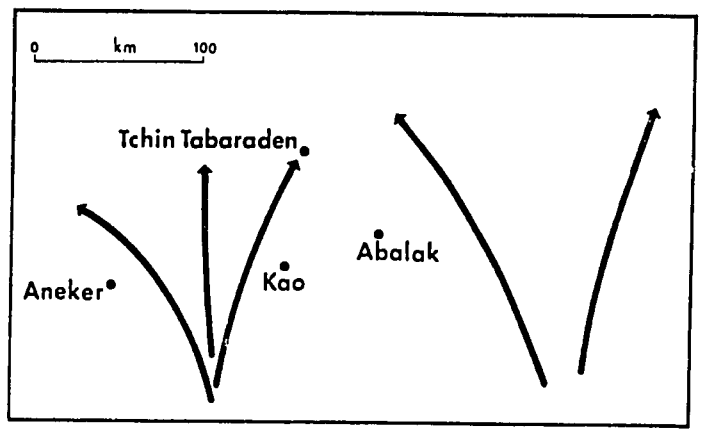


Figure 4.1.5 FulBe transhumance routes in Tahoua department

Table 4.1.8 Estimated FulBe population of the project zone

Sector	FulBe living permanently in the zone (people)	Additional FulBe cattle herds brought into the zone in the rains (herds)
Tahoua Department[1]		
1. North of Tahoua	1,000	400
2. East of Tahoua	5,000	300
Maradi Department		
3. East of Dakoro	4,000	100
Total	10,000 people	800 herds

Source: Project field surveys

Note: 1. Numbered areas refer to those shown in figure 4.1.4.

The air survey results in table 4.1.2 suggest a dry season population of 34,000 WoDaaBe/FulBe in the project zone, rising to about 42,000 towards the end of the rains in September. The ground survey results just reported suggest a resident WoDaaBe population in the zone of about 32,000 to 33,000 people, with a further 10,000 FulBe resident pastoralists; the 800 agropastoral FulBe herds which enter the zone in the rains are accompanied only by their herders who build no camps and are thus not visible from the air. Given the exiguity of WoDaaBe/FulBe camps, which are also sometimes hidden in thickets, it is likely that the air survey figures somewhat underestimate the WoDaaBe/FulBe dry season population in the zone, and that the ground survey figure of about 43,000 people for both groups combined is correct.

SEDENTARY AGROPASTORALISTS AND FARMERS

The project carried out no detailed research on the distribution and numbers of settled agropastoralists and peasant farmers. As discussed above, the air survey estimated a dry season "sedentary" Twareg population of about 65,000 people within the zone; the great majority of these are Kel Gress and sedentarised former Kel Dinnik slaves, in the Tahoua area, especially between Tahoua, Abalak, Kao and Keita. In the cultivation season the number of "sedentary" Twareg increases substantially (the estimated September 1982 population is 47 percent larger than the May 1981 population), probably at least in part as a result of the agricultural activities of a proportion of the Kel Dinnik pastoral population.

The project did not collect information on the overall size and distribution of the Hawsa population in the project zone. Generally, Hawsa live in settlements ranging in size from hamlets to towns, located in the southern part of the zone where there is enough rain for successful farming. Hawsa settlement in the area is relatively recent and is a result of the northern expansion of agriculture; demographic pressure on land in the higher rainfall zones farther south is prompting northward population movement into areas formerly used only by herders. This issue is dealt with in greater depth in chapter 4.4 below.

PASTORAL PRODUCTION SYSTEMS

The ethnic and language criteria used so far to describe the project zone's population are only one way of classifying the population, and from a development point of view they are less important in many respects than a classification of the ways herders and farmers in the zone organise and carry out their productive activities. To a certain extent these different production systems cut across ethnic and cultural classifications.

The focus of the research is livestock, and so the definition of production systems is based mainly on the importance of livestock in the economy. Two criteria are used here to define the production systems of interest in central Niger: the degree of dependence on livestock, and the type of agriculture associated with herding. More precisely stated, the two criteria are:

1. The degree of dependence on pastoral production for total gross revenue and for food supply

   A "pastoral production system" is defined as one in which 50 percent or more of household gross revenue (that is, the total value of marketed production plus the estimated value of subsistence production) comes from livestock or livestock-related activities (for example caravan trading), or where more than 15 percent of household food energy consumption consists of milk or milk products.

   An "agropastoral production system" is one in which more than 50 percent of household gross revenue comes from farming, and 10 to 50 percent from herding. These are somewhat arbitrary limits, but they define the main focus of interest - degree of dependence on animals - rather than focussing on patterns of movement (nomadic, transhumant, sedentary) which, although they are important for herd management, are a contingent aspect of the production system as such.

2. The type of agriculture associated with pastoralism

   Livestock-raising is found in Niger in conjunction with rainfed farming, with irrigated farming (both controlled and flood-retreat), and with irrigated gardening. Irrigated farming is not found in the project zone, but rainfed farming is important and gardening is not unusual.

The combination of these two criteria gives a simple classification of the three main production systems found in the project zone:

1. PASTORAL PRODUCTION SYSTEMS

1.1 Pure pastoralism

Characterised by an almost exclusive reliance on animals and animal-related activities for household revenue (although rarely for food consumption). There is no cultivation by or on behalf of households, and little use of crop residues by animals. The basic production units are independent nuclear families or goups of families joined together in camps whose composition varies seasonally and whose members cooperate to varying degrees in economic activities. All five domestic species are herded, with camels especially important in the north of the zone, cattle further south, sheep and goats everywhere, and donkeys also everywhere used for transport. Caravan trading, especially of salt, is an important source of household revenue for some herding groups.

Traditional geographic zones of influence of clans or sections used to exist, but without exclusive pasture rights as such in most cases; these zones of influence no longer exist. However, water points embodying labour (such as wells, but not springs or surface pools) are private property, and often provide de facto restriction on access to pasture. Dry season pastures tend to be occupied regularly by the same groups, partly because of water ownership, but also because of their detailed knowledge of ecological micro-niches. There is an annual pattern of sometimes irregular movement away from dry season pastures, especially during the rains and in some cases for the salt-cure.

In pure pastoral economies, cereals are acquired by barter (often for milk) or are bought with cash from the sale of animals. Pure pastoral economies are much involved in exchange: because they produce no food grains themselves, they have to sell milk or animals to cover their cereal requirements which are usually a large part of their total annual calorie consumption.

Pure pastoral economies traditionally combined family or servile labour with household-owned animals on communal pastures using communal or lineage-owned water. There are recent trends towards the creation of a market

in production factors, with an increase in hired labour, investment in animals in the pastoral economy and purchase of pastoral wells by non-pastoralists; these trends are discussed later in this report.

Pure pastoral production systems are found in the project zone among Twareg, WoDaaBe, FulBe and Arab herding populations.

1.2 Pastoralism associated with rainfed cropping

Characterised by a high degree of reliance on pastoral activities for household revenue, but in which rainfed cultivation by or on behalf of the household also contributes an important share (up to 50 percent) of revenue. Households usually do some farming, usually of millet, although they may invest little labour in this, clearing small fields, doing little field preparation and little or no weeding. At one extreme a bush field may simply be sown broadcast and left by a nomadic group who return at harvest time in the hope (which is only occasionally realised) of finding a crop. At the other extreme, pastoral production systems associated with rainfed cropping include herders with a substantial commitment to farming, usually in a village context, which nevertheless remains subsidiary to pastoralism in terms of household income. This includes both pastoral households which have too few animals to live exclusively from pastoralism and who are farming in order to build their herds back up to the minimum level for independent pastoral production, and also pastoralists who live in villages and farm regularly on a small scale, but specialise in herding, and exchange pastoral products (animals, milk, manure, traction and transport) with farmers in the same or neighbouring villages; this latter arrangement is particularly common in FulBe villages. Cattle are the commonest species herded in this production system, with varying numbers of sheep and goats also found.

The basic production units are independent nuclear families or groups of families, with considerable cooperation in herding: cattle from several households or a whole village may be taken north during the rainy season in the charge of specialised herders or herd boys from a few families, while most family members remain in the village. Because of the increased demand for labour where households are farming, there may be more cooperation in herding in this production system than in pure pastoralism.

The normal pattern of movement consists of a wet season migration of most of the animals north away from the farmed land in search of new pasture and to avoid crop damage; some milk cows often stay all year in the villages. In central Niger no traditional pasture rights are claimed by pastoralists who farm in this manner, although wells may be privately owned; where households in this production system normally belong to a pure pastoral production system and have started cultivation in response to poverty, they may be able to claim water rights and hence access to pasture at wells owned by their lineage. Animals make considerable use of crop residues after harvest, manuring the fields at the same time.

Households in this system are often able to acquire a proportion, which probably varies widely from year to year, of their annual cereal consumption requirements either from their own fields or from non-market exchanges with other households in their own villages. It is possible that some of these transactions are unequal, approximating more to tribute payments, where they take place between members of a formerly dominant herder society and their former dependents. Sale and exchange of animal products are the main source of the remaining cereals. Hired herdsmen are beginning to make an appearance in this system, although the creation of a production factor market is in other respects less far advanced than in the pure pastoral system.

Pastoral production systems associated with rainfed farming are common in the south of the project zone and further south also, especially among impoverished Twareg and their ex-dependents, and also among Fulße.

2. AGROPASTORAL PRODUCTION SYSTEMS

2.1 Agropastoralism with rainfed cultivation

In this system, rainfed farming is the main source of household revenues, although animals provide important additional income. The basic production units are nuclear or extended families with varying degrees of cooperation in farming and especially herding. The animals concerned are sheep and goats, together with cattle among wealthier households, and serve several functions: an investment of agricultural and trading earnings, inputs

to agriculture and productive assets in their own right, and an accumulation of important social resources. These animals may be put in the charge of a herder (in the case of people with no herding tradition, often a FulBe family) for most of the year, or they may be managed as a joint village herd or herds supervised either by villagers in turn or a hired villager. The animals are often taken away from the village during the farming season, although perhaps no further than a few kilometres to keep them out of growing crops. They use communal pastures, and usually spend the dry season on crop residues or adjacent pastures, watered at village wells.

Since the owners of these animals - who are generally among the richer farmers - grow at least a substantial part of their own cereal requirements and often have a surplus of grain for sale, their animals are used less for subsistence purposes than as an investment, and a source of cash for exceptional economic and social expenses (cereals in a bad year, marriage, sickness).

Agropastoral production systems are found in the south of the project zone and especially to the immediate south of it, especially among former Twareg dependents, and Hawsa.

Importance of production systems

This framework is sufficiently simple to enable a rough classification of the project zone's inhabitants into their main produciton systems. These to a certain degree follow ethnic or confederation lines.

The great majority of the Kel Ayr Twareg, Arabs, WoDaaBe and FulBe belong to the pure pastoral production system. The Kel Dinnik Twareg are more complicated. As discussed above, according to the air survey a substantial part of the Kel Dinnik population appears to shift from leather tents into "sedentary" thatch huts in the cultivation season, and experience on the ground suggests that it is in fact likely that they are farming. If the population living in leather tents as surveyed in the rainy season of 1982 (shown in table 4.1.3) is composed of purely pastoral Kel Dinnik plus about 4,000 Arabs, and the difference between the May 1981 and September 1982 population inhabiting leather tents is due largely to the shifting of these Twareg who cultivate into huts in the rains, then there are about 32,000

purely pastoral Kel Dinnik, and about 24,000 Kel Dinnik who belong to a pastoral production system associated with rainfed agriculture. The rest of the "sedentary" Twareg air survey category - largely Kel Gress - are assumed to be agropastoralists. In the mat tent category 20,000 people are assumed to belong to the Kel Ayr, and the rest to a variety of other pastoral Twareg groups, including Kel Gress, Igdalen and Kel Tadele. This category of "other mat tent dwellers" may however have to be reduced in the light of further surveys. Based on these assumptions, the estimate of the number of people in each of the three main production systems is shown in table 4.1.9.

Table 4.1.9 Estimated project zone dry season population: distribution by production system

Production system	Estimated dry season population	
	Number of people	Percent
Pure pastoralism		
Kel Ayr	20,000	9
Other mat tent dwellers[1]	31,000	14
Kel Dinnik	32,000	15
Arabs	4,000	2
WoDaaBe	33,000	15
FulBe	10,000	5
(Sub-total)	(130,000)	(59)
Pastoralism associated with rainfed farming		
Kel Dinnik	24,000	11
Agropastoralism[2]		
Kel Gress/ Kel Dinnik	65,000	30
TOTAL	219,000	100

Source: Project air and ground surveys.

Note: 1. Including Igdalen, Kel Tadele and other Twareg populations.

2. Not including Hawsa and other mainly farming people.

4.2 THE WODAABE

Intensive production systems research was carried out by the project at household level among the WoDaaBe in order to provide a better understanding of WoDaaBe herders' own production objectives, strategies, techniques and knowledge, and to identify key dynamic processes and constraints to the achievement of these objectives. In addition to the description of WoDaaBe techniques and perceptions of animal production and range use, the research attempted to identify both the nature of WoDaaBe production relationships in general, the scale of the main factor inputs and outputs, and also the variations within WoDaaBe society in parameters such as wealth or labor allocations. This chapter reports the results of that research. The underlying theme is both a search for a logical and consistent analysis, using the methods, language and conceptual models of empirical social science, of how the WoDaaBe organise their productive activities and what the main constraints to this are, but also a better understanding of the WoDaaBe's own formulation of their objectives, and the technical skills and knowledge they dispose of to achieve them.[1]

THE WODAABE YEAR

For the WoDaaBe, every season has particular characteristics: a way of life, a pace, problems, strategies, techniques and tasks. The WoDaaBe year is composed of eight seasons.

---

1. In transcribing Fulfulde words in this chapter, the capital letters "B", "D" and "Y" have been used to represent the three implosive or glotalised consonants. The "n" represents the velar "n". The consonant "c" is pronounced "sh" or "ch" by the WoDaaBe. In conformity with normal English usage, initial letters of Fulfulde words at the start of a sentence, and names such as WoDaaBe and BoDaaDo (singular of WoDaaBe) are also capitalized. All Fulfulde words are underlined, as are the Latin names of animals and plants. In order to lighten the text, Fulfulde words are used as sparingly as possible. The interested reader is referred to Maliki (1981) for the detailed WoDaaBe herding vocabulary in Fulfulde.

(1) Kokkobe (late May to late June)

The WoDaaBe use several words to describe this season: kokkobe from the word meaning long intervals between rains; guluwe, from the word describing the torrid heat experienced during the season of hot winds; balDe keß-keß, from the verb to get. This is the period during which it is possible to get a few things which however do not last long; one day you get, the next day you do not.

Exhausted by a long dry season, dominated by the constant need to balance grazing and water, the WoDaaBe go anywhere they think they will find a change. After the tornados which mark the start of the rains, the WoDaaBe leave their dry season pastures and water points and start to "follow the clouds", grazing their animals near the first ponds to be formed. For the WoDaaBe the new year is beginning. They make fun of themselves, saying that they behave like the ostrich, which, on hearing the first peals of thunder, moves to places where the clouds have begun to cross the sky.

Families begin to regroup; these are not yet the full gatherings of the rainy season, but simple meetings. The WoDaaBe meet at the same places, all in search of the same pasture and water. The first rains are scattered, and the pasture grows in ways which vary from place to place. This is a time of extreme mobility; it is impossible to stay in one place. The Baartol, the long journey which involves a complete change of grazing area, is characteristic of this season.

Substantial animal weight loss is typical of this season. This is not ordinary weight loss (known as foyre); special words are used to describe it: nalbel or ulfel, that is, emaciation. Ulfel denotes a real state of famine, even if the overall appearance of the animals is good. Ulfel has one characteristic sign: the animals always have watery eyes. Animals which have no choice but to graze on small tufts of fresh grass mixed with old hay are particularly prone to ulfel. When the first rains fall, the cows "smell" the new season - they feel the humidity. They need fresh grass and refuse hay which, wet by the rain, is no longer palatable. Although the animals can drink all they want, they do not gain weight and are constantly hungry. For sheep this time is particularly hard: their emaciation is serious and often fatal (they are susceptible to severe attacks of pneumonia).

However, after a few days, the sheep are allowed to graze on the first scattered tufts of new grass. Next it is the young calves' turn and finally the adult cows are allowed to graze, not intensively, but just enough to subsist. A special word (happina or noppina) is used to describe this grazing technique, and in the long run, its effects can be observed: at the end of this season the animals improve. They have not yet eaten enough to appease their hunger, but they are no longer in a state of famine. They are said to have "spat out hunger" and their bellies "to be henceforth black", because their excrement is bulkier and darker.

There are severe strains on the family economy during this season. Cows yield almost no milk. In order to eat, the WoDaaBe have to buy large quantities of cereals, at a time of year when prices are high. As a result, they must sell stock. This is the peak period of animal sales. In terms of human health, this is a trying time for the WoDaaBe who are weak and lose weight; children are particularly affected.

(2) Korsol (late June to late July)

After the long and arduous dry season and the suffering during the start of the rains, korsol is a time of happiness. Grass appears throughout the bush, and the animals can graze peacefully. By mid-morning they are already full and ruminate in the shade. The pasture which grows during this season is ideal; it is composed of thin blades of grass (woggo) which have not yet formed nodes, in contrast to the tall noded grass (jokko) which is typical of the latter part of the rainy season. For the WoDaaBe, it would be ideal to feed their animals on this soft grass all the time; in the main rainy season they make long journeys just to obtain this grass, but during korsol it is abundant, especially in the north, where the rainy season begins later than in the south. But there are also dangers: in this season, bloat, caused by some young grasses, can be fatal to the animals.[1]

---

1. The WoDaaBe know several types of toxic grass which grow in new pasture. Among them are Gisekia pharnacoides, Zornia glochidata, Peristrophe bicalcyculata and Tribulus terrestris.

During this season the cattle have a pressing need for small quantities of salt. A good herder will continue to give his animals salt right up to the Yaawol season, after the rains, and even in small amounts during the cold season.

In sharp contrast to the instability and mobility of the previous season, the korsol is spent in tranquility. No long journeys are made, only short trips within the same general area. During the korsol season, markets are a great attraction. At evening gatherings, members of the group are asked not start their long journeys of the following season until everyone has had a chance to go to the market.

At this time, milk production is considerable, and is said to be even greater now than in the main rainy season because the cows' udders do not yet have that "layer of flesh" which prevents perfect lactation. For several months during this and the following season, the WoDaaBe diet is based almost exclusively on milk. All the milk produced by the cows is drunk, and none is bartered.

(3) Ndunngu (August to September)

The season which the WoDaaBe call ndunngu (or the middle of the rainy season) is characterized by long journeys. A course is not charted, but an itinerary is selected, which varies by region and the habita of the different groups. Pastures become green and, even from a distance, the WoDaaBe are able to assess the intensity and significance of the dark green cover on the hills and valleys.

The scout (cewtoo, garsoo) of the group now has an important task to perform.[1] He scouts regularly and may be away from the camp for several days. When he returns the whole community gathers and forms a council (kinnal) which discusses the scout's findings. During these council

---

1. In general every migratory group (kinnidal) has its own scout.

meetings (held in the mornings and evenings) everyone has the right to speak. Journeys are determined on the basis of the scout's report about quality of pasture, the abundance of water and the presence of other groups.

Rainfall is generally quite regular during this season. However the hokkere (any substantial break between rains) is dreaded. There is often a long hokkere (15-20 days) during August, which is greatly feared because it upsets plant growth and adversely affects animal health. Water may suddenly become scarce: small ponds may dry up and large ponds become grey, muddy and stagnant. During ndunngu the ground is often covered with dew, which is good for the cattle. The WoDaaBe say that a cow that has spent all night in a pasture covered with dew wakes up the next morning with a supple and tender body. In contrast, dew is of no benefit to camels. Camels produce little milk during this season.[1]

From this season onwards and throughout the rest of the rainy season, the different family units of each fraction or segment (taarde) concentrate in a smaller number of camps, each containing many families. Once the major journeys are accomplished, the area within which families move is relatively limited.

Toward mid-September, these camps are found on the outer edge of the nomadic zone. Camps are generally close to the salt-licks (bagoriije) which vary in size and are scattered throughout the region. There are several ways of giving the salt earth to the animals: either by directly allowing the animals to lick the earth after a hole has been dug in the ground, or indirectly, by taking salt earth back to the camp on donkeys or camels.

At the end of this season, each segment (taarde) assembles for its customary annual gatherings (worso or renndo). For three or four days, the clan stays in the same place and conducts traditional ceremonies (especially marriages and naming ceremonies). Other clan gatherings may be organized to

---

1. According to WoDaaBe who raise camels, the camel's lactation cycle is the opposite of that of a cow; camel milk production peaks during the hot season, when cows yield almost no milk at all.

perform the ceremony of the unirki (a ritual to celebrate the transition of a youth into adulthood). Inter-clan gatherings may be arranged by young people either in the form of three-day meetings, or more structured and extended seven-day gatherings.

(4) Yaawol (October)

The Yaawol is the end of the rainy season. Ponds are still full, but vegetation begins to dry up. Herds no longer graze on fresh grass but eat hay. A special name is given to the sun during Yaawol: heemarye. It is said to be very hot and dangerous both for people and animals. Riding camels can barely endure long journeys. At this time, herders make a preliminary assessment of the wet season that has just ended. The season is appraised on the basis of three main criteria: animal weight gain, the quantity of milk production, and the number of cows in heat.

The densely concentrated camps begin to disperse. The extended family groups stay together a little longer if possible, but there are other constraints. Everyone is eager to hear news of grazing conditions. Slowly, the groups return to the area where they spend the dry season.

Cows' milk production has now considerably decreased. The animals respond to the change of season and pasture and cannot provide enough milk for households to live from milk alone. At the end of Yaawol, some WoDaaBe begin to move to the markets of the farming zone (where it is harvest time) to get millet and change their diet. In some regions, it is possible to find wild melons which ripen at this time. The WoDaaBe gather them to make a stew with hot peppers and salt. The animals are fond of this stew too and the whole fruit, including the stem and leaves, is considered excellent forage for the season.

The herds move to the large ponds filled by the rainy season, staying away from the dry season wells for as long as possible. At this time, the animals can still drink during the day.

(5) Coorol (November)

Coorol is an intermediate season. Nights begin to get cooler, though the days are still hot. A slight mist often covers the countryside.

Coorol is a short period of tranquility following the long journeys of the previous season; during coorol, WoDaaBe groups split up and gradually return to their dry season water points. At this time, it is possible to make an overall assessment of the rainy season's effect on particular grazing areas. One can see where "the bush has grown" or where the vegetation has not grown well. The latter areas are called malalaji, or the large strips of land which remain completely bare. The jujubes (Ziziphus mauritiana) ripen and the children spend entire days collecting them for food.

During coorol, the WoDaaBe return to markets. They buy mainly millet, together with waterskins, blankets and shoes. The WoDaaBe do not consider the animal markets very lively during this season: there are few buyers, prices are low and the herders do not sell their animals unless they have to.

Every herder fears a bush fire at this time. The WoDaaBe consider some regions particularly exposed to this danger.[1] These bush fires cause serious damage not only to pasture, but also to livestock and sometimes to people.

(6) Dabbunde (December to January)

This is the cold season during which households move to their main dry season camping area. The last herds leave the ponds and move to a permanent water point: a bore-hole (fanfi), deep well (woynndu) needing animal traction, or shallow well (Bunndu). The type of water point varies from

---

1. For example, the savanna woodland north-west of In Tawila.

region to region. Some herders may linger at the ponds; however, unless there are very good reasons, herders prefer not to stay at the ponds since they say that the cold water there is not good for the animals (especially the young calves).

The cold season must be managed in the correct manner if the herd is successfully to face the problems of the hot, dry season. The WoDaaBe generally return to particular areas at this time. Even if they are completely nomadic, all herding households have a place to which they return, a place to which they feel attached. This is their ngenndi (their homeland), their taaku (their base), their lesdi mbowaandi (the region they frequent). The return journeys to these dry season areas are not made in an arbitrary or haphazard manner.

Every lineage segment (taarde) has its own dry season area, and sometimes a large segment may have several. The ngenndi is more than just a water-point; it is an entire grazing area. The ngenndi strongly influences the life of the community through its economy (the location of markets within the ngenndi, the possibilities for barter with other herders or farmers), and its natural resources (the types and abundance of pasture, the location, type and capacity of water points).

It is rare to find only members of a single segment in a ngenndi; usually, the groups occupying each ngenndi are composed of more than one segment. This merging of migratory groups creates bonds of friendship as well as kinship. In addition of course, the WoDaaBe may share the ngenndi with other peoples: Twareg, FulBe and Arab herders as well as Hawsa farmers.

Camping near a well and a peaceful and regular life cause cows' milk production to increase appreciably, reversing the decline that occured at the end of the previous season, even though the animals are watered only every other day. Women prepare large amounts of curds and butter, and if it is possible in their region, they barter extensively, exchanging these products for millet.

This is the season when most labor migration to the large cities in the south takes place.

(7) Sudditte (February)

Sudditte is an intermediate season which starts during the cold season and ends gradually in the hot, dry season. Sometimes, it lasts only a few days and passes unnoticed. The morning fog, typical of the cold season, is lifted. Although the nights are still cool, they are no longer cold, and during the day the sun is hot.

At this time WoDaaBe camps are 5 to 7 kilometers from water points. Camps move at least once every 10 days. Animals are watered every two days. As the dry season approaches, cows' milk production decreases, but camels begin to produce more milk; the WoDaaBe say that this is due to the heat of the earth which, entering their bodies through the soles of their feet, stimulates milk production.

(8) CeeDu (late March to late May)

In its broadest sense, the term ceeDu describes the entire dry season, that is, the period between the last rains at the end of September and the first rains in May.[1] However, in its narrower sense ceeDu refers to the season immediately following the cold season.

The WoDaaBe consider ceeDu a time of great hardship. Caring for the herd requires a considerable effort from each member of the camp. During this season, the lineage segment divides into small camps, generally made up of two or three brushwood shelters, each inhabited by a woman and her children.

---

1. In this sense it is in contrast to ndunngu which describes the whole rainy season.

The majority of WoDaaBe camp near shallow wells. A great amount of work is needed to draw water from these wells. After finding a suitable place at the bottom of a dried-up pond, digging begins. This job is done by two people: one at the bottom of the well to dig and the other above, to remove the earth. After a few hours of hard work, the diggers reach water. Wells dug in sandy areas are reinforced with flexible branches and tall grass. If the water flow is too small, several wells have to be dug, and are used one after the other.

The well belongs to the two WoDaaBe who dug it (or who had it dug), and they take turns watering their herds every other day. The well is usually watched by night to prevent others from using it. When water is abundant, the well is not guarded so other WoDaaBe can come and water. This system of watering one's livestock at someone else's well is called Buto, and is governed by precise rules: hospitality requires that a herd travelling to another region or which has just arrived at the water point but as yet has no well of its own, is allowed to drink for a limited period.

By the middle of the dry season, a large number of shallow wells can no longer be used due to lack of water. Against their will, the WoDaaBe often have to leave excellent pastures for places near boreholes and deep wells, where there are many herds and little pasture. In particularly difficult years, herders have been known to camp as much as 70 kilometers from their water.

The WoDaaBe who water their herds at deep wells also have a difficult task. Each herder (or pair of herders) erects a forked branch at the well, with a pulley on an axle between the ends of the fork. The installation of this fork signifies the appropriation of some of the well water and thus, indirectly, the control of surrounding pastures. The amount of water drawn from the well is limited by the number of forks installed.

During the dry ceeDu season, camps move every twenty or thirty days. However, these journeys are always short and are movements around the same water point. The cows produce little milk, and cereals are the staple of

the WoDaaBe diet at this time. Household heads have to go at least once a month to markets to buy cereals. These journeys are time-consuming, because of the long distances to be covered. Sometimes the household head has to leave the camp for as much as a week; during this time, his herd is left in the care of a son, a brother or a friend, for whom this is a considerable additional task.

From late March onwards, the temperature is high. People suffer from the heat, from the hot wind from the north-east, and especially from thirst. Water is brought from the well to the camp in waterskins carried by donkeys. Children, starting at the age of seven or eight, are given this task. Every morning, they go to the well and usually do not return until well after sundown. The water they carry back to the camp is used to prepare food and to water the calves and lambs which remain at the camp. A few hours after the children return with the skins, there is almost no water left at the camp, and throughout the following day, people wait impatiently for the return of the donkeys.

When the south wind begins to blow, it is a sign that the rains are on their way. According to the WoDaaBe, this is the wind which brings the rainclouds. When the first rains fall, the new year begins, and the seasonal cycle starts again.

The pattern of the seasons and their main characteristics are shown in table 4.2.1.

Table 4.2.1 The seasons according to the WoDaaBe

Month	Season	Weather and environment	Social life	Main economic activities
May-June	kokkobe	First rains. Animals drink at ponds every day. First fresh grass.	Unstable groupings	Long journeys. Animals lose weight. Extensive livestock sales and purchases of millet.
July	korsol	Frequent rains. Plants start to grow.	Very active. Clans assemble.	Nomadic movement in a small area. Salt purchased. Calving period.
August-September	ndunngu	Storms. Morning dew.	Intense. Large clan and inter-clan gatherings.	Very frequent journeys over long distances.
October	Yaawol	End of rains. Bush dries up. Intensely hot sun.	Groups begin to scatter.	Return journeys to base. Low milk production.
November	coorol	Cool nights. Cattle water every other day.	Small unstable groupings.	Trips to the markets begin.
December-January	dabbunde	Cold season.	Family units.	Temporary increase in milk production. Markets. Barter.
February	sudditte	Hot days.	Family units	Decrease in milk production.
March-May	ceeDu	Intense heat.	Family units	Large purchase of millet, extensive sales. Watering.

DAABE HERDING TECHNIQUES

This section presents some of the main WoDaaBe techniques and fields of scientific knowledge concerning herding. These are described mainly from a WoDaaBe point of view.

Herd composition

The cattle herd

At night the young calves are tied to a rope, fastened to two posts located to the west of the camp. The youngest calves are tied to the south and the eldest to the north; this follows the direction of increasing seniority of women (north to south) not that of men, as discussed in the next section. These calves make up what is known as "the herd of young calves", which during the day, graze near the camp, far from their mothers. In the evening, after milking, they are tied up until the following morning. They suckle their mothers only twice a day, morning and evening.

Calves which have already been weaned make up another special group; they are not separated from the adult animals, but still require special care: at the well, for example, they are watered before the other animals in the herd.

The term sefre (pl. cefe) refers to the herd in general. For the WoDaaBe, a sefre comprises a minimum of 20 to 25 animals and a maximum of 60 to 70. A small herd of less then 20 to 25 animals is called fowtere. There is no specific term to describe a large herd; a person who has a very large herd is said to have "two herds". There is a special name for a herd noted for the beauty of its animals.

The herd which a BoDaaDo manages never exactly corresponds to the herd which he owns. The person in charge of a herd may be the legimate owner of some of the animals, or he may be the herder or manager of animals belonging to other people. This means that the person who manages the herd exercises

full rights of ownership over part of the herd at best, exercising only partial rights of usage on the other part. Table 4.2.2 shows the different categories of ownership and use of animals in a herd.

Table 4.2.2 WoDaaBe categories of ownership and use rights in animals

Traditional term	Ownership	Usage
alhalji[1]	Animal belonging to the herder himself	Absolute rights
darnaaji (senndereeji yeyirrijo)	Animals allotted by the husband to the wife during marriage ceremonies	Exclusive use rights for the wife and her children. Husband retains right to sell.
aenndereeji BiBBe	Animals pre-inherited by children	Exclusive use and disposal rights for the children.
haBBanaaji	Female animals on temporary loan from other herders	Rights of use over milk only. Full ownership of two or three calves.
diilaaji (or hawwaruuji)	Milk cows on temporary loan	Rights of use over milk only.
jokkere (or canoonooji)[2]	Animals kept for owner of other ethnic group (Hawsa, Twareg or Arabs)	Rights of use over milk only. No other compensation or salary is provided for herding labor.
dennaaji	Animals belonging to relatives or friends, for a more or less extended period	Rights of use over milk only.
puDDiri	Animal(s) received as bridewealth for the marriage of a daughter	Absolute rights of use and disposal

Notes:

1. Among the alhalji, a distinction is made between animals born in the herd (dimaaDi) and animals acquired by other means.

2. From the Hawsa sha, to drink; noono, milk.

These different categories of animal are present in the herd in varying proportions. Among some WoDaaBe groups, such as the Jiijiiru Hambooru and the Njapto'en in the Ader, alhalji or fully owned animals may make up no more than 20 to 30 percent of the herd, while jokkere or animals belonging to other ethnic groups are herded in large numbers.

WoDaaBe classify their cattle by age and, in the case of females, by the number of calves born. Table 4.2.3 gives the general classification.

Table 4.2.3 WoDaaBe categories of cattle according to age, sex and number of calvings

Males	Age[1] (years)	Females	Number of calvings
ngaari ndunnguuri	0-1	nyalohol ndunnguwol	-
ngaari Didiiri	1-2	nyalohol DiDiwol	-
ngaari tatiiri	2-3	wigge tatiye	-
ngaari nayiiri	3-4	wigge dikke	1
kotoori	5-7	haange	2-3
kalhaldi	7-9	nagge yeernge	4-6
kalhaldi gujumaari	>9	nagge wujjumae	>7

Note:
1. In fact WoDaaBe classify age by the number of rainy seasons the animal has lived through.

Females in the cattle herd

Female cattle occupy a privileged place within the WoDaaBe herding system as all their activities revolve around reproduction and milk production. The herder's main wish is the birth of a female and he conducts ceremonies to this end. The WoDaaBe say that females make up the

bonjereewal (literally, the main pillar of a house) as they are responsible for the increase in herd size. The females give their names to their descendants, whether male or female; thus a bull or a cow is called by its mother's name or by the name of a maternal ancestor. In contrast to the patrilineal system applied to people, the WoDaaBe follow a matrilineal system with regard to livestock.

A particularly valued animal is the female bull, or nagge ngaarye. This is a cow whose body is developed like a bull's and which remains sterile. The WoDaaBe are especially proud to have a ngaarye in their herd as she is beautiful, docile, huge and stands out among the other animals. She always leads the herd. The WoDaaBe prefer to keep a female bull until it is adult; usually they refuse to sell it and prefer to give it away as charity.

Milk cows

The females of the herd are divided into the following groups:

bireteedi: milk cows, also called saafeteeDi or konndooji.

njo'orDi: dry cows which produce no milk, also called gori.

Milk cows are the real wealth of the herd: they are not only a source of food but they also lend prestige to the herd. Cows are milked twice a day, in the morning and again in the evening. Before a cow is milked, its hindlegs, and sometimes its forelegs, are hobbled. The calf is untied from the calf rope and allowed to suckle for a while to stimulate the cow's milk flow. As soon as the milk comes, the calf is retied to the rope or to the mother's foreleg. It can also be simply guided away from the cow's udders with a stick; this depends on the habits of the individual cow. The woman milking the cow crouches near the animal, holding a calabash between her knees. After milking, the calf is once again released so that it can drink its fill of the remaining milk. Some herders take care that a heifer gets more milk than a young bull since it is said that the male is more resistant and stronger, thus requiring less milk. But for other herders all calves have the same value and are allowed the same amount of milk.

The bull

The WoDaaBe consider many desirable qualities in cattle to be hereditary. Paternal heritage is an important criterion in the choice of a bull; a good sire is said to "have a father". In WoDasBe genetics, four major qualities can be inherited: the color of the coat, the build of the body, character, and milking ability. The choice of a bull for breeding is thus based on both functional and aesthetic criteria, although the aesthetic criteria also contribute to the maintenance of a clearly defined race with functional advantages well understood by the WoDaaBe. The aesthetic criteria include qualities of the bull itself and of its ancestry. The following are the main aesthetic qualities of a good sire: it must be of Bororo ancestry; it must have a dark, even coat, the ideal being a bull which is rusty black in color; brown bulls which tend to become light are rejected; it must have a long pendulous navel, a slender head like a cow, a wide, long dewlap, long, widely spaced horns and a wide forehead; bulls whose horns bend backwards are rejected; it should have light-colored hairs at the end of its tail.

As or more important are the bull's functional qualities, chief among which is its ability to sire good milk cows. WoDaaBe genetics attributes the inheritance of good milking characteristics to the father, not the mother, and the WoDaaBe say that there are "milk" bulls and bulls "without milk", which show up in the milking qualities of the cows they engender.

An adult bull which has begun to mount its own daughters is removed from the herd in order to avoid problems resulting from inbreeding. In general the WoDaaBe try to prevent mating between parents and their offspring (heifer with its father and a bull with its mother). This type of union is called by the same word used to describe incest in human society. The reasons given against these unions are technical: weak offspring are likely

to be produced. In contrast, the most preferred union is that between full or half brothers and sisters, even if they share the same father or mother. This type of union is thought to reinforce the line and improve the breed.

Oxen

All bulls which have not been selected for reproduction are castrated, usually at between 2 and 3 years or age.[1] For the WoDaaBe, oxen are the "outstanding feature" of a herd, by far its most striking animals. The possession of oxen is a sign of wealth, of living capital. A large number of oxen facilitates the herder's work; since they are generally very docile and obey the herder's command, they lead the rest of the herd.

Oxen are mainly intended for sale. Some are chosen to become pack oxen which transport household luggage. They are also used at deep wells to raise the heavy water bucket for the rest of the herd.

A pack or draught ox is trained when it is very young; boys are entrusted with this task. A hole is made on the inside of the bull's nose through which a short cord is strung; a longer cord is tied to this to lead the ox. A number of factors determine the choice of a pack or draught ox: docility, sturdiness (it must be strong and have a back able to bear loads), patience. Preference is given to oxen with long horns. Failing this, oxen with short horns are chosen, since those with horns of medium length are likely to hurt the people who try to ride them.

Bororo versus Azawak cattle

The WoDaaBe are extremely fond of animals of "Bororo" stock (na'i BoDeeji, literally, red cattle). This is for emotional, cultural, aesthetic, economic and technical reasons.

---

1. Traditionally, the bull's ligaments are held between two sticks and crushed with the handle of an axe; there is a second method whereby the bull's testicles are crushed by tying a cord tightly around them.

The WoDaaBe say that the principal qualities of a Bororo animal are:

- woDDe; beauty
- ndimaaky; finesse and breed
- leeBre wo'ore; evenness of coat
- haynaare; it must stand out in the herd
- alkawal; fidelity or attachment to people or to the camp[1]

For a sire, the WoDaaBe choose by preference a Bororo bull. However, as far as cows are concerned, the ndellee (Azawak) is noted for certain important qualities: its remarkable resistance during the dry season, its ability to adapt to any kind of fodder (for example, trampled hay or hay of low quality found in the south). The Bororo cow is much more sensitive to seasonal changes and much more demanding with regard to pasture quality. In general, Azawak cows live longer. However, the WoDaaBe who own mixed herds unanimously agree that Bororo cows produce much more milk than Azawak cows: an Azawak cow cannot adequately feed a Bororo calf.[2]

Especially since the 1973 drought, WoDaaBe herds have contained substantial numbers of Azawak cows. This does not indicate a change in preference, but a necessity: Bororo cattle were very rare on the market after the drought. In any case, with good Bororo sires, they obtain a crossbreed (susanee) which is a highly valued cow, since it has the chief characteristics of both the Bororo and Azawak cows; with continued use of a Bororo sire, by the third or fourth generation a susanee becomes a Bororo.

---

1. The Bororo animals are called kiilniiDi (literally, animals which are attached to people and to the camp), while Azawaks are called duudooji (these animals display no particular attachment to anyone or anything). A thief, the WoDaaBe say, can steal a herd of Azawaks, but never a herd of Bororos.

2. An Azawak cow is barely able to feed a calf born of crossbreeding with a Bororo. This belief about the relative milk-producing abilities of Bororo and Azawak cows contradicts conventional wisdom based on research station data. It is possible that the explanation lies in a faulty experimental design: Bororo cattle herded under research station conditions do not do well, while Azawaka are not affected or even prosper.

Emotionally, every BoDaaDo is very attached to Bororo animals. For him, it is a way of reasserting his own BoDaaDo identity: it is his heritage, and is as important as his other traditions.

Sheep husbandry

Sheep (baali) are the main small ruminants raised by the WoDaaBe. They are generally bred for sale, not milk production, and are not normally milked. The WoDaaBe raise four breeds of sheep:

(a) The ngoraaji or Twareg sheep
(b) The pul-puli or FulBe sheep, which have white fleece and large ears.
(c) The Daakuuji, also called uudaaji, sheep whose fleece is a mixture of black and white.
(d) The konndooji, or wool sheep (uncommon and not highly prized).

The FulBe sheep are the most prized for their market value. They mature and increase in value very rapidly, and can be profitably sold after their first year of life. However their value decreases equally rapidly later in life. The castrated Twareg sheep, on the other hand, attain a very high commercial value from the third or fourth year of life.

The WoDaaBe distinguish sheep by sex and age as shown in table 4.2.4.

Table 4.2.4 WoDaaBe categories of sheep according to age, sex and number of lambings

Male	Age	Female	Age	Number of lambings
jawgel	0-4 months	bortel	0-4 months	-
njawdiri	5 months-1 year	mbortu	5 months-1 year	-
najwdiri caka-cakaari	1-3 years	kaabu	1-2 years	1-2
njawdiri gusummari	>3 years	cakaw (mbaalu)	2-3 years	3-5
		gusumaw (mbaalu)	4-5 years	6-7

The WoDaaBe sometimes graze their sheep separately from the cattle. In the course of the long journeys back and forth between the camp and water points, sheep do not move as quickly as cows and get tired trying to keep up. The separation of these herds requires attention and vigilance, especially at the end of the dry season. However, it is not always possible to separate the two herds because this entails a large work force. In this case, especially if the flock is small, an attempt is made to get the sheep to keep up with the cattle.

Sheep raising is particularly widespread among WoDaaBe groups living in the south of the project zone, for example, among the Gawwanko'en segment of the Gojanko'en and the Bii Korony'en to the north-west of In Tawila, and the east, especially in the Damergu.

The WoDaaBe try to control sheep reproduction by attaching the ram's penis with a cord to prevent intromission, until February. As a result most lambs are born during the rainy season.

Other animals

Goat raising is less widespread than that of sheep. Unlike sheep, goats are milked, and goat's milk is sometimes bartered mixed with cow's milk.

In this century, the WoDaaBe have been forced to diversify their herds. This is true not only as regards the partial adoption of Azawak cattle, but also with respect to the rearing of camels and donkeys. Camel raising is not widely practiced by the WoDaaBe. Male camels are found almost everywhere, mostly bought from Twareg, and are used to carry the baggage when camps move, and on other journeys. In contrast, female camels are raised only by a few groups, in particular the Cahidooji to the west of Tchin Tabaraden.

For matters related to camel husbandry, the WoDaaBe depend heavily on the Twareg to care for the camels, to train them for milking and to bleed them. However, young WoDaaBe increasingly train riding camels themselves.

The majority of WoDaaBe do not like and cannot properly digest camel's milk. However, those who raise camels greatly appreciate their milk, especially during the dry season. According to the WoDaaBe, their lactation cycle is not like that of cow's. The female camels give birth mainly during two periods of the year: korsol (late July) and dabbunde (the cold season between December and January). Mating depends on the bull camel, and takes place especially at the start of the rains between May and July and in October; the female camel's gestation period lasts 12 months (the WoDaaBe count camel gestation as 13-14 lunar months), and the calves are born either at the start of the following rainy season, or the following October. Because of this, their long lactation period, and their reliance on browse which is more abundsnt than grass in the dry season, camels tend to produce more milk in the dry season than cattle.

Table 4.2.5 gives the WoDaaBe camel terminology by age, sex and number of calvings.

Table 4.2.5 WoDaaBe categories of camels according to age, sex and number of calvings

Males	Age (years)	Females	Number of calvings
molel gorel	0-1	molel dewel	-
mola ngora	2-3	mola ndewa	-
asakaawa	3-5	ndikka	1
amaleeri	6-9	kaaba	2-3
amal caka-cakaari	9-12	ngelooba gusumawa	4-6
am gujumaari	>12	ngelooba gusumawa	> 6 calvings

Donkey-raising has only been recently adopted by the WoDaaBe, but for journeys and for carrying water they have progressively replaced draught

oxen. The majority of males are castrated early. Females breed between 3 and 12 years of age.

Herd management

During the rainy season

During the rainy season, that is during the period when the range is covered with green grass and the ponds are full of water, the major concern of the BoDaaDo herder is to vary the kind of pasture eaten by his herd. Camp mobility becomes a herd management tactic of great importance, due to the differences in quality and quantity of pasture from one area to another.

During the rainy season, a good herder constantly changes grazing area, moving continuously between the sandy soils of the hills, where particular grass species grow, and the clay soils of the plains where different equally valuable fodder species grow.[1]

During the first part of the rainy season, the BoDaaDo herder tends to choose the clay soils of the plains. The pasture there is palatable and nutritious, and water is in abundance. The animals can drink small amounts of water throughout the day. WoDaaBe herdsmen believe that this method of drinking while grazing is extremely beneficial to animals' health (it is said that it increases the volume of water in the animals' bloodstream). However, this strategy varies from one region to another; a constraint is the lack of basins in which rain water can collect. The lack of such basins is considered a serious problem in several regions.

At the beginning of the new rainy season, the WoDaaBe move very frequently in search of short, soft grass, which is considered very nourishing for the animals. The search for this grass is responsible to a large extent for the long journeys to the north, where the rainy season

---

1. Among particularly prized plants growing on the sandy soils, the WoDaaBe cite Schoenefeldia gracilis and Sporobolus festivus; on the clay plains, follere (possibly Triumfetta pentandra) and Peristrophe bicalcyculata. (All plant identifications in this chapter from WoDaaBe names, using the key in Peyre de Fabregues 1979).

begins later than in the south. In the south, the grass grows quickly and loses, according to the herder, its taste and nutritional value.

During the rainy season, the herders try to make best use of the abundance of water by making the animals drink every day and, if possible, several times a day. In the morning they are allowed to drink once, at midday they are made to drink again, and they are sometimes "shown the water" a third time in the late afternoon.

All of this care causes the lactation of milk cows to increase: their milk is abundant, "very liquid" and does not yield much butter. During this period, some cows can be milked up to three times a day (especially cows which have recently calved), although a cow with a young calf, especially a female, is not generally milked too much. In the evening, the same animal can sometimes be milked twice consecutively; the milk from this additional milking is very rich and nutritious.

During the dry season

At the end of the rainy season, especially when the camps move near the wells, the work changes significantly. A BoDaaDo herder's choice of camp site is determined then by three main criteria:

- habit, and familiarity with a given region. He considers it his ngenndi (his homeland), his lesdi (his country), his usual base;

- the abundance and quality of pastures. Areas are chosen where the dry hay is not too high and where the twigs are supple. The WoDaaBe avoid pastures where the grass is too high: they also move away from areas where the grass has practically not grown at all;

- the abundance and quality of water. The WoDaaBe pay special attention to the "capacities" of the water in the ponds, wells or bore holes. They know that particular water qualities can stimulate or prevent normal lactation. It is also said that water directly affects the fertility of the animals and their weight gain. The bitter water of some ponds and wells, said to be "capable", is particularly prized.

These criteria are important from the end of the rains until after the cold season. However, with the arrival of the dry season around February-March, and the difficulty of finding enough water and pasture, the herder knows that he must adapt his requirements to new circumstances and that it is up to each individual to judge which aspect should be stressed. Some prefer to remain in their region, near the wells, even if the pastures are not good; others choose good pasture near an abundant source of water. It is especially at this time of year that the herd is divided.

At the end of the dry season, towards the end of April, it is common to see the WoDaaBe return to the tall rank pastures or bare areas which were left untouched at the beginning of the season. During the dry season, when the herds move near the wells, the animals are watered every two days, alternating a watering day with a day in the pastures.

The need for salt

Animals have an urgent need for salt. The WoDaaBe use different words to describe this craving for salt, which is quite intense particularly from July until December-January, that is, throughout the time of year when pasture is abundant and the herd has a better diet and more water. At the beginning of the rainy season, the WoDaaBe look for salt at market for their livestock. There are different types of salt, whose value and price vary from region to region. The most common is coarse cooking salt (bought in small sacks of 20 kg each) purchased not for its nutritional value, but for its relatively low price. It is nevertheless thought that this salt is dangerous, because it is very strong, "hot", because it "burns the animals" and "penetrates their bones". It is also said that it might be a cause of night blindness.

From July until January animals are given salt in regular doses. They are given salt near a pond so that, as soon as they eat it, they can drink large amounts of water; however, despite these precautions, there are often accidents, which are sometimes fatal.

According to one BoDaaDo of the Cahidooji to the west of Tchin Tabaraden, the cows need salt primarily at the beginning of the rainy season (from the time the animals begin to eat enough new grass) and the cold season. He thinks that 4 kg per cow per year is adequate salt intake. In his view, this amount should be given as follows:

- the first dose in mid-July when the animals have already started to eat fresh grass;
- the second two weeks afterwards;
- the third 20 days later;
- the fourth dose immediately after the last rains, when the pastures have begun to dry up;
- the fifth and last dose at the beginning of the cold season (mid-December).

Cattle are not usually given salt during the hot dry season. According to the same person, who also raises camels, the quantity of salt needed for camels is much greater than that for cattle. Roughly 10 kg of salt are needed per year to sustain a camel; this salt is given throughout the year.

During the rainy season herders try to take their animals to the salt-licks. They are found in many regions with varying grades of salt. The best and most sought after are far to the north and the herds cannot always reach them. Before the 1973 drought, groups of Yaamanko'en and Bii Korony'en from the Ichin Tabaraden, In Waggar, Tamaya areas, would go as far as the salt areas north of Ingal. However, today they no longer go there, saying that there is little rainfall and good pastures are scarce. Some groups of Bii Nga'en and Bii Korony'en who spend the dry season in Ingal itself still take their herds to these salt-licks.

Animals which "crave salt" are very nervous; they do not graze very much, but wander about, often near the camp, closely watching the movements of their herder, waiting to be given salt. They lose a great deal of weight. Sometimes motivated by this intense craving, they eat large quantities of slightly salty earth from ant-hills, or the bitter earth of some clay plains, which often causes fatal accidents through obstruction of the gut. Salty plants, especially Ipomea acanthorcarpa and follere (possibly Triumfetta pentandra), can meet the animals' salt needs, but are now becoming very rare.

Improving herd fertility

In order to increase the fertility of his herd, every BoDaaDo herder gives his animals salt mixed with wheat, date pits, and pits from the fruit of the tree Lawsonia inermis. These seeds and pits have a common characteristic: they represent the external form of the female sexual organ, and the name of this practice, rewo, is derived from the word which describes the condition of being female. The aim of rewo is to increase the number of cattle and other animals in the herd through frequent calvings. Rewo is aimed especially at the sire who is served apart from the other animals and is allowed to eat as much as he wants. When the sire is satisfied, the rest of the rewo is given to the females.

Whether considered a pastoral technique, (which would depend on an analysis of the nutritional value of the supplement given to the animals), or a symbolic fertility rite, the rewo is a major concern of every BoDaaDo herder interested in the fertility and health of his herd.

A day in the life of a herder and his herd

A good herder spends a considerable part of his day and sometimes part of the night grazing and watering his animals. In the morning, after milking, the herdsman leads the entire herd, including young calves, out towards pasture. Returning to the camp, he separates the young calves from their mothers (it is said that he "makes the calves camp"), and takes the adult animals to graze; at the end of the dry season this may be as far as 10 km from the camp. In the later part of the morning, when it is very hot, the herder lets his animals rest in the shade, if possible, near a copse; this is the hour of rest, a "return to the shade".

At the beginning of the afternoon, the herder once again leads his animals to pasture, where they graze until late afternoon. They return to camp before sundown. The calves, which have been tied to the rope before their mothers' arrival, are now released one by one, so that they can suckle their mothers. After milking, the calves are once again tied to the rope and remain there all night. The cows stay in their place in front of the camp, but during the night they may go off alone and graze.

On watering day this pattern is broken. After the calves have been separated from the rest of the herd in the morning, the herd goes to the well. The herder waters them upon arrival and then once again before they return to the camp around sundown. On watering day, the herd grazes mostly at night. But this pattern varies according to the region and the herders; often those who do not have private wells are obliged to water their herds at night.

The daily activities described above are typical of a day when the camp does not move. The day the camp moves, the calves are immediately taken to the new camp site, and the rest of the camp (the women and the baggage) follows during the morning, after the cows have left for the pastures.

Gestation

Estrus and covering

When a cow is in heat for a whole week, the bull follows it about. After a week, if the cow consents, the bull covers her. The average estrus cycle, according to the WoDaaBe, is two to three weeks long (20 days), although there are cows with longer and shorter cycles.

What a herder expects most of a cow is fertility. For this reason a cow with a short estrus cycle is highly valued. With such a cow, when estrus starts again after calving, the bull is never prevented from covering her, even if she is feeding a young calf. As soon as it is certain that the cow is pregnant, the calf is "released behind her," that is, the cow is no longer milked and the calf is allowed to drink all the available milk, until lactation ceases.

The WoDaaBee do not try to control the season of cattle reproduction, although they think that calving at the end of the rainy season makes the cow lose a considerable amount of weight during the following dry season.

A cow which, despite a regular estrus cycle and previous normal calvings, does not become pregnant, is called by a special name. The BoDaaDo herder finds this phenomenon very disturbing. It is feared that as

time goes by, the cow will end up not coming into estrus at all. On the first signs of sterility, the herder tries traditional ritual practices, and also supplements its feed with sorghum. A cow which does not conceive for two years is considered sterile and is removed from the herd.

For the WoDaaBe there are several causes of sterility in cows. It may be due to nature; the animal is simply sterile just as another one has long horns or an even coat. But it is believed that the little nerves on the tongue are often the cause of sterility; therefore, these are removed, even if the cow regularly goes into heat. The WoDaaBe believe that these nerves prevent the animal from grazing normally. In removing them, though, care must be taken that none of them are swallowed by the cow, otherwise it will be sterile forever. A cow may also become sterile after one or more abortions. It is also generally said that a heifer which is the twin of a bull may become sterile if its twin leaves the herd.

Accidents during gestation

Several accidents, varying in seriousness, may occur during gestation. The most serious of these is abortion. The WoDaaBe make a distinction between abortion proper (wuftere) and the simple death of the embryo when the fetus is less than one month old (pallangel).

Abortion proper may be caused by several factors. When it seems that one of his cows is likely to miscarry, the first reflex of a BoDaaDo is to think that a tabu of the family or segment has not been observed and that the misfortune is a logical consequence. However, abortion may also be due to accidents such as sudden falls or gorings. The WoDaaBe do not link abortion to specific illnesses. When direct intervention is judged useful a herder will give a mixture of salt and pounded fruits from the rima-jogohi tree (Crotolaria podocarpa) to the animal which has aborted or which is likely to abort. To a cow which has aborted, the WoDaaBe give a drink made of pounded branches of the siifahi tree (unidentified). A cow which has had three or four consecutive abortions is usually sold. However, it is thought that one or two consecutive abortions do not prevent a cow from reaching the full term of a subsequent gestation.

Abortion proper is considered to be an actual calving, even if the fetus is only two or three months old. In the traditional haBBanae system of lending cows, a wuftere abortion is included among the three calvings allowed the borrower while a pallangel early embryo death is not considered.

Another less serious accident during gestation is uterine prolapse, when part of the womb slips out of place. In this case, the WoDaaBe prepare a remedy using sudda-esahi (unidentified) and hot pepper. This is mixed with water, then forced into the animal's rectum. After a cow prone to uterine prolapse calves, the herder closely monitors the return of the uterus to its normal position after the placenta has been expelled.

For a cow at an advanced stage of gestation, another problem which frequently occurs is congestion of the udder. In the WoDaaBe opinion, however, this is not an illness but a simple physiological condition of an animal about to calve. But this can also occur under other circumstances: a cow which is with calf or lactating may develop this condition if it moves to pastures richer than the ones to which it is accustomed, or if it is given a large dose of salt after a long period without. In some cases this swelling of the udder may reach the limbs. Normally, the entire udder is affected, but sometimes there is congestion in only one part. The WoDaaBe treat this congestion by rubbing the udder with a mixture of cream and the ashes of a bird's nest made of kapok.

At a very advanced stage of gestation, another complication may arise. The "cow which is in a hurry" drops its calf long before calving is due and this premature birth, probably due to a brucellus abortion, inevitably means the calf's death.

Detecting pregnancy

For a heifer calving for the first time, the WoDaaBe identify a sure sign of gestation towards the fifth month: for a short time (from a few days up to one month) the heifer's udder slightly increases in size. This condition is observed again just before calving. For an adult cow, it is not until the seventh month that pregnancy can be confirmed, by a bump in the abdomen indicating the presence of a calf.

A sharp decrease in milk production can also be an indirect sign of gestation. According to the WoDaaBe, this is true especially after the third month for cows which had shown signs of being in heat. Very often from the fifth or sixth month of gestation, the pregnant cow forcibly weans its suckling calf.

In contrast to what is done for ewes and female goats, the WoDaaBe do not palpate the abdomen of cows to detect gestation.

Care of the cow during gestation

Only the heifer calving for the first time receives special care during gestation. Throughout the last month before calving, its udders are washed and massaged regularly. It is said that this makes the heifer get used to being touched and prevents it refusing to suckle its new-born calf, or to be milked.

Special attention is paid to a cow about to calve which is still nursing another calf. In extreme cases, there are cows whose milk has not dried up completely within two months of the new calving. In order to preserve the cow's strength for the next calving, the WoDaaBe dry up the milk, most commonly by separating the calf from its mother and taking it to another herd. The herder may also pierce the nostrils of the calf and insert a small pointed stick; when the calf gets close to its mother, it pricks its udders with the stick and the mother responds by kicking it away violently. The herder may also rub excrement on the teats every day, which reduces the calf's appetite.

Calving

Pre-calving signs

Changes in the udder's appearance are the surest way for the WoDaaBe to know that the cow is about to calve. It is said at that time that the cow "is making an udder" or that it has "released its udder". Other more accurate physiological signs are also observed: the vulva of the cow swells, becomes visible, soft and wrinkled and starts to hang. The animal

stretches continually, raising its tail as if to urinate and its whole body moves involuntarily. The WoDaaBe say that on the eve of calving, the ligaments which hold the sacrum and the tail together "break": they become very supple and move. This is an unmistakeble sign that calving is imminent.

Another sign is that the animal become fretful and anxious: it constantly tries to leave the herd, to go off alone into the bush. It is generally said that the anxiety of a cow which is going to drop a male calf is stronger and more violent than that of a cow which is going to have a female. The cows feels a pressing need to leave the herd, and the herder has to pay twice as much attention as he normally would to prevent her.

Birth complications

Apart from abortion the most dangerous birth complication is an abnormal position of the calf. In the commonest case, the head is inclined backwards and does not follow the movement of the descending hooves. The WoDaaBe know that if they are not to lose the calf, they have to intervene rapidly and remove it. They try to grasp the calf's jaw, attaching a cord to it and pulling gently. Throughout the operation, the cow remains lying down. There can also be an abnormal position of the pelvic girdle or the limbs. The WoDaaBe know that this is particularly dangerous for the calf.

The neck of the womb is sometimes too narrow to allow the passage of the calf. If the vagina is not torn under the pressure of contractions, the herder himself cuts the cervix with a razor blade. Generally speaking, any difficult and painful expulsion of the calf will cause discomfort: the cow may lose a considerable amount of blood mixed with pus, and its vulva may become black. However, herders do not consider these complications serious. But after a difficult delivery, some cows become sterile; this is especially the case with cows whose calves die in utero and are not immediately expelled.

Another possible mishap is the birth of a calf with major physical deformities. The cause is unknown; it is said that it could result from a dreadful fright which the cow had during gestation. Cows with major

deformities are simply abandoned. Unless the mother can be made to adopt another calf an attempt is made to keep less deformed calves until they are weaned in order to keep the mother in lactation.

After calving, another complication can arise from non-expulsion of the afterbirth. When this happens, the WoDaaBe give the cow a drink made of pounded fruits from the siifahi tree (unidentified).

The calving season

The majority of births take place during the rainy season, particularly in July. According to the WoDaaBe, this is by far the best period because the calf is born at a time of year when the mothers' milk production is abundant and regular. Births occurring during the late dry season (May) are also liked because the good season is near.

In contrast, the births occurring during Yaawol (October-November) are not welcomed. Mothers lose a great deal of weight throughout the subsequent dry season, and since calves do not benefit from normal lactation, they do not grow well. However, it is thought that in favorable circumstances (abundant pasture, proximity of water), births at the end of the rainy season make possible a rapid increase in the herd, since cows which drop a calf during Yaawol have a good chance of becoming pregnant again during the next rainy season.

Care of the new born

As soon as the calf is born, it must be picked up by its hind legs so that fragments of the afterbirth can be expelled from the nostrils. If the calf begins to struggle violently and drag itself about on the ground or shake its ears, this is an indication that it will begin to breathe normally. The WoDaaBe also often blow into its nostrils to help open the respiratory tract.

The WoDaaBe believe it very important that the cow licks its calf immediately after birth. The cow should lick until the calf is completely dry. This is essential to prepare the cow for suckling. If the

cow refuses to lick its calf, the WoDaaBe resort to "magical" practices. An expert is called in, who knows the magical words; while uttering these sayings, he blows and spits into the cow's ears, nostrils, mouth and anus.

If this is ineffective, the WoDaaBe inflict severe physical pain on the cow to overcome its stubborness and refusal to lick its calf. Rolled-up rags and leaves are inserted into the cow's vulva. The animal becomes crazed with pain; when the rags and leaves are removed it eventually calms down and licks the calf.

Some cows obstinately refuse to accept their calf, even if they have already licked and cleaned them. The cow does not take care of the calf or allow it to suckle. In such a case, the herder raises the cow's tail, blows into its vagina. The aim is to change the cow's attitude by inflicting pain on it; this is also practiced to stimulate the milk flow of a cow after the death of its calf. If the cow finally accepts its calf, the herder helps the new-born to stand up and holds it up to suckle its mother.

If the cow still refuses its calf, an attempt is made to have the calf adopted by another cow which is still lactating. Usually the cow which is chosen is a good milker and is docile and calm. Even so, sometimes at the beginning its horns have to be held while the calf is suckling, in order for it to get accustomed to the calf. If the new-born is female, the WoDaaBe always try to make another cow adopt it. If the calf is male, it is left to die or it is slaughtered reluctantly. There are animals which, at every new calving, refuse their calves. In general, once this has happened two or three times, such an animal is sold.

If the calf dies shortly after birth the WoDaaBe try to get the mother of the dead calf used to being suckled by another calf, in order to keep her in lactation. In order to do this, the WoDaaBe make another calf wear the skin of the dead calf. The mother smells the skin of its own calf and allows the new calf to suckle. The cow's milk flow is stimulated, the calf is removed and the herder is able to milk the cow. In cases when the cow

continues to resist the herder blows into its vagina as described above. However, some cows are very docile and can be milked directly, after their udders have been simply massaged.

In general, the WoDaaBe try to milk cows after the birth of a calf, however much the cow resists. It is thought that if the cow is not milked it could become ill or lose weight.

The WoDaaBe consider it important for a young calf to drink its mother's colostrum from the first day of life. The colostrum is a thick, heavy milk, brownish in colour. The calf is allowed to suckle when it wants. During its first weeks of life, the calf usually suffers from diarrhoea. This diarrhoea is not considered harmful; rather it is seen as a sign that the animal is satisfied and is in good health. If the calf does not have diarrhoea, it is thought that the mother is not a good milker or that its milk is not good. Young calves which have been well-fed on their mothers' colostrum are valued for their beauty.

When the calf is full, the remaining colostrum is milked from the cow and cooked with butter and salt as a treat for children. The colostrum is also mixed with ordinary milk to make a brownish butter which is liked.

The WoDaaBe begin to milk cows one week after calving. A heifer which has calved for the first time may be milked four days after calving.

Main forage plants

WoDaaBe herders possess a detailed knowledge of the grazing and medicinal values of plants; for them, plants also have magical values.

The WoDaaBe distinguish between several stages in plant growth and development; at each stage the plant has different characteristics. Animals respond differently to each plant at each stage of its vegetative cycle. Animals do not derive much benefit from grazing on newly germinated plants at the very beginning of the rainy season, but they are well-nourished during the following stage, when the plants begin to grow. Animals derive even greater nutritive value from the plant when it is in full bloom and begins to seed. There are several phases of this period,

based on the growth of the plant and, especially, the animals' response to it. The final stage of the vegetative cycle is ramification or "subdivision" of the plant which has reached maturity. After the plant reaches maturity, it dries up, as a result of the progressive loss of humidity in the soil. After this point, the WoDaaBe no longer talk of "grass", but "hay".

Every plant has its own vegetative cycle which varies in length. At every stage in its development, each forage plant has its own characteristics and its own properties. According to the WoDaaBe, these properties have a direct effect on the quality and quantity of the herd's milk production and also on the ease with which the animals gain weight. In the words of WoDaaBe herders, a good forage plant directly increases the strength of an animal because it increases the quantity and improves the quality of the marrow (busam) in which the sturdiness and the robustness of an animal reside.

Plants are categorized according to the type of soil in which they grow and in which they are best able to flourish. In this respect the WoDaaBe differentiate between plants which grow on clay soils with swampy basins and ponds, on the main plains and plateaux, and on sandy dune soils.

According to the WoDaaBe, variable rainfall can cause changes in species mix in a given region from one year to the next. This can be clearly seen with regard to the alternation of two major species: Schoenefeldia gracilis which needs regular rainfall at long intervals and is unable to withstand long periods without rainfall, and Cenchrus biflorus which is much more resistant and tends to grow more during years of scanty rainfall.

With regard to palatibility and nutritive value, the WoDaaBe consider Sporobolus festivus and Andropogon gayanus best for cattle, followed by Ipomea acanthocarpa, Triumfetta pentandra (? - follere), Aristida funiculata and Citrullus lanata. For camels, Acacia lacta, Blepharis linariifolia and Leptadenia hastata are judged best. For a full list of forage plants with the WoDaaBe judgement of their merits, see Maliki (1981).

Main diseases of livestock

The WoDaaBe identify and diagnose a large number of diseases affecting their livestock. Among the diseases there are serious and fatal ones, dangerous ones and simple illnesses. Diseases have causes. However, a real disease, unlike all kinds of "ills" (transgression of a tabu or witchcraft) has no real explanation. It is quite simply a disease.

The WoDaaBe treat some diseases with techniques which are more of a pharmaceutical than a "magical" nature, although there is a thin line between these for the BoDaaDo. One of the most frequent treatments is burning. Other treatments including scarring, bleeding, incisions or the use of ointments, with powders and pomade made from roots, barks or fruits.

As with human diseases, the diseases affecting livestock are divided into two groups: "hot" diseases and "cold" diseases. The former are the most dangerous and usually the most serious: the animal stops grazing entirely, their bodies are "on fire" and they die very quickly. If the animal begins to graze again, it will recover. "Cold" diseases do not prevent the animal from grazing, but they derive no benefit from their food and lose weight. Contagious diseases such as rinderpest and anthrax are placed in a separate category. The sick animal is removed from the herd and placed in a pen where it is given water and fodder until it has completely recovered.

The WoDsaBe do not make any specific connection between diseases and seasons. Only a particular rainy season fever, bloat and calves' diarrhea are linked to the season. The other diseases may afflict the animals at any time of the year.

Among the cattle diseases and other health problems which are well recognized, described and named by the WoDaaBe are anthrax, blackleg, streptothricosis, foot rot, various types of abscess, various types of diarrhea, night blindness (for which the cause is correctly identified), bloat, mastitis, contageous bovine pleuropneumonia (for which an effective traditional vaccination technique exists), foot and mouth, rinderpest and ricketts. A full list of animal diseeses and treatments, as seen by the WoDaaBe, is contained in Maliki (1981).

SOCIAL ORGANIZATION AND PRODUCTION

WoDaaBe society is organized into groups whose members can trace their kinship to a putative common ancestor. These lineages are called leYYi (s. lenyol).[1] Male and female children belong to their father's lenyol. In reality the definition of a lenyol is fluid and changes over time. For example groups can move away from their original lenyol and be incorporated into another lenyol as a result of intermarriage and long use of the same pasture and water. The members of a lenyol often use the same general dry and wet season pastures, but habitually do not make common decisions about resource use or economic activities.

LeYYi are subdivided into segments known as taare (s. taarde). Although taare are now sometimes the main administratively-recognised unit, and thus have an administratively-appointed chief, they perform few direct resource management functions. The taarde however has a group responsibility for some redistribution of animal wealth to ensure the economic viability of its component household units. The taarde is also an important level for social interaction. At the end of the rainy season members of the same taarde celebrate their annual worso ceremony at which animals are slaughtered for the name-giving ceremonies of children born or for marriages contracted during the past year. The meat of the animals slaughtered is shared among all the members of the taarde. The importance attached to the solidarity of the taarde is illustrated by the fact that a household's absence from the worso of its taarde either indicates a serious dispute, or is the start of the process of fission by which a new taarde is formed.

---

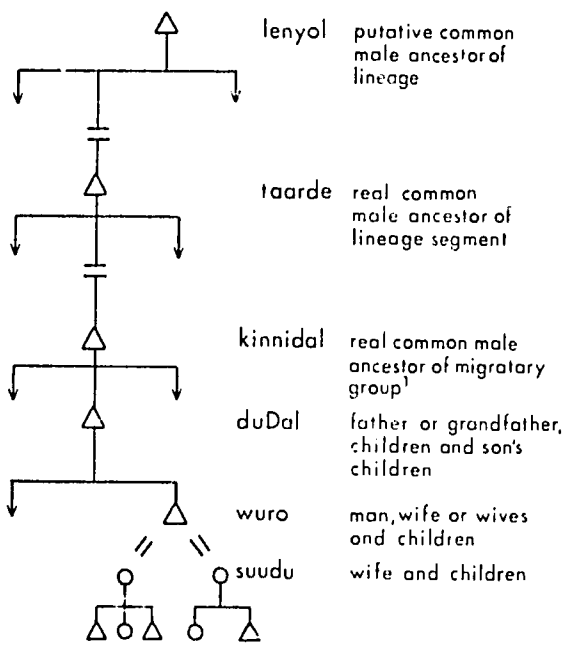
1. The notion of lenyol, and other words used by the WoDaaBe to designate particular levels in the social structure, is almost as flexible as the social structure itself. Lenyol is used simultaneously to designate the maximal lineage (of which there are two in Niger : Degereeji and Alijam), the group with a more or less mythical common ancestor, and the group which maintains real social relationships. Similarly the terms wuro, duDal and taarde are all used at times in place of each other, perhaps from a sense that indeed wuro evolves into duDal, duDal into taarde, and so on. The use of these terms here as defined in the next three pages should not be read to imply a more formal and rigid terminology than the WoDaaBe themselves use.

Taare are further subdivided into migratory groups (hinnideyBe or kinnidal). The migratory group may over a time incorporate by marriage unrelated households which use the same dry season pasture and water. This migratory group has more significance for decision-making and resource use than any higher unit in WoDaaBe society, particularly in the rainy season when more abundant pasture and water allow greater concentrations of animals and people, and more concerted actions. This is reflected in the fact that the kinnidal has a traditional leader (arDo), and a rainy season pasture scout (garsoo or cewtoo). Members of the same migratory group gradually gather together in the same area at the beginning of the rainy season, and consult about camp movements. By contrast to the dry season, when the migratory group shares a common pasture area (ngenndi) but individual households make their own decisions about movement, in the rainy season migratory group members tend to migrate together. The rainy season kinnal meeting, composed of the adult herd-owning heads of households of the whole kinnidal, consults together about the group's rainy season movement, based on the recommendations of the pasture scout. The rainy season kinnal also discusses and settles disputes between migratory group members which have arisen during the preceeding year concerning such issues as marriages, inheritance and disregard of social prohibitions. The function of the leader of each kinnidal is to help the group reach a consensus, to use his prestige to implement decisions reached at the kinnal, and to represent the migratory group to outsiders. The leader of the kinnidal is sometimes now appointed as an administrative chief.

Migratory groups are composed of duDe (s. duDal), the lowest structural unit in WoDaaBe society above the level of the household. A duDal is composed of the sons of a same father with their children and their son's children. Women who marry outside their duDal remain members even though they reside with their husband's duDal, and women who marry into a duDal do not become members of it although their children do. In the rainy season members of the duDal ideally camp and move together; in the dry season, where traditional wells are jointly owned, or shallow sand wells are jointly dug and cleaned, and watering is carried out on alternative days, cooperation is generally between members of the same duDal. At any time of year, a camp composed of more than one household is likely to be made up of members of the same duDal; cooperation between households in herd management and domestic tasks is most likely to take place within the duDal.

The wuro (pl. gure) is the minimum unit of WoDaaBe social organisation, composed of a man and his wife or wives and children. It is both a residential unit and the level of herd management. Ideally it consititutes an autonomous production and herd management unit; the members of a wuro depend on a single herd for their subsistance although animals are individually owned by members of the wuro. A wuro is composed of one or more cuuDi (s. suudu), which designates both the brushwood shelter each wife constructs and in which she lives, cooks and raises her children, and also the cleavage between children of one father and different mothers.

Figure 4.2.1 depicts these various levels of social organization in WoDaaBe society.



1 The migratory group sometimes also includes unrelated households

Figure 4.2.1 Levels of social organization in WoDaaBe society

It should be noted that the WoDaaBe social structure described above, which effectively organises most aspects of WoDaaBe economy and society, bears little relationship to the administrative structure through which the government classifies and attempts to administer the WoDaaBe. The administrative model, borrowed from Twareg society, assigns the WoDaaBe to "fractions" (which may correspond to the taarde, kinnidal or even duDal), each with its own chief ("arDo"); at a higher administrative level these fractions are joined together in "groupements" which are either mainly WoDaaBe or are put under the sedentary FulBe chiefs of the agricultural zone.

Households, camps and production units

It is easy to pass a WoDaaBe camp in the bush and mistake it for a disorderly pile of branches. Its material components are limited; there are normally no huts or tents. However the layout of the elements (shown in figure 4.2.2) that make up the camp and its conceptual arrangement are strictly defined and related to many aspects of WoDaaBe thought and behaviour. The suudu is the woman's space, from which certain categories of relatives and all outsiders are excluded. Conceptually it is defined as a circle opening to the west. Sometimes, particularly in the rainy season when a household is moving camp almost daily, it is physically defined only by a few branches laid down to the east, behind the bed and table on which the household utensils are kept. At other times, most often during the cold dry season when protection is needed from the wind and camps stay longer in one place, the branches can be built up higher and the circle completely closed except for an entry. The woman can also define this area by cleaning the space within it, removing grass and sweeping it clear.[1]

---

1. Practices vary between groups and individuals. Some women are known for constructing more elaborate cuuDi, and in some lineages tents can occasionally be set up or small huts constructed by tying mats over bent branches. When passing an abandoned suudu in the bush a BoDaaDo can usually identify by its form the lineage of the builder and the season in which it was built.

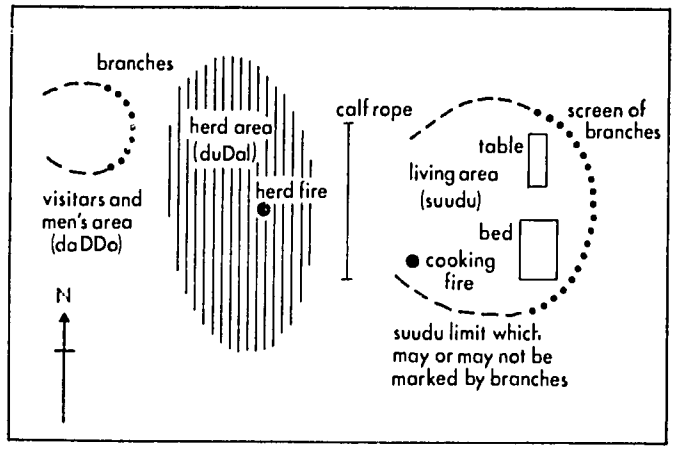


Figure 4.2.2 Layout of WoDaaBe suudu

The calf rope is always pegged down in a north-south direction directly to the west of the suudu, and when the herd gathers for the night it is in the area called the duDal to the west of the calf rope. During the rainy season a fire is lit in the middle of the duDal around which the cattle gather.

Particularly during the rainy season when several families camp together, or whenever there are visitors, the men eat together in the daDDo, an area to the west of the duDal. This may be formed by a small screen of branches opening to the west, or may have no physical definition other than the shade of a tree.

When a man has more than one wife who has a suudu, the cuuDi are arranged in order of the wives' precedence from north to south. The koobgal or betrothed wife, has seniority over the te'gal wife who is married by mutual consent as an adult, and if there is more than one of them, the te'gal wives' precedence is determined by the chronological order in which they were married. When a camp (hoDorde, pl. koDolle) is composed of more than one man who has a wife with a suudu, the cuuDi are aligned in a north-south direction with those of the senior man to the south. Seniority is determined by kinship, not by age. Figures 4.2.3 and 4.2.4 illustrate these two cases.

Men whose wives have not yet constructed a suudu and women with no suudu of their own have no defined living area of their own and at night simply take a mat and sleep nearby.

The physical appearance of the camp is thus rudimentary. However strict rules and prohibitions are attached to its arrangements and people's movements around it (for example the calf rope cannot be stepped over except by certain categories of relatives, women must approach the daDDo from the south), and the sociological structure of the group can be read from the arrangment of its components.

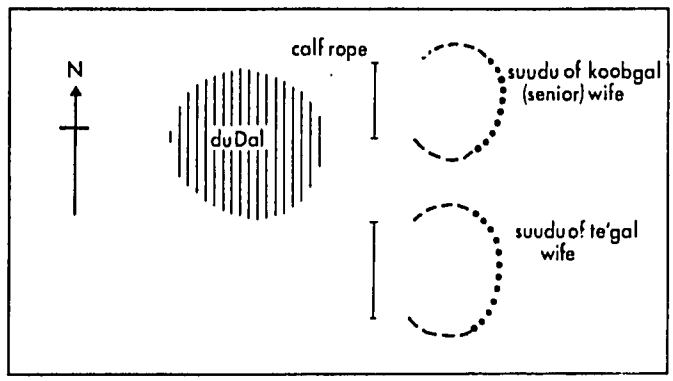


Figure 4.2.3 Layout of WoDaaBe camp of a man with two wives

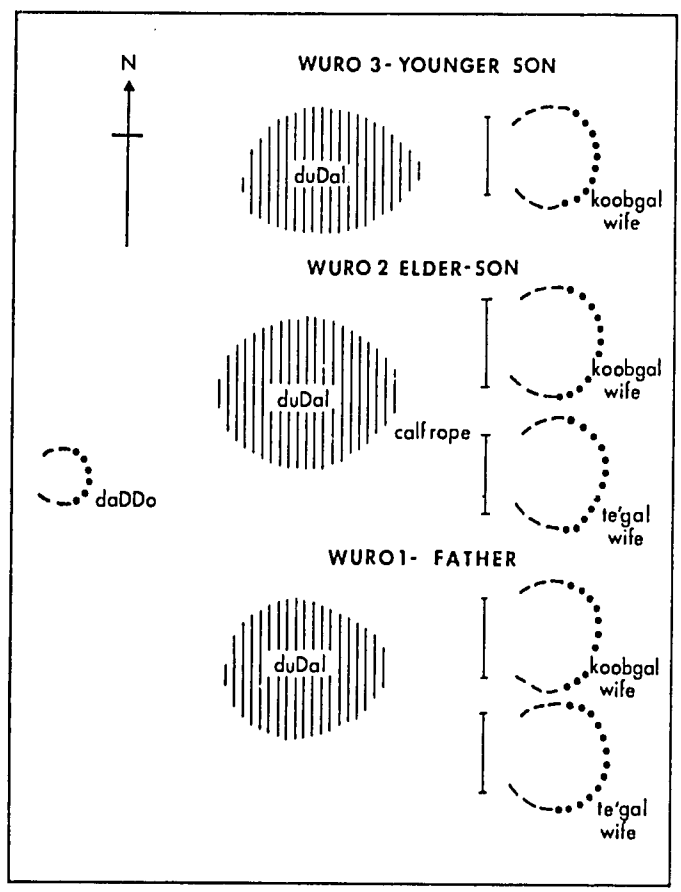


Figure 4.2.4 Layout of WoDaaBe camp of several households

The basic social unit, the wuro, consisting of a man, his wife or wives (each with her suudu) and children, is the ideal economic production unit in WoDaaBe society. However at the beginning and the end of the domestic cycle, or because of insufficient labor due to other circumstances, or animal losses, several gure may combine to form a common camp (hoDorde) in order to overcome unviability through cooperation. Viable individual units also sometimes camp together to form a hoDorde.[1] In this case each wuro maintains its animals in a separate herd, and they are watered and pastured separately.[2]

However there is often cooperation within a common camp. For example, one member will water the herd of another while the latter is away at market. There is consultation between the different herd owners of a camp about camp movements. The men of a camp eat together in one daDDo to which the women of individual households bring their contributions to the meal shared by the men. In the dry season if shallow wells are used, members of a camp cooperate in well-digging and cleaning, and water their herds on alternate days at the same wells. The most usual arrangement for common residence is that of a father with his sons, or brothers, or, less frequently, paternal cousins. Members of a camp usually belong to the same duDal.

Residence patterns and the level of cooperation between units vary considerably according to season. In the rainy season more abundant pasture and water allow greater concentrations of animals and people. Members of the same fraction (or taarde, the sub-group of the lineage), who have been scattered in separate camps during the dry season, move more closely together, and the number of households in each camp increases. Milk production is at its maximum at this period and this as well as the proximity of camps increases the circulation of milk between households through a series of exchanges, called baDal.

---

1. The term hoDorde means simply camp and has no social organizational implications like suudu or wuro. In theory a wuro with one or two cuuDi constitutes as much a hoDorde as a large rainy season gathering of many gure.

2. In the following text, the terms "shelter", "household" and "camp" will be used to translate the WoDaaBe concepts of suudu, wuro and hoDorde respectively.

However, labor demands during the rainy season are somewhat reduced, and the increased proximity of camps and consultation between camps of the same migratory group during the rainy season does not necessarily lead to increased cooperation between households with respect to work. Each herd continues to be pastured separately, even during the worso. The rainy season gatherings do represent, however, the cohesiveness of the patrilineal group upon which its members can rely for animals to establish or reestablish the autonomy and viability of individual households.

Marriage

There are three forms of marriage among the WoDaaBe. Marriage by betrothal (koobgal) is arranged in infancy for all WoDaaBe children, preferably within the duDal, and ideally between the children of brothers. Marriage between adults (te'gal) arranged by the spouses themselves should in theory take place only between members of different leYYi. Te'gal marriages are always the source of tension because they involve a women and her potential children leaving the husband to whom she was betrothed as a child; the husband and his group resent this loss. Because te'gal marriages usually cause hostility that disrupts group solidarity, such marriages are prohibited within the taarde and strongly discouraged within the lenyol. The WoDaaBe also practice widow inheritance, ba'atal, the marriage by a man of his dead brother's widow.

Animal ownership

Animal ownership among the WoDaaBe is in most senses individual. Only when a child is still entirely dependent on his father is there a sort of co-ownership (kawtal) between the child and his father of the child's future herd. Animals which are watered and pastured together as a distinct herd normally belong to the members of a single wuro. Even within the wuro however, animal ownership is clearly defined between husband's, wives' and childrens' animals. However, the various transactions with animals in WoDaaBe society mean that more than one person may hold use rights in an animal. Table 4.2.2 above listed the main ownership and use rights concerned.

It is upon the members of his duDal that an individual depends for his initial herd. The system of koobgal marriage limits the dispersal of the animals of the duDal and since te'gal marriage does not involve bridewealth payments, the attempt to retain animals at the level of the duDal is reinforced.

There is in WoDaaBe society social pressure against large differences in animal wealth, and this is translated into gifts and loans of animals from richer to poorer individuals. These transactions redistribute animal wealth mainly within the taarde, within which there is felt to be a special responsibility to ensure each member households' viability. However haBBanaß animal loans also take place between members of different taare and between members of different leYYi; in these cases they have a less redistributive role and are more for the purpose of creating social ties and links of economic reciprocity between individuals and between groups.

Pasture use

Pasture use during the rainy season can be seen as determined at the level of the kinnidal in that there is consultation between migratory group members about where and when to move. Decision-making about pasture and water use during the dry season takes place at the level of the wuro but members of the kinnidal use the same general dry season area. If deep, privately-owned traditional wells are used for dry season watering they are generally the property of a duDal, whose members finance their construction. In areas where shallow wells are used, these must be dug each year in low-lying areas and usually necessitate cooperation between two households because two adult men must work together, one to dig and the other to remove the sand. After the initial digging, the herds of the two owners are watered on alternate days, and the owners cooperate in cleaning the wells. Because of the small scale of these operations, it is generally two members of the same duDal who dig and operate shallow sand wells in common.

Summary: economic functions and social structure

Table 4.2.6 summarises some of the functions related to economic production performed at different levels in the WoDaaBe social structure just described.

Table 4.2.6 Some functions performed at different levels in WoDaaBe society

	General	Resource use	
		Dry season	Wet season
lenyol (lineage)	- haBBanae animal loans - ngaanyka: competitive festival between young people of different leYYi		
(lineage)	- te'gal marriage discouraged		
taarde (fraction or segment)	- (modern administrative chief "arDo") - annual ceremony for marriages and name-giving (worso) - redistribution of animal wealth to ensure household viability		
kinnidal or hinnideyBe (migratory group)	- traditional consensual leader (arDo) - (modern administrative chief "arDo")	- common pasture area (ngenndi) but no coordinated decision-making	- coordinated decision making about pasture use through: garsoo (pasture scout) kinnal (consultative meeting on movements, marriages, inheritance, behaviour).
duDal	- betrothal marriage (koobgal) - provision of basic herd for new household formation - ownership of deep wells	- dig, clean and use shallow wells together	- members camp and move together
wuro (household)	- ideally, an autonomous production and herd management unit	- decisions about pasture use	

	- common residence and daily herd pasturing and watering - cereal purchase and allocation - adult men eat together
suudu (shelter)	- milking, allocation of milk for consumption, barter of milk for cereals - food preparation; women and children eat together - child raising

HOUSEHOLDS, HERDS AND THE DOMESTIC CYCLE

As just described, the basic unit of production in WoDaaBe society is the wuro, the household, consisting usually of a man, his wife or wives and their dependent children. Ideally this unit is self-sufficient: it owns a herd large enough to meet its subsistence needs and is composed of enough people of different ages and sexes to function autonomously.

The capital base, the herd, and the human population providing labor both fluctuate over time. Because the production unit in WoDaaBe society is small, the equilibrium between capital and labor is easily disrupted. Mechanisms that attempt to establish, or restore, the economic viability of component households are an important part of the organization of WoDaaBe society. Cooperation between households takes place primarily when the viability of individual households breaks down.

Departures from the ideal model, resulting in non-viability, are due to insufficient household labor or insufficient capital for domestic production to meet the household's needs. The reasons for disequilibrium are either structural or due to particular circumstances. In a structural sense, all WoDaaBe households are unviable at the beginning and at the final stage of the domestic cycle. At the beginning of the domestic cycle, when the household is first established, even if it starts out with an adequate herd, it does not have enough labor and must remain dependent on another household until marriage and the birth and growth of children provide labor for autonomous production. Towards the end of the domestic cycle, the children of a household progressively leave to form separate units and the household's animals are distributed to provide subsistence for these new units. A household in the final stage of the domestic cycle is unviable and becomes dependent on another unit.

At any stage of the domestic cycle, particular circumstances, such as drought or animal deaths from disease, can cause a breakdown in household viability. Redistributive mechanisms provide loans or gifts of animals, particularly within the patrilineage, to restore the self-sufficiency of individual household units.

This section details the parallel evolution through the domestic cycle of the human population and the animal population, and the mechanisms within WoDaaBe society that balance these two fluctuating populations at the household level. Cooperation between units takes place at different levels of social organization for different purposes and these will be identified.

The domestic unit model[1]

The human cycle

While still a child, a BoDaaDo is betrothed to someone within his or her patrilineage; ideally, the children of brothers are betrothed. Marriage is a long process marked by the slaughter of three bulls at different stages as the couple is growing up.

---

1. See Stenning (1971) for a complete description of the WoDaaBe domestic cycle.

During childhood, the future spouses remain in their respective parents' camps where from a young age both boys and girls perform essential pastoral and household tasks. At the age of four or five, children gather wood, or, accompanied by a woman or older child, ride donkeys carrying water sacks to fetch water for the camp. In the dry season the entire day can be spent going after water, and children who do this necessary task free adults for more arduous work. Slightly older children care for lambs and kids in the camp. When they are 8 or 10 years old children help with the calves, separating them from the cows after milking, and watching them while they pasture near the camp during the day. They also watch over or fetch adult animals that are not far from the camp. A girl of 9 or 10 helps make butter, rocking a closed calebash of curdled milk back and forth until butter forms. Between 10 and 12 years a young boy can start to tend sheep and goats alone in the bush. A girl begins to pound millet when she is 11 or 12 years. At around 12 years of age children of both sexes accompany adults and the family herd to the well and help direct draught animals or keep back animals that are waiting to be watered. At 14 or 15 years a girl begins to milk, and at around 15 a boy begins to tend the cattle herd on his own in the bush.

These are the rough minimum ages for the main tasks. Division of labor among the WoDaaBe is flexible and depends on the age and sex composition of the family. In a family with sufficient adult labor, children begin these tasks at later ages; when there is a labor shortage, young men can milk cows or even pound millet, and girls and women can do limited pasturing.

When she reaches child-bearing age, a young woman goes to live in the camp of the father of the man to whom she has been betrothed since childhood. She and her husband remain entirely dependent on the husband's father's household. The young couple has no defined living area of their own, and they simply sleep on a mat at the edge of the parents' camp. They are fed by the husband's parents: the father provides all cereals through the sale of his own animals and his wife controls the distribution of milk. The young man continues to help tend his father's herd as he did before his wife came to live in the camp, and his wife helps her mother-in-law with household tasks: pounding millet, cooking, fetching domestic water, milking. Her mother-in-law directs this work and continues to control the family herd's milk and the proceeds obtained from the barter and sale of milk products.

When she is several months pregnant the young wife returns to her own father's camp to give birth, and remains there until the child is weaned. During this two to three year period there are strict avoidance relations between the young couple and each remains dependent on his or her own father's household. It is only when the woman returns to her husband's camp after this period spent apart following the birth of her first or second child that the couple begins the process of forming a separate household.

This stage is clearly marked by the construction of the woman's shelter or suudu, alongside her mother-in-law's suudu, with a calf rope pegged down in front of it, to which are attached the calves that belong to her husband. All the household items that make up the suudu are given to a woman by her mother, and are the woman's property. The maintenance of the suudu is the wife's responsibility and she uses earnings from milk products to replace household articles when necessary.

The material goods that constitute a suudu involve a considerable expense for the wife's parents. Because artisanal work among the WoDaaBe is very limited most equipment and utensils are bought in the market or from Twareg. A BoDaaDo woman must spend years accumulating the belongings necessary for her daughter's suudu, which can add up over 100,000 CFA.

The establishment of the suudu normally indicates the forming of a separate production unit or household. The husband normally separates his herd from his father's, and is now responsible for his economic needs and those of his wife and child. He must sell his own animals to provide cereals for them. His wife pounds and prepares these cereals, milks her husband's cows and controls their milk. She contributes millet and milk to the daDDo, the area west of the camp where the men living in the camp gather to eat and receive guests. She feeds her children within her suudu, and can sell or exchange for cereals the milk products of the animals she milks.

Full autonomy of the household however is only achieved gradually as necessary labor becomes available through the birth and growth of children, and perhaps further marriages. A man can be married to more than one woman by betrothal (koobgal). There is also a second form of marriage (te'gal) arranged by the spouses themselves when they are adults. Each wife has her own suudu and prepares each meal separately, rather than alternating as co-wives as in many Sahelian societies. A woman and her adolescent daughters and young children eat within her suudu and each wife contributes to her husband's and older sons' meal in the daDDo.

Women, married either by koobgal or te'gal can leave their husbands to return to their father's camp or to contract a te'gal marriage with another man. Although a woman can leave with young children, children belong undisputedly to the lineage (lenyol) of their father (pater, the man to whom the woman is married when the child is conceived). Older children remain in their father's camp and younger children who leave with their mother return to their father's camp when they begin working around the age of 7 or 8 years. It is uncommon for a BoDaaDo, who hopes to have as many children as possible, to divorce his wife. If he does not get along with her he is more likely to contract an additional marriage. The size of his herd rather than strict rules limits the number of wives a man has at one time. In the project zone, an approximate calculation made in the course of the general survey of WoDaaBe production systems (described below) gave 1.4 wives per adult male at a given time. Because the unit of production is the family and labor ideally comes from within this unit, great importance is attached to producing children. Many magical practices and much social prestige are related to a large family.[1]

---

1. This ideology should be contrasted with evidence of relatively low fertility among the WoDaaBe (see INSEE/SEDES 1966) as among pastoralists in general. Although the household must provide sufficient labor, there are reasons for pastoralists to keep their overall growth rate low in comparison to agricultural populations (see Swift 1977 and 1982: 163).

There is no clear beginning to the stage of dissolution of the household. Children leave to form separate households while new members are still being added through additional marriages and further births of children. Adult sons leave their parents' camp to set up their own households and daughters leave to live in their husband's camp. Initially these departures can be compensated as younger siblings grow older and assure necessary labor. Eventually however, loss of labor makes the household unviable.

When a man stops acquiring wives and producing children his head is shaved. Until this time hair, which indicates beauty and virility, is allowed to grow long. The youngest son normally supports his ageing father who gradually has been doing less active herding. The father then progressively defers to his son's herd management decisions. Although the older men speak first and are listened to with respect in discussions about camp movements, during which pasture, water, and may other factors are weighed, it is recognized that the young men, who are actually doing the herding, have the most direct knowledge of these things, and it is their opinions that carry the most weight.

Production in WoDaaBe society is therefore organized in clearly defined units whose composition changes during the course of the domestic cycle. Parallel to the evolution of household composition is the evolution of the herd on which household subsistence depends. The economy of the WoDaaBe is based entirely on livestock raising and requires a more precise balance of people with animals than a more diversified economy. Amongst Twareg pastoralists in the project zone for example, agriculture, commerce or salaries of civil servants in some cases provide alternative revenues when animal capital is insufficient. Agro-pastoralists can shift their subsistence base. These alterratives are not available to the WoDaaBe. Flexibility comes instead from a highly institutionalized system of animal allocation and redistribution. [1]

---

1. See Baxter (1975) for a general discussion of this among pastoralists.

The animal cycle

One week after his birth, a male BoDaaDo receives a heifer from his father, as the nucleus of his own future household herd. This gift is normally made at his naming ceremony, marked by the slaughter of an animal. If the ceremony is delayed until the annual gathering (worso) of the lineage fraction in the following rainy season, the infant nevertheless receives a heifer one week after his birth. The animal should be a heifer, although if the father has no heifer he may give an adult cow instead.

Infant girls may receive a heifer from their father, at birth or around 10 years, but do not necessarily do so. If two girls are born in succession, at the birth of the second they may receive one heifer to be shared between them.

The infant's father is the only person obliged to give a heifer, but the mother may give a second from among her own animals, and as the child grows its parents or paternal and maternal kin may give additional animals. As the child gets older the gift from kin is more likely to be haBBanae, a loaned cow whose three calves become the property of the borrower, but which is itself returned to the donor. The child's maternal uncle should give or loan an animal at some time during childhood.

The child's father however has the main responsibility for providing his child with the nucleus of the herd on which the child's future household will depend. In addition to the first heifer given at naming, the father gradually designates from among his own herd animals to his son so that by the time the son's wife constructs her suudu the couple will have a herd sufficient for their independent subsistence. The initial heifer and succeeding animals given by the father to his son are normally taken from the cows (called sendereeji) and their off-spring allocated to the child's mother at her marriage for milking. The father may give an animal which has not been allocated as sendereeji to any of his wives, or an animal he receives from outside his herd; he may not however give an animal from among the sendereeji of another of his wives.

A child's herd slowly grows as he gets older: he is given animals and these reproduce. Until he sets up his own household, his animals are managed by his father in his father's herd according to strict rules. The father may sell old cows belonging to his son, but must give or buy with the proceeds of the sale a replacement heifer or adult cow which becomes part of his son's herd. The father may sell young male animals from the child's herd, for example when he has none of his own to sell to buy cereals or meet other needs, and normally does so as they reach maturity; but each time he does this, he must replace the sold male animal with a heifer or adult cow in his son's herd. In theory and traditional practice, a young man does not start exploiting his herd, by selling males or old females, without replacing them by females, until he marries, forms an independent production unit and has consumption needs separate from those of his parents.

Girls generally have a smaller herd than boys. Where two sisters share an initial heifer, its offspring are divided alternately between the sisters, the first calf going to the oldest, the second to the youngest, and so on. A woman's animals belong to her and to her lineage, but when she has children her animals are passed on to these children and thus become the property of her husband's lineage. If possible a mother will give a heifer to her own male infants at birth, and also to female infants if she has enough, as is done by the father.

When the child is older he adds to his herd himself by contracting animal loans with relatives or age-mates. A young man goes through a period of intensified social relations when he is frequenting the rainy season dances and gatherings, and forming and reinforcing social ties. This is the period of his life when he gives and receives the most <u>haƁƁanae</u> loans. Women also give and receive <u>haƁƁanae</u> loans at this stage of their life.

When the young man's wife first comes to live with him in his father's camp, he shows her her <u>sendereeji</u> from among the herd he has been accumulating: usually a male to be castrated and used for carrying the household goods when camp is moved, and three females. The woman does not own these animals: she can not sell them or otherwise dispose of them without her husband's permission. At this stage her mother-in-law still has full rights

to the milk from these animals but later the wife will have exclusive milking rights to her sendereeji and will control the use of their milk. Her sendereeji and their off-spring are inherited only by her children. Each wife receives her own sendereeji and can not use the milk of the sendereeji of another wife.

When a woman first comes to live with her husband in his father's camp she does not normally bring all her own animals which have been accumulating in her father's herd, although she may bring some of them. Her animals are brought into the production unit only when she returns to her husband's camp after the two year period of residence with her parents after the birth of her first child. At this time, especially if he has not given her an animal earlier, her father should give his daughter a heifer, called the wiige paDe, which, together with its offspring, remain her own property rather than becoming the property of her husband. Sometimes she waits until she has had more than one child before separating her animals from her father or brothers' herd. From then on, although her husband can sell one of her animals, for example a male of a suitable age for marketing, he should in theory replace it with another animal. The wife's animals should be sold only to meet the production unit's consumption requirements for which she is responsible, for example all the household items comprising the suudu, and they cannot be sold to meet those production unit expenses which are the responsibility of the husband (cereals, herding equipment).

Although the sale of woman's animals is generally transacted by her husband (or brother), WoDaaBe women can and do market their own animals, in marked contrast to other ethnic groups. Although WoDaaBe women must fulfill their economic responsibilities within the household, they themselves decide how to dispose of the proceeds of the sale of their animals. They can of course be subject to varying pressures from their husbands depending upon the relation between the couple and the degree of poverty of the husband.

The critical point in the evolution of the herd is the moment at which a man's wife builds her suudu. Without a wife, or until his wife has given birth, a man does not have a suudu and is necessarily dependent on another

household. Although he owns animals which he has the right to sell, exchange or loan before this time, he does not really exploit his herd because he does not have his own household with milking calebashes or cooking utensils; he does not eat separately from his father's household, so he does not have to sell animals to buy cereals. Until his wife builds her suudu and she and her husband form a separate production unit, the future head of household's animals are managed within his father's herd. The son does not have any economic responsibilities to this parental household. The father must meet the subsistence needs of the family, including the dependent son and his young wife, by selling only his own animals, not those of his son. The theoretically untouched animals belonging to his son therefore increase at a faster rate, the normal rate of biological reproduction, because animals are not being sold to meet subsistence needs. However the milk of the animals in the son's herd is the property of his mother and is allocated for consumption, exchanged or sold by her.

Once his wife has her own suudu, however, the son must provide cereals and meet all his own family's other needs. To do this he has to begin selling his own animals which are his only source of income. His wife also contributes to the family's cereal needs by exchanging the milk products of her own and her husband's cows for cereals. Once a wife has her suudu, control of the milk of her husband's animals is transferred to her from her husband's mother.

Even before his wife constructs her suudu, a man starts to allocate his animals to his own children beginning at the birth of his first child. This system of pre-inheritance, operating according to the same rules by which he himself acquired the nucleus of his herd from his own father, provides the next generation with its means of subsistence, but is a further drain on the young man's herd.

These depletions mean that the family herd's rate of growth is much lower than before the family constituted a separate production unit and its own suudu. The household's herd changes from an "investment" herd, reproducing at a rate of up to 15 percent a year, to a "production" herd whose rate of growth drops to at best 2.5 percent because animals are being sold from it to

meet the family's needs. This rate of growth lasts throughout the period the family has the most dependents. The herd owner must also set aside animals for his children's investment herds, which can them only be used for milk. Exceptional expenses (animals for slaughter at name-giving ceremonies of children, or the purchase of articles for a daughter's suudu)[1] also occur during this period, further burdening the family's resources. This critical period lasts until the next generation becomes independent: sons separate their animals from the father's herd and become self-sufficient and daughters leave to live with their husbands.

Some compensation during this time comes from an increase in the number of haBBanae animals received. Also, children bring animals into the domestic herd in the form of gifts and loans from relatives and friends within and from outside the group. Although these animals belong to the child's investment herd, they add to the milk available to the family. Other animals come into the family's herd as wives bear children and bring their personal animals to their husband's camp. Gifts of puDDiri animals when daughters marry come from daughters' husbands. Practice varies from group to group, but generally only one animal is given while some groups give no bridewealth. As sons establish independent households and daughters leave to live with their husbands, the herd owner's economic responsibilities are gradually reduced. At the same time, his animals are progressively allocated. A man with adult children has ideally distributed his herd to these children. He has already stopped receiving haBBanae loans.[2] In fact an old man who dies leaving animals that are not already designated is looked upon with disapproval, partly because this can cause disputes, but also because herd ownership should be turned over to the next generation. A BoDaaDo's greatest responsibility is to provide the nucleus of a herd for his sons. He should not hold on to animals for himself once his sons' wives and his daughters have constructed their own cuuDi.

---

1. See Maliki (1981): slaughter animals for a son's koobgal marriage come from animals already allocated to the son's investment herd.

2. An exception to this is the arDo (fraction chief) who may continue to receive haBBanaaji out of respect and because of his prestige. The arDo also has more extended social obligations and economic responsibilities.

Animals in the herd belonging to a woman who has no children go to her father (or brothers or another patrilateral relative of the woman) when she dies or when her husband's herd is dispersed. In this sense a woman and her property remain part of her own lineage. It is only through inheritance to her children, who belong to her husband's lineage, (but never to her co-wives' children), that her animals become the property of her husband's group.

Parallel evolution of people and animals within the duDal

Although WoDaaBe animal ownership is individual, there are many senses in which there is an identification between the human group and the animals it depends on. In Fulfulde, the word indicating the area to the west of the camp where a family's herd spends the night is duDal, and by extension duDal also means "herd" in Fulfulde. At the same time duDal signifies the human group living from those animals: the sons of a same father, with their families and sons' families. There are several ways in which the animals belonging to this group have a certain unity; the animal population and human population within the duDal evolve in parallel.

Marriage by betrothal (koobgal), decided by the group, ideally takes place within the duDal, preferably between the children of brothers. Through inheritance from their father, these brothers' herds are constituted of animals from the same original herd. By arranging a marriage between their children they prevent the dispersion of the duDal's capital base. The second form of marriage (te'gal), decided by the spouses themselves when they are adult, must be between people of different lineages. However in this form of marriage, there is no exchange of animals, and the animals of the duDal remain intact.[1]

---

1. A te'gal wife brings her own animals to her new husband's herd, and through inheritance to their children they do become the property of her husband's lineage (any animals given to children she has by her first (koobgal) marriage remain in her lineage). But the WoDaaBe try to prevent losing women (and their animals) through te'gal to other lineages. They try equally hard to win te'gal wives from other lineages.

Ideally the evolving cattle herd of the duDal is thus an almost closed population, from which animals are sold when necessary, but into which recruitment takes place mainly by birth, to a lesser extent through haBBanae loans of cows from outside the duDal, and through the loan or purchase of outside bulls particularly prized for their genetic qualities. This well-defined cattle population is thus in important respects a structural parallel of the patrilineally-organized human group which lives from it. The genealogies of the animals of a duDal are well known to the members of the duDal and they can easily trace them 10 or 20 generations back, much further than they can trace their own ancestry. The WoDaaBe consider that many of the characteristics they look for in cattle (high fertility, good milk production, a docile temperament, sturdiness) are hereditary. They are thus uneasy about buying a cow on the open market whose lineage is unknown. They also fear introducing a disease into their herd by buying an unknown animal. They far prefer that their cows give birth to females rather than males, although theoretically they could sell a male to buy a female in its place.

The separate herds belonging to the members of a duDal are symbolically thought of as one herd when they are gathered together at the worso for the slaughter of the third bull finalizing a koobgal marriage. The father and paternal uncles of the future husband array their animals from which the relatives of the future wife choose the bull to be slaughtered. This is done with great pride, and it is considered that the collective wealth and beauty of the duDal herd are being demonstrated.

Animals are distributed within the duDal, either by direct inheritance from father to son or through gifts from paternal uncles, to provide an individual with the herd necessary to form an independent production unit. Once the nucleus of the herd is formed from within the duDal, its owner engages in the haBBanae system of animal loans with individuals outside the duDal. These loans are a redistributive mechanism (by which richer families help poorer families) primarily within the fraction (taarde). Outside the fraction, they are a means of establishing social relations and economic ties of reciprocity.

Departures from the model

WoDaaBe society is organized in structurally equal, relatively autonomous units. The basic unit of production is ideally the lowest level of social organization, a self-sufficient household. This is a useful structure in a highly variable environment where it is often advantageous for small units to be able to scatter widely while maintaining their economic viability. It is also advantageous for a group like the WoDaaBe who have quite recently moved into an area long dominated by the Twareg, hierarchically-structured and more politically powerful.

There is a tension between the ideal of autonomous households and the ideal of wider group (duDal and taarde) solidarity, which plays an essential role at all levels of WoDaaBe social organization. The family's initial access to labor and animals comes from the wider group, and the household relies on wider group solidarity when economic viability breaks down. Inadequate labor within production units is dealt with by temporary cooperation between units. The hazards of livestock-raising in a risky environment where a herd can be wiped out by drought or disease are countered by the responsibility of the wider group, particularly its richer members, to provide animals to a household with an insufficient herd.

In terms of the organization of production, the moment at which a household constitutes an independent unit is determined by the labor it can mobilize and the availability of animals to ensure subsistence. The viability of the household of the parents of either the husband or wife can also have an effect.

Labor shortages

When a woman constructs her suudu, even if the herd the family owns at this stage is sufficient for its needs, it is difficult for the household to operate autonomously until some children are old enough to help with some work. The tasks involved in tending the herd (pasturing and watering separately different species of animals, well-digging, tending calves kept apart from the rest of the herd) and running the household (milking, pounding cereals, cooking, collecting firewood, fetching water, watching children, moving camp, going to market) are various and require different people to be in different places at different times.

The head of the household must have someone old enough to tend the herd so he can be free to leave his camp for varying lengths of time. If his herd is to be managed effectively he must camp where pasture is best and be able to spend the time necessary to travel to the market that offers the best prices. He should be able to spend enough time at the market to sell his animals well. Discussions in the market or in other camps also provide valuable information about pasture and water elsewhere. Social relations, the most important safeguard in a risky environment, must be maintained through regular contact with other WoDaaBe in scattered camps.

A temporary labor shortage at the beginning of the domestic cycle is normally overcome by keeping the family's animals in the husband's father's herd until the family has enough labor; a combined herd reduces labor requirements substantially. Brothers frequently combine their herds when one or both have labor shortages. If the father is dead, younger sons who do not yet have wives or enough children remain attached to their eldest brother's camp until they can be independent. Similar arrangements can be made with other relatives but are less common. If the family's herd is adequate, a labor shortage can also be coped with by taking on an unmarried relative, or more rarely by hiring a FulBe herdboy or a Twareg to help with watering, to permit the family to function independently.

At the end of the domestic cycle when children have left the household, it is the responsibility of the youngest son to remain with his parents. As they are less able to work the older couple becomes dependent on the labor of the youngest son's family.

Labor shortages arise most typically at the beginning and the end of the domestic cycle, but are dealt with in similar ways if they cause problems at other times. In situations of minor labor shortage, a household will camp close enough to another (usually closely related) household to allow temporary cooperation. For example in a household in which there is only one woman old enough to milk and the men are all occupied with other tasks, when the woman is ill or absent, a woman from another camp will help with milking. Labor can be loaned on a longer term basis, but generally only between brothers. If one

brother has no adolescent or adult sons and another has several, one of these latter can be charged with the dry season watering of his uncle's herd, instead of combining the two herds.

Herds, again generally belonging to a father and his sons or to a group of brothers, are combined into one while a herd-owner is absent for dry season migrant labor if enough workers do not remain behind in his household. This is seen as a less than desirable situation however and the herds are immediately separated again upon the return of the migrant even if the two owners live in the same camp.

General practice is for a BoDaaDo to wait until his wife has built her suudu before separating his animals from his father's herd. Essentially, he overcomes the lack of labor that a wife would provide by relying on his mother and her suudu. An infrequent alternative is the practice called gortaalo when a herd-owner without a suudu attaches himself to the household of a relative. There are various reasons for someone to leave his parents' household before he has the labor to form a viable domestic unit. He may want to prevent an irresponsible or needy father from selling his animals, or feel that his father is a poor herder (in terms of searching for the best pasture for example) and want to make his own herd management decisions. His father could be dead and his mother remarried to someone with whom he does not get on. The gortaalo maintains a separate herd and exploits it to provide for his needs but relies on the domestic labor of another household.

Animal shortages

The normal process of establishing and maintaining an autonomous production unit can be delayed or disrupted by the poverty of the parents' household and more generally by the lack of animals in the kin group on which an individual relies to provide him with animals.

If the father's herd has been insufficient for the subsistence needs of his family, it is likely that he will not have been able to allocate the necessary number of animals to his son. This delays the separation of the son's herd from his father's or older brother's. In this case, when the son's wife constructs her suudu the couple form a separate production unit in the

aense that the son has responsibility for their subsistence, and his herd changes from an investment to a production herd. However the actual physical separation of his animals from his father's herd is delayed, and the son, although a herd owner, is not the head of a herd management unit. His animals are pastured and watered with his father's as a single herd. When there is a combined herd of this sort a herd owner does not make the independent decisions about herd management that are part of the WoDaaBe ideal of autonomy.

There has been an increasing trend, stimulated by the drought of the early 1970s, for young men to start selling animals from their investment herd before they have the subsistence obligations that begin when their wives construct the suudu. It is not uncommon now for youths of 15 or 16 to sell animals from their investment herd to make purchases (clothing, swords, riding camels) that their fathers would have been able to provide in the past, or that were thought unnecessary.

The construction of the suudu, determinative for the formation of a separate production unit, can also be delayed by the poverty of the wife's parents. In the past a woman was given her suudu when she returned to her husband's camp after the birth of her first child. Now her parents may not be able to accumulate the items that compose the suudu until she has two children.

These various factors prolong the initial period of dependency of the new household. Continued association with another household is the normal way of coping with an animal shortage at the beginning of the domestic cycle. Unless the animal resources of the duDal or taarde as a whole have dropped below the level where some households can give or lend animals to a needy family without threatening their own viability, a family that has had to remain dependent eventually builds up a sufficient herd through animal gifts and haBBanae loans. Diilae loans, by which lactating animals are given for a shorter period, then returned to their owner along with their offapring, do not add animals to the herd, but by providing milk they help reduce cereal needs and consequently the sale of animals.

Even if a household has been unable to overcome an animal shortage through loans and gifts, it will finally separate from its parent household nonetheless, and resort to other means in order to function independently. Families will cope with an inaufficient herd either by tending animals that belong to other ethnic groups (jokkere) to obtain the milk of lactating animals, or they will send members out of the pastoral zone during the dry season to earn money. In some cases both strategies are used, but neither strategy permits an accumulation of animals to rectify permanently a shortage.

When a household has been adequately provided for, the wife is able to construct her suudu when she returns to her husband's camp after the weaning of her first child, and the family has a sufficient herd to meet its needs when the herd is separated from the husband's father's. At any time however animals can be lost due to any number of misfortunes. When this happens, the same mechanisms of animal gifts and loans are relied on to restore viability. If the household is not able to obtain animals from within the duDal or taarde, a temporary shortage of animals becomes a permanent one, and herding jokkere animals or seasonal migrant labor are the only options available if the household is to stay in the pastoral economy.[1]

However a household that is obliged to resort to one or both of these strategies because of its incapacity to meet its needs is often excluded from the normal network of animal loans. WoDaaBe are reluctant to loan haBBanae cows to people whose herds contain jokkere animals for several reasons.[2] They say that jokkere herds usually contain a high percentage of males and worry about the increased possibility of their haBBanae animals being harmed by the unruliness of such herds. The WoDaaBe are also concerned about diseases introduced by village-based jokkere animals (to such an extent that they avoid camping in an area occupied by herders with large jokkere herds).

---

1. The word jokkere is derived from the verb jokka, to stick or join together, and jokkere means a group of animals which is simply "stuck on" to the household herd; jokkere animals do not share in the organic unity, derived in part from a common genealogy, of the household herd. Jokkere does not take place between WoDaaBe.

2. It will be recalled tht in chapter 3.2 it was shown that WoDaaBe herds containing jokkere animals had significantly fewer haBBanaeji animals than those without.

Furthermore it is generally recognized that the management strategies of herders who tend a high percentage of jokkere animals are modified, resulting in less good conditions for their herds. The movements of the herder are often restricted by the owner of the jokkere who prefers to have his animals close enough to his village in order to maintain contact with the herder, to sell one of his animals more easily when he wants to, to claim a female when she comes into lactation, or to check on the condition of his animals.

Decisions in which the location of the best pasture and water should be overriding are also modified by the greater tendency of herders with jokkere to use boreholes. WoDaaBe herding their own animals generally use boreholes as a last resort because large concentrations of animals degrade the surrounding pasture, and borehole water is often thought not to be good for the animals. However the labor involved in watering at other sorts of wells is considerably more demanding; the advantages are clearly reduced if most of the animals do not belong to the herder. Moreover a poor herder obliged to take on jokkere is more likely to have members of his family absent on dry season migration, and may not have the labor necessary to use a traditional well.

Even if a BoDaaDo has no jokkere, he is less likely to receive haBBanae loans if he engages in migrant labor. Because of his poverty he may be compelled to leave his herd with less than adequate supervision. In the sample studies one extremely poor family was forced to have the head of household, two wives and three adult and adolescent sons absent during the dry season, leaving the herd and camp to be looked after by a nine year old son and a pregnant seventeen year old daughter. Although in cases like this there is support from relatives in neighboring camps, the care of the animals inevitably suffers.

There are other circumstances that can make a BoDaaDo less likely to receive support from his relatives in times of need; for example, failure to attend the rainy season gathering of the fraction (taarde), which is an important manifestation of group solidarity, or other behaviour that shows an unacceptable disregard for the group.

There is not a definite pattern to the relation between givers and receivers of animals, although the obligation is clearly strongest between closely related kin and is increased by the relative wealth of a person. HaBBanae loans however often take place between members of different primary lineages (leYYi) and can be based on friendship, and the effort to establish wide-ranging social and economic ties, rather than kinship.[1]

While a household at the beginning of the domestic cycle necessarily has a shortage of labor and can have a shortage of animals, a household at the end of the domestic cycle has insufficient labor and insufficient animals to meet its needs. It is thus dissolved, ceasing to exist as a production, residential or social unit. The father generally becomes dependent on the household of his youngest son who feeds him and buys him whatever clothing or other items he needs. Each of the wives of the household at the end of the domestic cycle usually goes to live in the camp of her own eldest son who similarly supports her.

Households and production units: some examples

Three cases from the household economics sample described in greater detail below show some of the ways in which cooperation takes place between different units for production and herd management when households are unviable at different stages in the domestic cycle.

The first case consists of three brothers (A,B and C). The middle brother (B), with his wife and four children, has a separate wuro and a separate herd, which he waters and pastures apart from his brothers' herd. B sells animals from his herd to buy cereals and to meet the other needs of his wuro. He is thus largely independent. The eldest brother (A) has two wives, one of whom has a suudu and two children, while the other has not yet given

1. When a haBBanae animal is received from another lineage, a te'gal wife from that lineage can claim control over its milk.

birth, and therefore has no suudu. The two children of A's deceased sister are also dependent on A's household. The youngest brother (C) during part of the study had a young wife with no children who later left him to return to her father. He then married a woman with two children who built her suudu soon after coming to live in the camp. The organization of these production units is shown in figure 4.2.5. They may be summarized as 3 herd owners, 2-3 shelters (suudu), 2-3 households (wuro), 2 herds, combined into a single camp (hoDorde) all year.

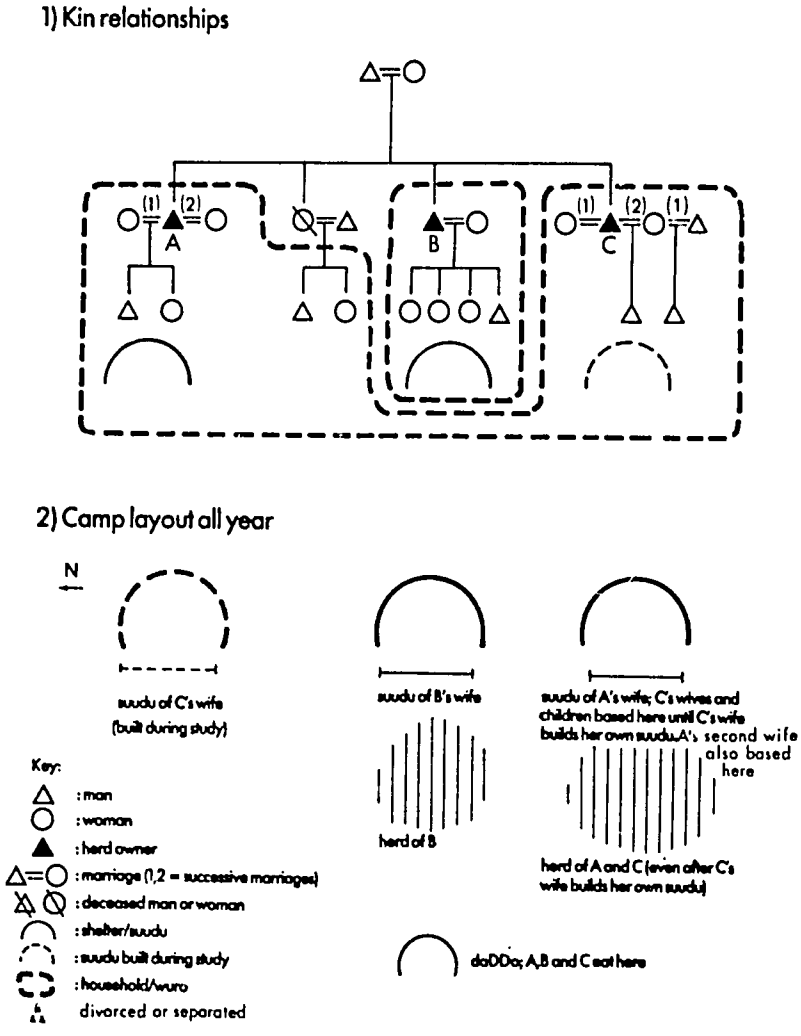


Figure 4.2.5 WoDaaBe households and production units: case 1

The animals of A and C are combined for management purposes into one herd. This is partly because C, at the beginning stage of the domestic cycle, could not form a separate production unit until he had a wife with a suudu. However, even once his wife had built her suudu and C could theoretically form a production unit separate from A, A and C kept their animals in one herd because neither had enough animals to be self-sufficient. Both A and C purchase cereals with the proceeds from their own individually owned animals, but they share their cereals.

Both in the rainy and dry seasons, A, B, and C form a single camp. Each of the wives with a suudu and a calf-rope brings millet and milk to the daDDo where A, B and C eat. Although there are two separate herds for management purposes, there is a considerable amount of assitance between A, B and C for pasturing, watering and well-digging. Because even the joint herd of A and C is inaufficient for subsistence, A, accompanied by one or the other of his wives, leaves the camp each dry season and sells traditional medicines in Mali, the Ivory Coast or Guinea while his wives earn money by braiding hair. During his absence the two herds (A and C's joint herd and B's herd) are combined into one for management purposes. They are watered and pastured together, but are separated into two herds as soon as A returns.

The second example consists of a father, D and his sons, (in order of birth) E, F, G, H, and I. The oldest three sons (E, F, and G) have separated their herds from their father's herd, and each manages his own herd entirely independently. Each constitutes a separate wuro because each has at least one wife with a suudu. They form three self-sufficient production units. The fourth wuro and production unit consists of the father (D) with his two youngest sons, H and I. Neither of the wives of H and I has constructed a suudu so these families remain part of the wuro of their father. Two of his daughters, one divorced and one separated from her husband, are also dependent on D. Neither has a suudu. The organization of these production units is shown in figure 4.2.6. They comprise 6 herd owners, 5 shelters, 4 households, 4 herds, 4 dry season camps and a single rainy season camp.

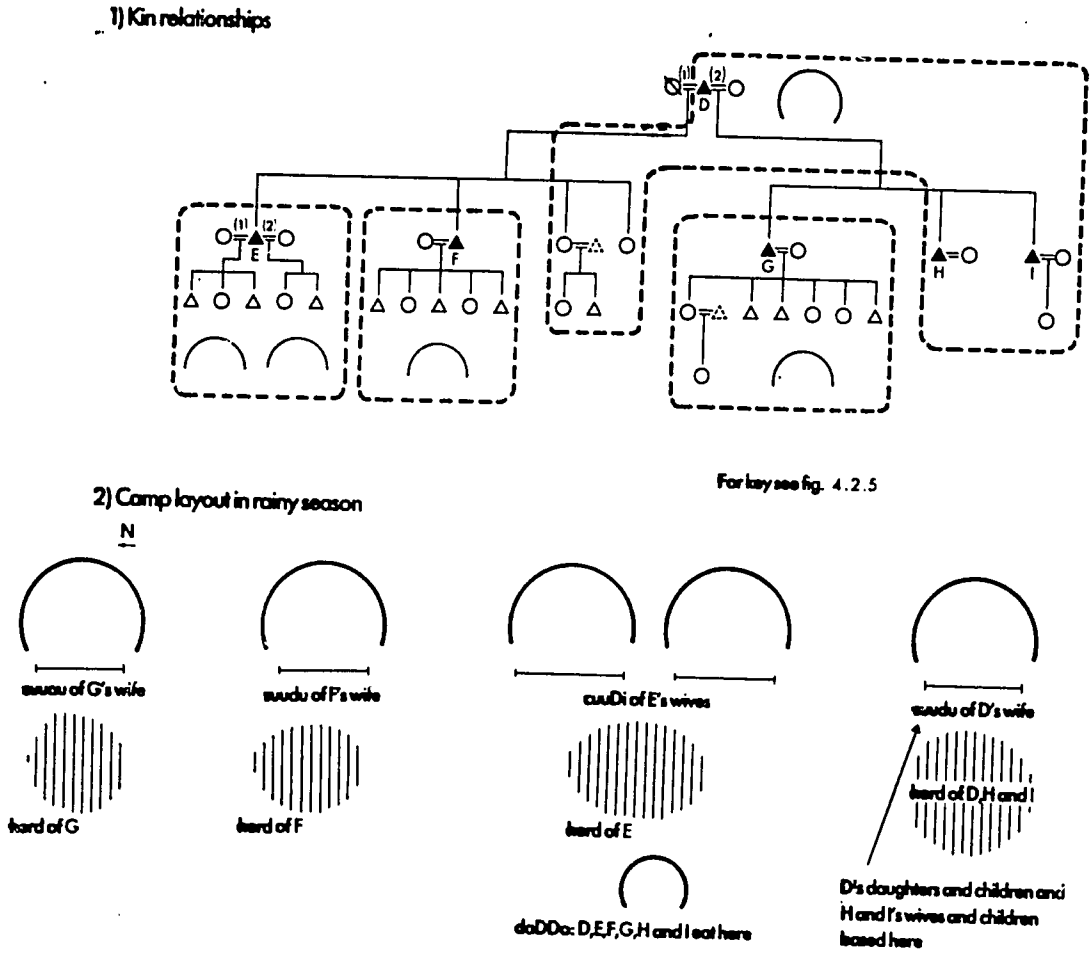


Figure 4.2.6 WoDaaBe households and production units: case 2

The animals of D, H and I form one herd which is tended together. H and I do most of the actual watering and pasturing because D is in his sixties, but D continues to make the main decisions about camp movement and pasture and water point use. It is D's obligation to provide cereals for the whole wuro

(including his wife, his two daughters and their children, and his two sons and their wives and children). Despite this, D cannot sell from the combined herd animals that belong to any of his children; he must sell only his own animals to meet the wuro's cereal needs. H and I have the right to sell their own animals but are not obliged to contribute cereals for their own consumption or for the general consumption needs of the wuro.

The wives of H and I help their mother-in-law, the wife of D, with all household tasks. The wife of D is the only woman in the wuro who has a suudu: she therefore controls the milk of the combined herd, including the milk of H and I's animals.

In the dry season, the four gure (D-H-I, E, F and G) camp separately and each has its own daDDo. In the rainy season the four gure camp together, forming one hoDorde with one daDDo, the men's common eating place. The wife of D is helped with pounding cereals, cooking and milking by D's two daughters and the wives of H and I.

The dependence of H and I on their parents is partly a function of their stage in the domestic cycle, but is also related to the fact that neither has enough animals to meet his own family's needs. By this stage, D ought to have provided H and I with enough animals to support themselves as he did for E, F and, to a lesser extent, G. G sometimes herds entrusted animals (jokkere) belonging to Twareg to meet the subsistence needs of his wuro. There was some talk of favoritism to the sons of D's first wife (E and F) at the expense of those of his second wife (G, H and I). It is also possible that D had designated animals to E, F and G, about ten years older than H and I, but that when the time came to provide the bulk of H's and I's herds, he was suffering from heavy animal losses at the time of the 1968 - 1973 drought. Everyone in D's taarde suffered substantial losses at that time, so poverty at the segment level has made the normal system of animal redistribution ineffective. D has been unable to recover from his losses and is now obliged to use productive animals from his herd to meet subsistence needs, even without having provided H and I with adequate herds. For several years H and his wife have been going to Nigeria during the dry season, H to work as a watchman and his wife to braid hair. They have not been able to save anything in order to add to H's meagre herd.

The wuro of E has a labor shortage. E has two young daughters (seven and four) and two baby sons. An older son (nineteen years old) has never stayed long in his father's camp and gives no help with herding. E nonetheless has been able to maintain his wuro's autonomy as a production and herd management unit because he has an adequate herd and was able to get a young FulBe boy to help him with watering and pasturing. His herd is not sufficiently large however for him to give animals to his half-borthers without threatening his own household's viability.

The third case is that of five sons of a deceased father (J, K, L, M, and N, in order of birth). The oldest, J, the son of a different mother than the four others, has an indpendent wuro (with two wives and two cuuDi). He usually camps near the others in the rainy season, but even at this time does not camp with them in one hoDorde. The organization of these production units is shown in figure 4.2.7, and comprises 5 herd owners, 5-7 shelters, 3 households, 3 herds, 2 (sometimes 3) dry season camps and 2 rainy season camps.

L has four wives, two with cuuDi. The third constructed her suudu during the study and the fourth had just given birth and did not have a suudu. L and his wives form an independent production and herd management unit, with a separate cereal stock provided by the sale of L's animals. However L always camps in the same hoDorde with K, M and N in the rainy season and usually in the dry season as well. In spite of a large family and a small herd, L has managed to maintain autonomy mainly by contracting a large number of haBBanae loans.

K has two wives, one with a suudu and one without. K also has in his wuro a sixteen year old son by a third wife who is deceased. K's two youngest brothers, M and N, are dependant on his wuro. The wife of M gave birth and constructed her suudu toward the end of the study. The wife of the youngest brother, N, has not yet come to live in the camp.

The animals of K, M, and N are in one herd and are paatured and watered together, with K making the herd management decisions, and K, his son, M and N doing the work. The wuro has sufficient herding labour, but since their herd is too small to provide for all of the people dependent on it, M and his wife go to Nigeria during the dry season to work. They are not able to save anything to bring back to the camp.

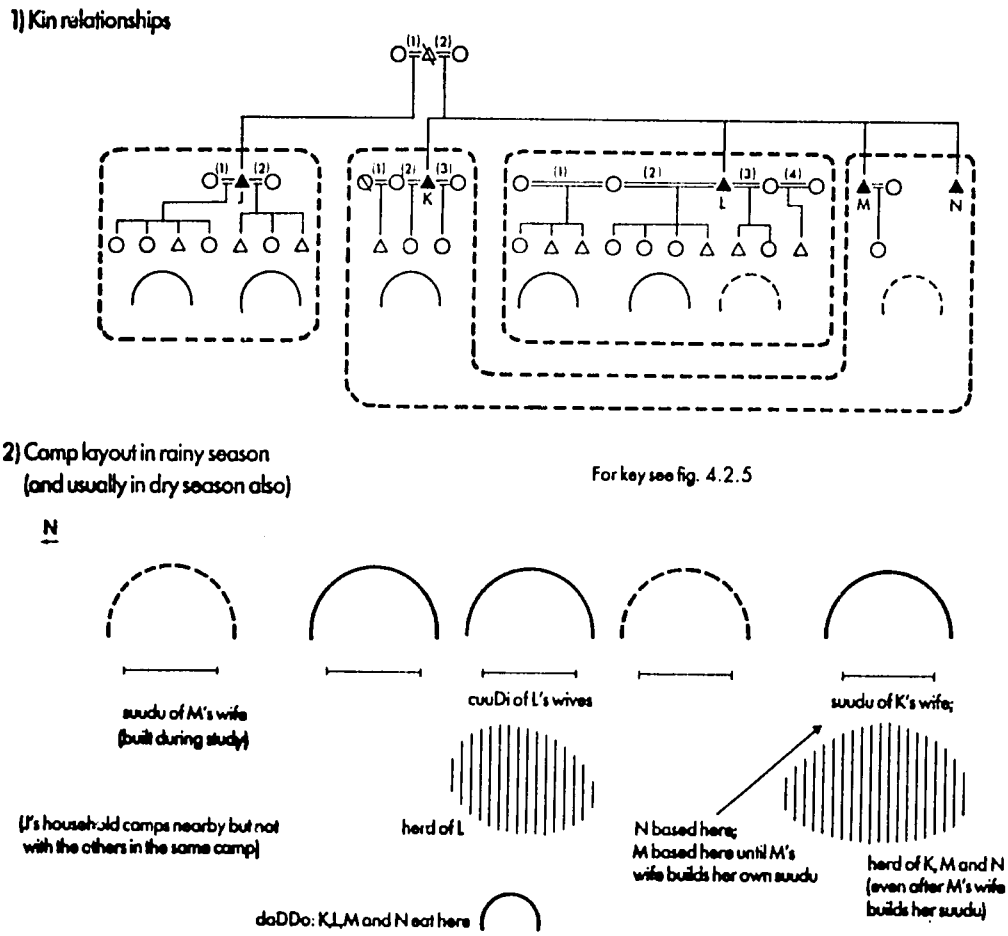


Figure 4.2.7 WoDaaBe households and production units: case 3

K must provide cereals for everyone in the wuro through the sales of his own animals. Although M did not buy cereals during most of the study period, at the very end (soon after his wife had constructed her suudu) he bought a small sack of rice, marking the beginning of his separation into a distinct production unit where he will provide for his own family's needs through the sale of his animals. He will probably keep his animals in the same herd with K's and N's animals for some time to come due to their small number.

These three examples suggest some of the complexity of the organization of economic production in WoDaaBe society, with changes in the extent of cooperation and common action, in decision-making and resource management according to the season and to stages in the domestic cycle, as well as in response to contingent events and to personal choices. These data do however point to the key minimum economic production unit as the wuro, or household, defined as the social unit (usually a man and his wife or wives and their dependent children, plus in some cases his dependent brothers and their wives and children, or other dependent kin) living from a jointly-managed herd, and sharing a common budget for major expenses; key economic decisions concerning herd management, the sale of animals to buy cereals and the allocation of cereals are taken at the level of the wuro, which emerges from the data as a well-defined unit at any moment in time even though it changes over time as it moves through the domestic cycle. Some important economic activities are carried out at the suudu or shelter level (especially milking and the allocation of milk for consumption or barter), and also at the level of a camp (hoDorde) made up of several households (some coordinated resource management decisions; this is also the level at which adult men eat). But the wuro remains the key unit in the organization of economic activities.

HOUSEHOLD PRODUCTION

Objectives

In order to explore the dynamics of production and constraints to its improvement in the WoDaaBe economy, the project undertook a detailed household level study of production and marketing in a small sample of WoDaaBe households. The intention was to advance understanding of the way the WoDaaBe pastoral production system functions, what the herders' objectives are, how they achieve them, and what are the main consequences of this for development policies and programs.

The research focussed mainly on household level processes because in the WoDaaBe and other Sahelian pastoral economies households are the most basic decision-making units where pastoral production is concerned: the sum of decisions taken at this level determines the activities of camps and wider

groups as a whole. Studiea of individual households or production units permit an understanding of the behaviour, strategies, goals and resource management of people in production systems; it is at the household level that people herd animals, allocate labor and manage budgets.

Little is known about the economics of household level activities in paatoral production systems. The main objectives of this research were therefore to provide basic information on the labor requirements of the main activities undertaken by WoDaaBe herders, on household budgets, and to identify the constraints to economic development and increased herder well being.

In agricultural production in the Sahel, labor is generally the limiting resource, despite considerable seasonal underemployemnt. Much recent research has concentrated on identifying, measuring and experimenting with ways to overcome this bottleneck. By comparison, almost nothing is known about the labor requirements of Sahelian pastoralism. Research on this theme was therefore intended to describe the main ways pastoral households use labor, the number of hours worked per year at different tasks by different categories of people, and the variations in labor allocations between production units within the same economy. Such a description is essential to understanding how the WoDaaBe economy uses labor, how it differs in respect of labor use from Sahelian agricultural economies, and the extent to which labor is a constraint on increased production or increased welfare. It is clear that seasonal labor constraints are likely to be important; in particular, dry season watering is a demanding activity for which much of the available male labor is mobilized. It is commonly assumed that in pastoral economies such as that of the WoDaaBe, dry season watering is the main labor constraint, one which could perhaps be relieved by new technologies such as simple pumps, improved animal traction harness, or improved surface water.

One potentially important characteristic of pastoral labor allocations is the fact that some tasks, eapecially herd supervision, are subject to important economies of scale. One herder can under most circumstances pasture a herd of 30 or 40 cattle as well as a herd of 10 cattle. Herd supervison labor increases not in a linear relationship to herd size, but in a step-like

progression, each threshold marking a point where an additional full-time herder is needed. The existence of potentially large economies of scale in herding open up for pastoral households or development groups such as pastoral associations a large number of options concerning cooperative herd management strategies with other households.

Although labor is a potentially important limiting factor in Sahelian pastoral production systems such as that of the WoDaaBe, a more important limiting factor is capital, in the form of a productive herd or flock of domestic animals, without which independent production is not possible. Ownership of livestock capital determines effective access to land on communal ranges, and also enables households to mobilize labor through loans of milking animals. The technical relationships between these production factors, their implications for efficiency and welfare, and for development (for example in terms of a specially adapted credit program) were among the main themes of the household research. This is especially important given the large-scale losses of animals by herders during the 1973 drought and the difficulty many of them have had in rebuilding their herds afterwards, and the simultaneous process by which non-pastoralists have been investing economic surplus from other sectors in livestock which they entrust to herders to look after on their behalf.

The household studies are also aimed at providing a clearer quantitative understanding of household incomes and expenditures, in order to clarify herders' marketing behaviour, their cereal consumption (quantities purchased, prices paid, and terms of trade with animals and animal products sold), to define more clearly the problem of poverty in the WoDaaBe context and to identify the main policies likely to improve the wellbeing of herders, especially the poorer ones.

Methodology

The WoDaaBe sample in which the household research was carried out consisted of 19 families. Four of these were dependent on other families in the sample and had varying degrees of autonomy. In two cases two sons were still attached to their fathers' unit, and in two other cases younger brothers were gradually separating from older brothers. In the light of the data gathered during the study the families were grouped into 16 household

production units for analysis. For budget analysis, one of these production units was dropped because it moved during the study far away from its enumerator, and the data were too irregular.

The small size of the sample had both advantages and disadvantages. Its size was limited by fieldwork conditions among the WoDaaBe which are explained below. The constraints on detailed and accurate data collection over at least a year among the WoDaaBe are such that the participating families were selected not by random sampling, but as a deliberate choice of families which seemed typical of the WoDaaBe economy in the Tahoua-Tchin Tabaraden area, and which were willing and able to cooperate in the study. The researcher then attempted to deal with the problem of representivity by collecting comparative data throughout the region to make it possible to place the detailed household quantitative studies within a discussion of the variations in the organization of production among different WoDaaBe groups and between different parts of the project zone, and to measure more accurately how the sample families were, and were not, representatative of the broader WoDaaBe economy. This broader, shallower enquiry is reported later in this chapter.

The lack of precise and time-series data on household production among pastoralists has hampered an understanding of production systems based on livestock-raising. An attempt to fill this gap with research on the WoDaaBe quickly revealed some of the reasons these data have been lacking. Distances between households, a high degree of mobility, and conditions that make it hard for non-WoDaaBe to spend prolonged periods of time in WoDaaBe camps make any sort of data collection difficult. Because household budget and labor data were based on recall and had to be collected twice a week, the enumerators filling out the data forms had to be permanently resident in the camps. Distances and mobility of camps make it impossible for an enumerator based in a village to contact the families with sufficient frequency and regularity. It soon became obvious that someone who is not BoDaaDo could not remain in the camps permanently for a year. WoDaaBe camps are rudimentary even compared to Twareg pastoralists' camps. The WoDaaBe do not use tents or construct huts, and during a good part of the year are separated into individual household units rather than the groups of households found in Twareg or most other pastoralists' camps even at the height of the dry season.

Data collection had to continue at least a year to cover seasonal variations and could not have gaps if it was to be accurate. It was unrealistic to think that even someone from another Fulfulde-speaking group could cut himself off from his own family and social milieu for a year and maintain enough enthusiasm to work reliably. During preliminary work, the researcher found that Fulani translators who had several years of schooling, but were from livestock-raising families so they were familiar with conditions in the bush, could not spend more than three weeks at a time in WoDaaBe camps. The lack of all but the most basic physical comforts, monotony and cultural differences caused tensions to develop after this period. Even other Fulfulde-speakers, if not WoDaaBe, are considered by the WoDaaBe as outsiders, and they make this felt.

The only alternative was to have WoDaaBe herders themselves collect the data. However only a few WoDaaBe children have spent any time in school and none have learned sufficient French or writing skills for the data collection required. In any case only adult heads of household would be accepted to do the questioning necessary for the study, and none of these have had any schooling. Islam has had only a superficial effect on the WoDaaBe and they are not literate in Arabic. In the Tchin Tabaraden area however most WoDaaBe speak Tamasheq as a second language, and the researcher was able to find a few WoDaaBe who know Tifinagh, the phonetic script used to write Tamasheq. They had learned Tifinagh from frequent contact with Twareg, and because it is phonetic they could use it to write Fulfulde. Although Tifinagh is not normally used to write Fulfulde, and some of the sounds in Tamasheq and Fulfulde are different, each WoDaaBe enumerator adapted it in his own way and was able to write down information sufficiently clearly to read it back when the researcher translated the twice-weekly questionnaires.

Four enumerators were found who were familiar with Tifinagh and interested enough in the study to go through the long training period. They were aged between 25 and 40 years, and were all household heads. Each enumerator was only able to question from three to five families in addition to his own. All WoDaaBe heads of household are also herd owners, and their herding work is onerous, particularly in the dry season. Every other day the herder leaves the camp with his animals in the morning and often does not

return until late at night, and sometimes early the next morning, when watering is particularly slow and arduous and distances to water points long (up to 20 kilometers). If shallow wells are being used they must be cleaned out on the alternate days the herd is not being watered. Even in the wet season, WoDaaBe herders are constantly with their animals while they pasture and water, whereas Twareg animals often pasture and go to the well unaccompanied. The more frequent moving of WoDaaBe camps also means that WoDaaBe herders are less available for non-pastoral work than Twareg.

In addition to the limited amount of free time, distances between camps are long. Although each enumerator questioned families that normally remained close to his own, even in the wet season some of these families were five kilometers apart and in the dry season each family could be separated from the next by a camel ride of several hours.

Furthermore, even after practice, filling out the questionnaire forms was a slow job for the enumerators, who had no previous experience with writing, with numbers, with situating figures in the right lines and columns, and who had to sound out laboriously each word as they wrote it down.

As a result of these problems, the number of families that could be questioned was limited. They had to be people who normally moved in relatively close association with the enumerator's camp, they had to be whole-heartedly willing to participate in the study to ensure that the information given would be as accurate as possible, and they had to be people with whom the enumerator had enough personal contact that they had confidence in him and he could trust their replies.

In spite of the limitations, there are distinct advantages to having herders themselves collecting data. Their direct knowledge of everyday life in the camps, both in general and of specific circumstances, helped provide more accurate and complete data than if it had been collected by an outsider asking questions. Furthermore, involving the WoDaaBe themselves in gathering data which was to serve as a basis for development policies was seen as a first step toward their participation in the elaboration of these policies.

The first contact with the chief of the administrative 9th nomadic group, which covers the WoDaaBe in the Tahoua department, was in April 1980. This was followed up in June 1980, and in July the researcher began a training and preparation period which took five months. During this time contact was gradually built up with a small group of WoDaaBe, enumerators were identified, trained and put through a trial data-collection period, and considerable time was spent explaining the study and ensuring that the families concerned understood what was involved and wanted to participate. The researcher tried to make clear that they could not expect direct benefits from the study but that it was undertaken in the hope that an improved understanding of the WoDaaBe's problems would contribute to finding solutions that would be better adapted to their needs. This was something that they considered acceptable, particularly because the WoDaaBe feel isolated from what is going on in the rest of the country and from decision-making processes.

The enumerators had to be taught to write numbers, practice writing Tifinagh so that they could write more quickly, and had to learn to use the questionnaire forms which were complicated for someone with no schooling. Time spent on labor tasks was recorded in hours which the WoDaaBe were not initially familiar with. Each enumerator was given and taught to read a watch so that he could familiarize himself with the length of time represented by an hour. During training sessions the researcher drilled them by indicating the position of the sun when a task began and the position of the sun when it was finished and asking them to estimate how much time was spent. Although all of these procedures where lengthy, the enumerators had few difficulties after practice. In cases where they had trouble writing prices that involved numbers higher than 20 or 30, they simply wrote out the price in words in Tifinagh.

Each enumerator began data collection on one family and other families were added gradually as he became more experienced. In November 1980 the first families were started and in September 1981 the last of the 19 families were begun. Data collection continued until September 1982 so there is from one to two year's data on each WoDaaBe family in the sample.

It was decided to have the enumerators include their own families in the study. Although the enumerators' salaries make their budget data unrepresentative, because there are no WoDaaBe with regular salaries, the ease with which they could include this additional labor data made it worthwhile. It was also thought that it would be interesting to see how unaccustomed income would be used.

Each enumerator was paid the minimum wage in Niger (20,000 FCFA a month), which was raised in the course of the study (to 28,000 FCFA). He was also loaned a camel belonging to the Livestock Service. Families participating in the study received small gifts of tea and sugar roughly every three months.

Once data collection was underway, the researcher had to go over each of the questionnaire forms with each enumerator. This was necessary because there was no one else with the educational level necessary to do coding who know both Tifinagh and FulFulde so that he could read the sheets. Although it was extremely time-consuming, it was invaluable for soliciting further information and clarification.

In the beginning the researcher translated the Tifinagh into Fulfulde on the questionnaire forms and then coded it. It was important to record the WoDaaBe's system of categorizing labor activities and the specific terminology they used (for example, there are different words for daily watering and dry season watering done every other day, and different worda for pasturing depending on the time of day and duration). Later, after this terminology had been well documented, the data were coded directly in the bush as the researcher went over the forms with the enumerators, noting unusual terms as they came up. Two Fulani assistants with five and seven years' schooling added up bi-weekly totals of time devoted to different labor tasks.

It was only because the sample was so small that it was possible to go over the sheets in such detail. This was partly a necessity because of the limited writing skills of the enumerators, but also a distinct advantage. In some cases what was written down actually served more as a memory jogger for the enumerators. For example in Tifinagh there are no vowels, so actives and passives, which in Fulfulde are distinguished by different vowel lengths,

could not be distinguished by what was written alone ("he gave" as opposed to "he was given"; "he loaned" as opposed to "he was loaned"). Cross-checking ahowed that the memories of the enumerators were impressive, and were of course increased by their direct knowledge of all the activities and transactions that went on. Within a small group of WoDaaBe, everyone is aware for example of the sale of an animal, its price, age, sex, condition, buyer, because such things are the subject of endless conversation.

At the same time, incomplete information could be added to and obviously incorrect information could be picked up immediately and modified. This progressively increased the accuracy and quality of the enumerators' work. When they knew that errors and inconsistencies would be pointed out quickly, they worked more conscientiously.

Often things that seemed like errors or anomalies, once further explanations were given, turned out to be indications of practices or techniques that the researcher had not been aware of or had not fully understood. The discussions begun by this sort of questioning provided information essential to fill out the context into which the purely quantitative data must be put if it is to have any meaning.

Furthermore, the time involved in sitting in camps going over the forms meant that the researcher developed a familiarity with everyday happenings, procedures and personalities. Theae observations served as a cross-check on the data being gathered. Simply being present during spontaneous discussions contributed to a general understanding of situations and conditions. Details as diverse as low market prices for a particular week, pasture conditions, friction between individuals, the sous-préfet sending out goumiers (the Nomad Guard) to take WoDaaBe children to achool, helped make sense of otherwise inexplicable things (for example, market behaviour, camp movements, joining or splitting of families).

The researcher used several additional ways to cross-check the data recorded. A series of standard labor activities were timed and price information was collected in marketa. Researchers supervising similar atudies have checked on enumerators by making unannounced visita to the sample and

repeating an interview to compare with what was recorded. While this has been satisfactory in other contexts, the close interaction among WoDaaBe sample families and between the sample families and the enumerators was such that the researcher felt that repeating interviews would be seen by everyone concerned as a lack of confidence in the enumerators. Given the risks the enumerators were running in undertaking something entirely inhabitual to the WoDaaBe, the importance of not shaming a BoDaaDo in front of members of his group, and the necessity of maintaining a certain level of personal confidence on all sides, it was decided to use indirect methods of cross-checking.

There were several weaknesses in the study which should be taken into consideration. It is likely that young children's work is underestimated. From the age of about four or five years both boys and girls help out with a large number of small but essential tasks: collecting wood, accompanying (with an older child or woman) donkeys for watering and collecting domestic water, keeping the cows away from their calves during milking, helping at the well by directing draught animals or keeping animals away while others are being watered.

Some characteristic prohibitions observed by the WoDaaBe complicated data collection. For example, when a man's wife is several months pregnant with their first child, she returns to her father's camp until she has given birth and often remains until the child is weaned. During this period there are strict avoidance relations between the husband and his wife's family, and the husband does not approach his parents-in-laws' camp while his wife is there. During the study, the wife of one of the enumerators returned to her father's camp to give birth. Her father's family was one of those being interviewed by her husband. Because the enumerator and his father-in-law are close relatives, they had another relationship that superseded the avoidance relation and the enumerator could continue talking to his father-in-law, but he could not enter the camp to interview each member of the family as he normally would. He had to improvise by catching members of the family outside the camp or asking some members about others' activities.

For milk production calculations, the enumerators recorded the number of cows that were being milked for each three and four day period. Because of a general prohibition on talking about such things, the enumerators could not ask directly how many cows were being milked but had to observe how many calves were at the calf-rope and find out if any of the lactating cows were not being milked for some reason.

It was difficult to convince the enumerators to ask the women systematically what they did each day. The men insisted they knew what the women were doing, even those women who remained in the camp while the men were at the well all day. The researcher cross-checked the activities recorded with her own observations until the women's work seemed to be recorded accurately.

Non-market exchange transactions are often underestimated in household budget studies. The WoDaaBe enumerators recorded barter of animals and consumption items well, but one category of exchange, milk products or tobacco bartered for cereals or money, created difficulties. This exchange is controlled and carried out exclusively by women, usually outside their camps, and during the cold season can account for a large proportion of the cereals consumed by the family. The enumerators were not usually present during the exchange and the quantities involved were difficult for them to measure. The researcher tried to compensate for the imprecision of this data by questioning the women retrospectively, and by setting up an additional study during which an enumerator questioned seven to nine women daily and measured and recorded the amounts of curdled milk, butter and tobacco given and the quantities of cereals obtained.

There were several cases during the study when individual families moved too far away from the enumerator's camp for him to visit them regularly. This caused gaps in the data for some households for varying periods of time (from one or two to 15 or more weeks). In these cases, once the family moved back, the enumerator summarized the budget data to cover the missing period. This could not however be done with labor data.

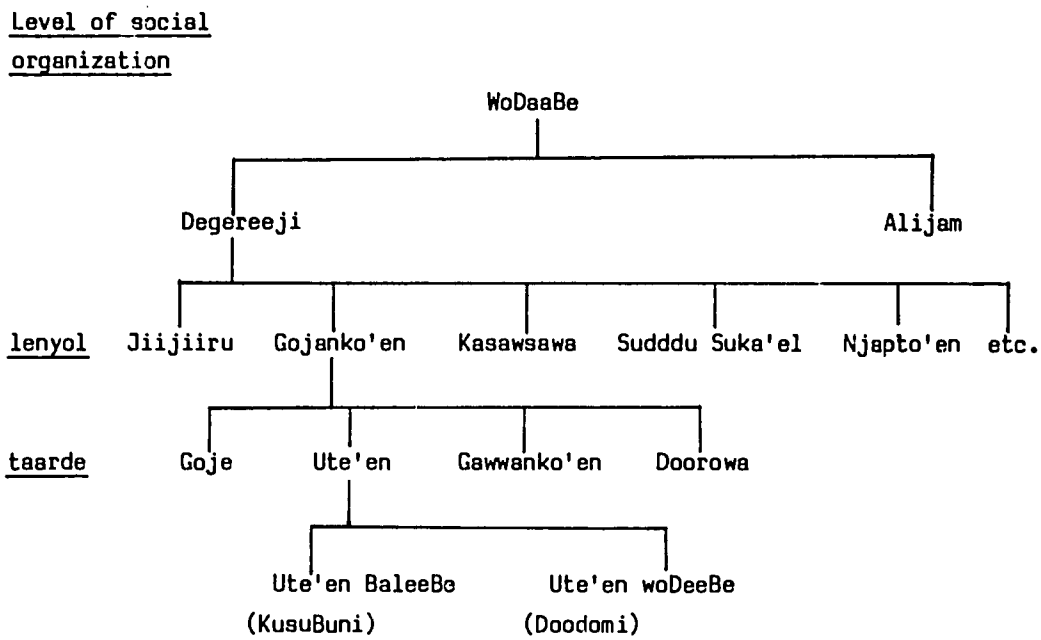
The rainy season of 1981 was poor and resulted in unusually sparse 1981-1982 dry season pasture. Three families in the study moved completely out of the area during the 1981-1982 dry season. Because the 1982 rainy season began late, these families did not return until September. The families that did remain in the area were more scattered than usual and remained so for a longer period of time than in normal years.

This situation was complicated by the fact that one of the families that moved away was the father of one of the enumerators. Because his brother was away in Nigeria working, and his father was old, the enumerator was obliged to stay with his father to help with the herd. He managed to keep collecting data on the families he interviewed by occasionally hiring a Twareg to help his father at the well and travelling long distances (from west of Akarana to the Tchin Tabaraden area) to question his families. He was able to do this less regularly than during the rest of the study and the quality of the data suffered somewhat as a result.

Sample description

The WoDaaBe in the project zone are divided into two maximal lineages based on agnatic descent, the Degereeji and the Alijam. Within these two major groupings are several primary lineages (lenyol). The household production study was done among the Gojanko'en, one of the six Degereeji lineages, who move both in the rainy and dry seasons within a region between Tchin Tabaraden, Kao and Abalak, with several groups around Chadawanka. Like other WoDaaaBe lineages, the Gojanko'en (approximately 5,000 people) are divided into smaller groupings on the basis of agnatic kinship and common use of an area. There are four Gojanko'en fractions: Ute'en, Goje, Gawwanko'en and Doorowa. The Ute'en (around 1,500 people) comprise two sub-groups, the Ute'en BaleeBe and the Ute'en woDeeBe. The detailed household- level studies were carried out among eleven Ute'en BaleeBe families descended from the same great-grandfather (in one case, grandfather), KusuBuni. In the sample were also eight Ute'en woDeeBe families whose heads of household are all grandsons or great-grandsons of Doodomi. The position of the sample households within the WoDaaBe of the project zone is shown in figure 4.2.8.

Figure 4.2.8 Position of sample families within WoDaabe lineage structure



Like the other WoDaaBe groups in Niger, the Gojanko'en started moving from northern Nigeria at the beginning of this century. The Ute'en BaleeBe arrived in the area between Labanda and Chadawanka around 1920-1930 and remained there until the 1973 drought, after which they moved north to the area around Kao. They now normally use an area with a radius of about 30 kilometers with Tchin Tabaraden at its extreme western edge. In 1974 the administrative chief of the Ute'en BaleeBe was named chief of the Tahoua Department 9th nomadic group through which most WoDaaBe in Tahoua are officially administered. The Ute'en woDeeBe arrived in the area around Durum (50 km south west of Tchin Tabaraden) in the 1920-1930s and have remained there until the present. Both groups had longer transhumance routes before the drought than they now have. Their dry season point of departure was further south, and the Ute'en BaleeBe went as far north as the salt areas around Ingal.

The general region used by the Gojanko'en is shared by members of other WoDaaBe lineages, the Jiijiiru, the Njapto'en and the Bii Korony'en. The lineage with which the Gojanko'en have the closest relations of cooperation is the Jiijiiru (the ancestor of the Jiijiiru and the ancestor of the Gojanko'en are said to have been twins). Most animal loans between the Gojanko'en and other lineages take place with the Jiijiiru and the Najpto'en. The majority of Gojanko'en marriages with women from another lineage are with Bii Korony'en women, and more Gojanko'en women marry into the Bii Korony'en than into other groups. This relation between the Gojanko'en and the Bii Korony'en is both a source of tension (between groups that have "lost" women to each other through te'gal marriage), and a source of ties (because the maternal relatives of many Gojanko'en are Bii Korony'en).

The WoDaaBe represent a distinctive pattern of mobile livestock raising. However within this general model there is considerable variation between WoDaaBe groups and between different geographical areas. In order to situate in a wider context the sample in which household-level studies were done, the characteristics of the Gojanko'en are discussed here with respect to the range of variation found among the WoDaaBe groups in the project zone.

The Gojanko'en share the same general area with Twareg herders and cultivators. There are frequent difficulties between the two ethnic groups over the use of resources. But they also cooperate in many ways: the Gojanko'en exchange milk products or tobacco with Twareg who cultivate sorghum around Durum and Sarsadan. They often hire Twareg to help with well digging and consult Twareg when they need to treat their camels. Some Gojanko'en families herd cattle belonging to Twareg for a season or more permanently. As a result of these contacts, the Gojanko'en are more influenced by the Twareg than are WoDaaBe groups in other areas. They speak Tamasheq more readily than Hausa and a few Gojanko'en have even adopted Twareg tents.

The Gojanko'en, when compared to other WoDaaBe, are among the least mobile. In this respect they are most similar to some Bii Hamma'en around Dakoro or Abalak. Although they continue to move camp in the dry season, they normally stay within a restricted area and their rainy season movements do not

cover more than about 40 or 50 kilometers. Because of this they use markets more often than most other WoDaaBe groups. Although the Gojanko'en go to markets less often in the rainy season, they continue to go regularly, whereas many WoDaaBe stop using markets entirely during this period. They have become used to purchasing items that are not generally used by other WoDaaBe (rice, peanut oil, cotton seed).

During the dry season their water points are mainly shallow wells which they dig each year in low-lying areas. There is no private ownership of deep wells as is found among the WoDaaBe in the Dakoro area for example. The Gojanko'en occasionally use public boreholes, and sometimes use surface water pools later in the dry season than is habitual for the WoDaaBe (in places such as Durum where water remains all year).

Although most WoDaaBe rely primarily on cattle with some small ruminants, there are WoDaaBe groups that also have female camels or large sheep flocks. The species composition of the sample Ute'en herds however is typical of that of the WoDaaBe in general.[1]

In terms of animal ownership per person, the Gojanko'en are in the middle range of WoDaaBe groups (i.e. there are WoDaaBe who own more animals and others who own fewer animals on average per person than the Gojanko'en). The same is true of the proportion of families among the Gojanko'en who herd animals belonging to other ethnic groups, and the proportion of Gojanko'en who leave the pastoral zone on labor migration to earn money in the dry season. The amount of cereals obtained through the exchange of milk products or tobacco is also moderate with respect to other WoDaaBe groups, some of whom do not practice this sort of exchange at all, while others meet a larger proportion of their cereal needs through exchange than do the Gojanko'en. The Gojanko'en have particularly good opportunities for exchange (they are close to markets and to cultivating Twareg groups) but often do not have enough milk to exchange.

---

1. Among the Gawwanko'en, who are somewhat apart from the other Gojanko'en, both geographically and in some other respects, there are families who have small camel herds and some who rely heavily on sheep.

Having their fraction chief named chief of the 9th nomadic group has not made the Ute'en BaleeBe more powerful with respect to other WoDaaBe groups. Other possible advantages (improved access to the administration or to government handouts) have only affected the chief's immediate family, which was not in the sample, and have not had a significant effect on the group as a whole.

The Doodomi sample families use an area of the Azawagh west and southwest of Tchin Tabaraden. It is bounded to the south by the hilly area (Aguzera) bordering the northern edge to the Ader. Their movements during the period of the household studies are shown in figures 4.2.9. and 4.2.10. They spend the dry season around Durum and Abalagh (a low-lying area about five kilometers north of Durum). With the first scattered rains they move slightly north, taking advantage of a region of stable sandy dunes (called Yolde by the WoDaaBe) where rain infiltrates easily and grass begins to grow as soon as it rains. They continue to move gradually north, following the rainfall. By the time the rains are well underway they have reached the Tadist valley which runs west of Tchin Tabaraden. They spend most of the rainy season in this valley, which offers a wide variety of different grass species, and in clay plains (called katar by the WoDaaBe) north of the Tadist. Because of the hard flat surface of the katar the rain infiltrates less easily and grass appears later than in the Yolde. At the height of the rainy season the katar has many surface water pools and animals do not have to be taken far to water.

As the rains end and surface water dries up, the Doodomi'en begin to move south of the Tadist using the secondary and parallel valleys, the Tarjaghlal and the Tazar. For the dry season they continue south of the Yolde in which water is difficult to reach during the dry season. They thus return to the surface water at Durum and other low-lying areas nearby where they can dig shallow wells. Their normal yearly movements cover about 80-90 kilometers from Durum to northwest of Tchin Tabaraden and back to their dry season area.

The Doodomi families normally use the Tchin Tabaraden market and, somewhat less often, the Taza market (to the south) which offers both higher prices for their animals and lower prices for cereal and other consumption goods, but which is further away and requires a longer absence from the herd and camp. They occasionally use the Kao market.

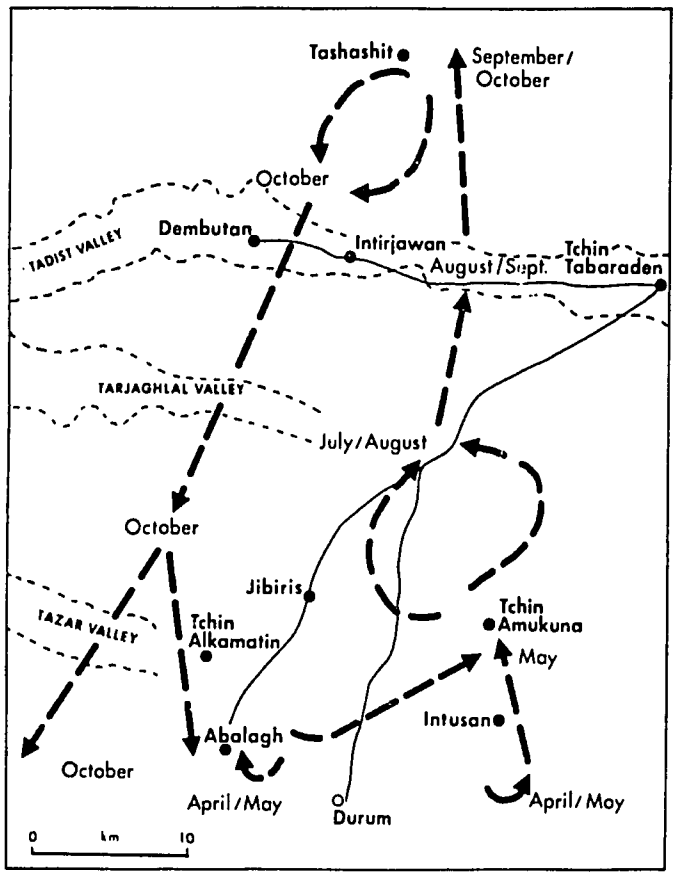


Figure 4.2.9 Movements of WoDaaBe sample households (Doodomi'en), April to October 1981

The KusuBuni families move in a more restricted area than the Doodomi'en; they are show in figures 4.2.11 and 4.2.12. In a normal year their rainy season area is not very different from their dry season area. They are 20-40 kilometers east and southeast of Tchin Tabaraden in an area of katar, typical of the Azawagh in which water points are abundant both in the rainy and dry season. This area is crossed by the Allabo valley, running north south-west.

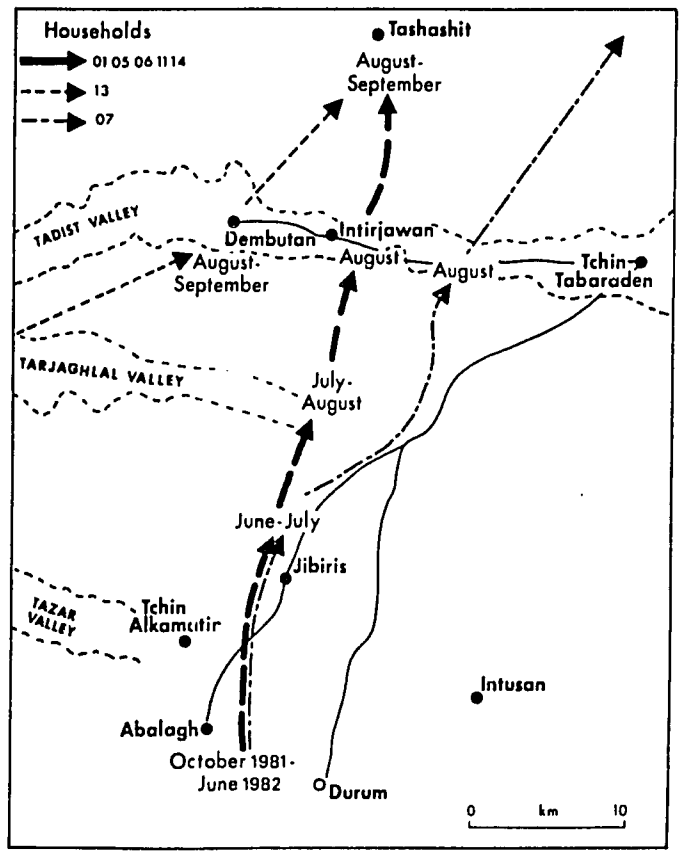


Figure 4.2.10 Movements of WoDaaBe sample households (Doodomi'en) October 1981 to September 1982

The Allabo (and secondary valleys, Chinfargasan, Sisikkan and Intusan) provide many places where shallow wells can be dug in the dry season. At the beginning of the rainy season the KusuBuni'en move slightly south toward Kao to use the early pasture of the Yolde and then move north back into the katar, where grass begins to grow about a month after the first rains. This group uses primarily the Tchin Tabaraden market, sometimes Kao, and less frequently Abalak.

In the dry season of 1981-1982, poor pasture followed by late rains caused families in both groups to scatter more than normal. One of the Doodomi sample families moved about 85 kilometers west of the normal dry season area, and did not rejoin the other families until September. Among the KusuBuni'en three sample families moved to the borehole at Tofamenir (60-70 kilometers north east of where they normally are) at the beginning of the dry season, and then moved east of Abouhaya (about 100-200 kilometers east of

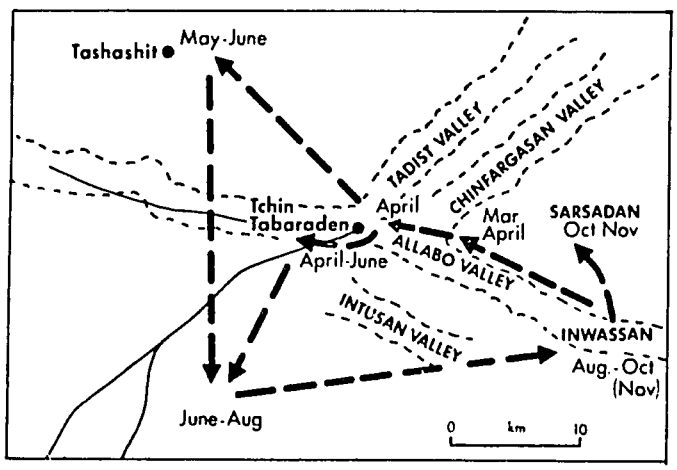


Figure 4.2.11 Movements of WoDaaBe sample households (KusuBuni'en), March to November 1981

where they normally spend the dry season). Five other KusuBuni sample families spent the 1981-1982 dry season 50-60 kilometers south of their habitual area.

The WoDaaBe sample consisted of a total of between 130 and 166 people, depending on when the census was made. These are divided for analytic purposes into 15 households, defined, as discussed above, as the wuro

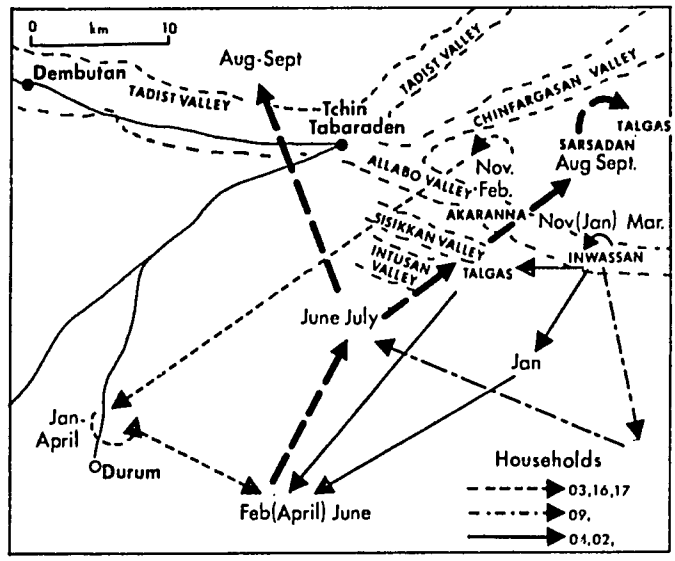


Figure 4.2.12 Movements of WoDaaBe sample households (KusuBuni'en), November 1981 to September 1982

consisting of the social unit (usually a man and his wife or wives and their dependent children, plus in some cases his dependent brothers and their wives and children, or other dependent kin) living from a jointly-managed herd, and sharing a common budget for major expenses. Based on this definition, within the sample, men whose wives had not yet come to live with them, or women who had not yet gone to live with their husband, were considered part of the household of their older brother or father, depending on where they worked and were fed. Divorced women were also considered part of the household of their father or brother. Older men or women who no longer had a household of their own were considered members of the household of the son that fed them. Women pregnant with their first child who had returned to their father's household to give birth (where they remain until the child is about two years old) were considered part of their father's household.

Table 4.2.7 Demographic structure of WoDaaBe sample

Age (years)	Numbers of people[1] Male	Female
0 - 2	14	10
2 - 5	6	15
5 - 9	8	14
9 - 15	6	4
15 - 19	7	9
19 - 41	21	37
41 - 61	5	4
61 +	2	4
Total	69	97

Note:
1. Numbers based on the full household census.
At any one moment fewer people usually present.

Of the nineteen adult men whose wives were with them in the sample, four were dependent in this way on other families in the sample. There were two cases of a younger brother and his wife dependent on an older brother,[1] and one case of two brothers with their wives and children dependent on their father. There were thus three joint households in the sample. In seven cases a husband had more than one wife (six men had two wives, and one man had four). When there are co-wives, each woman eventually constructs a separate suudu, or shelter: the sample consisted of a total of 23 cuuDi, with an average of 6.0 people (including children) attached to each suudu. The average number of people per household in the 15 households was 8.7 (± 2.9). Table 4.2.7 gives the age/sex breakdown of the sample population. Because the

1. In the course of the study the wives of both of these younger brothers constructed their cuuDi and their husbands began buying cereals.

size of the sample is too small for any demographic analysis, age categories were defined on the basis of the division of labor, and include all persons who lived, worked and ate for over a month in one of the sample households during the period of study. The actual number of people in the sample at any one time was around 140.

Table 4.2.8 Mean household livestock holdings in WoDaaBe sample

	Mean holdings		
	Total TLU [1]	Cattle owned and loaned	All cattle (including jokkere)
Per household	17.7	22.9	24.7
Per person	2.0	2.6	2.8

Note:
1. Cattle (owned and loaned), sheep, goats and camels.

Table 4.2.8 shows mean livestock holdings in the sample. The mean household herd was 23 cattle, or 25 if the entrusted jokkere cattle herded by two households are included. There were no extreme differences in wealth (defined by the number of animals owned per person) between families in the sample, as table 4.2.9 shows. There is however a range from 3.9 TLU/person to 0.5 TLU/person.[1] Only two households in the sample exceed the theoretical poverty threshold of 3 TLU/person;[2] the others do not own herds sufficient for their independent subsistence. This situation is true of many WoDaaBe households in the project zone, which are obliged to find additional ways of meeting their subsistence needs. One recourse is to herd animals belonging to other ethnic groups (jokkere), thus increasing the milk supply available to

1. Camels, cattle, sheep/goats counted as 1, 0.7 and 0.1 TLU respectively.

2. See below.

the household. Jokkere animals cannot be sold, so are not a source of income. Two families in the sample herded jokkere cattle belonging to Twareg (25 and 2 head respectively).[1] These animals were excluded from the calculations of total TLU per person and total cattle per person. Animals on haBBanae loan from other WoDaaBe were included in these calculations.

Table 4.2.9 Animal distribution in WoDaaBe sample

No. of TLU/person	Households		People		Total TLU	
	No.	(%)	No.	(%)	No.	(%)
< 2	6	(40)	57	(44)	73.3	(28)
2 - 3	7	(47)	59	(45)	138.8	(52)
> 3	2	(13)	15	(11)	53.8	(20)
Total	15	(100)	131	(100)	265.9	(100)

1. Because the size of a family's herd fluctuates constantly due to animal sales, deaths, births, one point in the late study period was taken for these calculations. There were other times when a third family herded jokkere.

HOUSEHOLD BUDGETS

Household budget data were collected twice weekly at the nuclear family level. The enumerator recorded everything bought or sold by any member of the household, as well as all exchanges, gifts or loans in cash or kind. The place of the transaction (which market, or in the bush) was also recorded. When a household moved too far away for the enumerator to reach it on his twice weekly visits, or, in one case, a death in the family made questionning impossible for several weeks, the budget data for the missing period was summarized on the enumerator's next visit. When people were absent on migrant labor, other members of the household remained behind to care for the herd, so data collection went on normally. On the migrant's return, his or her earnings and expenses were summarized.

For the purpose of budget analysis, the data were aggregated into wuro or household production units as defined earlier. One production unit was excluded from the budget analysis because of a prolonged period when the enumerator could not reach it for questionning. So budget data are analysed for 14 household production units, with an average size of 8.9 people.

The household production units thus defined are common herd management and budgetary units. As discussed earlier, until a man's wife has given birth and constructed her suudu, she does not prepare meals, and husband and wife are dependent on his father or older brother for cereals and other subsistence items. Although livestock are individually owned, the household head can, after consultation, sell animals belonging to dependent members of his wuro. Conversely, a dependent son or brother has no economic responsibilities to the household which would oblige him to sell his own animals; all his expenditures are discretionary. The animals belonging to the household head and all other wuro members are managed together in a single joint herd.

The head of the household is responsible for providing cereals for all members of the household, clothing for his wives and children, and equipment and food supplements for the herd (ropes, hobbles, water sacks, troughs, animal salts, fodder). A married woman must provide the domestic equipment (bed, mortar, pestle, mats, calebashes, cooking pots and other utensils), and

the condiments necessary for cooking. Milk from the household herd belongs to the wife of the head of the household. It was found in the course of the study that when she obtains cereals from the exchange of curdled milk and butter, a woman contributes these to household consumption rather than selling or exchanging them to obtain things for heraelf. On the other hand, when the woman has no money, her husband will give her what she needa to buy domestic items (particularly mats which have to be replaced regularly) and condimenta.

The budget analysis year runs from August 1981 to July 1982.[1] It is divided into four three-month seasons: the rains and the period immediately after the rains (August to October 1981), the cold season (November 1981 to January 1982), the hot season (February to April 1982), and a transition period between the hot season and the rains (May to July 1982). The actual cut-off points are necessarily somewhat arbitrary in terms of the start and end of each season.

These periods correspond to marked differences in weather, in pasture and water, in milk production, in food consumption, in camp movements and herd management patterns. In the rainy season there is a relative abundance of green grass and surface water. Cattle produce most milk at this time, and least cereals are eaten. Camps are close to each other and there is more socializing and sharing of food. By the cold dry season, the rains have stopped, the grass has dried and daily watering of animals has started. Camps are more separated.

Milk supply is reduced but there is usually enough to exchange for cereals from the recent harvest. During the hot dry season, individual households are extremely dispersed. Watering takes place every other day, involving hard work in extreme heat. Virtually all the milk is left for calves, and cereal consumption is high. Both people and animals are poorly fed. The transition period to the rainy season is a time of frequent, long and irregular camp movements to use the first green grass and surface water. Milk production

---

1. Data collection for some households extended as long as two years, but the analysis period selected was the most complete data set.

does not increase until the rains are well underway. The poor nutritional state of people continues through this season; animals are also thin and their mortality is high.

The budgets of the sample households are large overall because of the high level of dependence of the WoDaaBe on the market. Half or more of their calorie needs are met by cereals, which must be obtained through purchase or exchange. Their main souce of cash for cereal purchases is livestock sales, particularly cattle. Furthermore, the cattle herds are not large enough to provide naturally the right age and sex mix for optimum milk production and reproduction, so animals have to be bought and sold to maintain the necessary herd structure. Many items that the WoDaaBe once produced themselves (ropes from bark or leather, mats and saddle blankets from bark, sandals and breeches from leather), are now either purchased ready-made or the materials to make them are bought. Other items (cotton seed, bran, cooking oil, animal salt,[1] camels, donkeys) have become necessary purchases because of the movement of the WoDaaBe into dryer areas. A few new luxury items are now bought in the market (flashlights, radios, Twareg clothing). One important previous expenditure is not now necessary: animal taxes were eliminated in 1974, and head tax in 1977.

(1) Expenditure

Food Purchases

Cereals

The cereals most regularly eaten by WoDaaBe sample members are millet, sorghum, and to a lesser extent, rice. The WoDaaBe prefer millet to sorghum, but millet is usually slightly more expensive. White sorghum is preferred to red which is used for emergency food distributions. Rice is much more expensive than millet or sorghum. It is only since the 1973 drought, when women started visiting towns in the south to earn money, that they have begun eating rice, and there are some WoDaaBe women who do not know how to prepare rice. Rice does not dissolve in milk as millet does, so the WoDaaBe can not use it to prepare their preferred food, and they buy it mainly when they have

1. Many WoDaaBe groups no longer go as far north as the areas where salt deposits are found, and other salty areas, for example to the west of Kao, seem to have been exhausted.

no milk to mix with millet. Rice is also bought in the rainy season when the WoDaaBe are moving frequently, because it does not have to be pounded and is easier to prepare.

Small amounts of wild fonio are obtained by the sample households through exchange with Twareg. Little is available in the markets, except at Kao where Twareg eklan bring it for sale. There were no cases of fonio purchases in the sample families. Macaroni, which is imported and expensive, is a more recent innovation than rice and is bought in very small quantities.

Cereals in Niger are officially marketed by the Office des produits vivriers du Niger (OPVN). The purpose of these government cereal stocks is to reduce speculation and supply cereals at controlled prices to that part of the population that does not grow them. The shops open from May until the harvest in October. The WoDaaBe need cereals least in August, September and October (the rainy season), as this is when they have most milk. They buy cereals mainly between November and July, so the opening of the government cereal stocks in May could only meet a part of their needs. Access to cereals at controlled prices from May to July, a time of high cereal and low animal prices, would be valuable, but even once OPVN cereal shops open, the WoDaaBe can not easily use them. Shops are in market towns usually far from WoDaaBe camps; supplies and opening times are irregular; civil servants and their families have priority. Often the WoDaaBe, after a wait of several days, can only buy a few kilograms at a time; this is clearly impractical for a herder who has left his animals unsupervised in the bush.

Therefore the WoDaaBe buy most of their cereals on the open market at much higher prices, but where they can usually find the amount they need. Sample families use the markets at Tchin Tabaraden, Kao and Abalak, with only minor price difference for cereals between them. New roads have in the last few years made cereal transport easier but cereal prices have actually increased in the pastoral zone because of increased fuel prices (Eddy 1979: 311).

Several factors influence cereal availability and prices. Cereals are sold in the market by private merchants, and prices are in theory regulated; however in practice the regulations are not enforced. Prices vary through the

year according to the agricultural cycle, dipping just before the harvest as merchants try to sell what is left of the previous year's grain, and rising steadily as cereals become scarcer until the following harvest. Unpredictable and sharper price fluctuations also occur within the year, and from year to year. The success of the harvest is an important determinant of grain availability and price, but other factors intervene: the opening or closing of the Nigerian border to cereal movements, hoarding by producers or speculators, cereal prices in neighboring countries, fluctuations in exchange rates (particularly between the CFA and the naira).

Table 4.2.10 illustrates the variability of cereal prices, by showing millet and sorghum prices actually paid by WoDaaBe by sample members over two years. Prices vary within the period by over 100 percent.[1] The extreme undependability of the cereal market for herders is shown by the high standard deviations even within seasons, running from 17 to 49 percent of the mean price. The highest variability in prices is in the transistion season of 1981, the year which has the more typical price profile for cereals. This extreme variability in cereal prices adds to other factors making the transition season the most uncertain and difficult time of the year for the WoDaaBe.

---

1. Prices in the 1981 hot and transition seasons were higher than indicated but sample members simply could not buy cereals at their peak (millet reached 400 CFA/kg at the Tchin Tabaraden market).

Table 4.2.10 Seasonal variation in prices paid by WoDaaBe sample households for main cereals

	Mean seasonal price (CFA/kg) of:					
	millet			sorghum		
	n[1]	mean price	(±SD%)	n	mean price	(±SD%)
1981						
Cold season	5	80	(±32)	5	75	(±32)
Hot season	14	124	(±29)	15	104	(±21)
Transition season	10	157	(±49)	20	152	(±44)
Rains	8	157	(±27)	10	146	(±27)
1982						
Cold season	18	194	(±23)	19	161	(±19)
Hot season	17	186	(±17)	14	166	(±19)
Transition season	30	140	(±19)	6	145	(±20)
Rains	12	170	(±22)	1	150	-
Survey year (August 1981 - July 1982)	73	166	(±25)	49	157	(±21)

Note: 1. Number of transactions.

Figure 4.2.13 shows mean monthly prices paid by sample members for cereals, including rice. Because it is mainly imported, rice prices are unaffected by the local harvest and remain fairly constant; the standard deviation for mean monthly prices paid for rice is relatively low and stable compared to those for millet and sorghum. Until the millet and sorghum harvest in October, 1981

is a typical year with a general rise in millet and sorghum prices, although there are sharp price fluctuations. The pre-harvest drop in millet prices comes earlier than that for sorghum as millet is usually harvested before sorghum.

After the 1981 harvest the pattern changes. Rainfall during the 1981 rainy season was very low. Because of the poor harvest, buyers feared that cereals would be scarce until the following year's harvest. In October and November OPVN buys grain from farmers, who often hold back their stocks at this time to be able to get higher free market prices later. In a year when prices were expected to rise more than usual because of supply shortages, producers had good reason to do this, particularly as it was generally felt in 1982 that OPVN's prices were much too low. In some markets close to the southern agricultural zone (for example Dakoro), there were no cereals in the market after the 1981 harvest; they could only be bought in small quantities from the producers in secret at night. As a result of these influences, millet and sorghum prices did not fall after the 1981 harvest, but rose, and stayed high throughout the cold and hot seasons.

Millet and sorghum prices dropped sharply in the 1982 transition season due to a sudden large influx of grain from Nigeria. Several factors explain this. High cereal prices in Niger were an attraction. The naira was devalued; the CFA, tied to the French franc, is more stable, and attractive at times of finaincial uncertainty in Nigeria. The Niger government also opened the border to cereal trade.

The availability of milk is another important determinant of cereal purchases. WoDaaBe drink milk whenever they can, and in the rainy season milk is an important food, considerably reducing cereal requirements. As milk declines, cereal purchases rise. Table 4.2.11 shows the seasonal variation in milk available to WoDaaBe households. These measurements were done in the year preceeding the household budget analysis year but were made in the same sample households. Measurements are the average of several consecutive days in the month indicated, not the average for the whole season. The figures probably overstate the amounts of milk available per person in the hot and transition seasons.

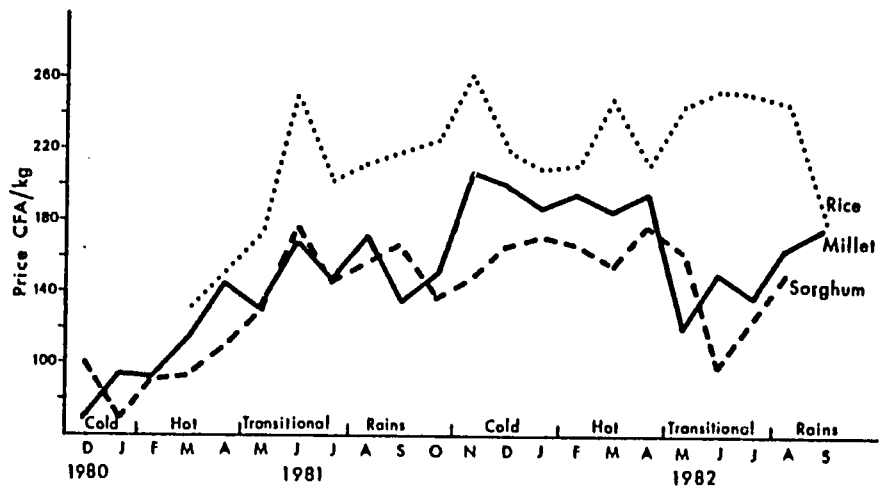


Figure 4.2.13 Mean monthly cereal prices paid by WoDaaBe sample households

Table 4.2.11 Milk available to WoDaaBe households in different seasons

	August 1980 (rains)	November 1980 (cold)	February 1981 (hot)	May 1981 (transition)	September 1981 (rains)
Milk production (liters/lactating cow)	2.35	1.35	0.64	0	n.a.
Milk consumption (liters/person)	n.a.	1.37	0.66	0.37	2.43

Source: Loutan (1982a: 54-55). Milk production measured from individual cows; milk consumption estimated.

Table 4.2.12 summarizes mean sample household cereal purchases by season in the survey year (August 1981 through July 1982). In the rainy season, when there is most milk, households purchased less than half the quantity of cereals they bought in the cold, hot and transition seasons.

Table 4.2.12 WoDaaBe net cereal purchases in main survey year

	Season				Year total
	rains	cold	hot	transition	
Mean household expenditure on cereals (CFA)	16,904	41,334	38,846	37,775	134,859
Mean net quantity of cereals purchased per household (kg)[1]	104	241	219	263	831
Mean seasonal price of millet (CFA ±SD%)	157(±27)	194(±23)	186(±17)	140(±19)	166(±25)

Note: 1. Calculated as gross quantity purchased net of one case of sale of cereals in the cold season.

Cereal purchases rose sharply in the cold season when animals normally are in good condition and cereal prices are at their lowest. Herders buy cereals at this time even though milk is still available and cereals can be obtained through barter. Cold season purchases at good prices may also be used to constitute small stocks for the following seasons.

Cereal needs rise in the hot season because of negligible milk, no cereal inflows from barter, and increaaed calorie needs due to the extreme heat, long distances to wells, and arduous work at thia time. However, the absence of adult men and women on migrant labor in this season reduces the amounts of cereals needed in the camps, as discuased later. In the transition seaaon, migrants return and total cereal requirements rise again. Transition season cereal needs vary considerably from year to year, depending on when the main rains arrive, grass begins to grow, and cows start lactating again. In the survey year, after a few scattered ahowers, there was little rain until late in the transition season. The animals, already weakened by a particularly bad dry season, were in very poor condition and giving scarcely any milk.[1] As a result, cereal purchases in this season were important, and were made easier by lower than usual ceral prices.

The WoDaaBe also obtain cereals through barter (sippal) with milk products. Women in the sample households exchanged curdled milk (the WoDaaBe never sell or exchange fresh milk) and butter in the market or in the camps of Twareg who cultivate small fields, mainly of sorghum, at Durum and Sarsadan, two low-lying areas in the project zone. Two meaaures of milk are exchanged for one measure of cereal throughout the period when barter takes place, but as milk production drops, WoDaaBe women adapt the terms of the exchange by mixing water with the milk; the proportion of water to milk increases as milk becomes scarcer.

The amount of cereals that can be obtained through barter depends on the amount of milk available to the household. But sippal does not only concern surplus milk. Terms of trade are such that more calories can be obtained by exchanging milk for cereals, than by drinking it. It is advantageous even for households with a small number of milk cows to exchange milk for grains.[2] However during the hot and transition seasons the small herds of the sample families

---

1. Many cattle had stomach occlusions from eating grass that had just sprouted but did not grow because of the lack of rain. The grass was so short that the animals could not avoid ingesting soil while grazing.

2. In the case of a poor household with too few milk cows to meet its consumption needs this would not justify a conversion of all milk into cereals to obtain more calories, because milk also provides necessary protein.

gave such little amounts of milk that it was not worth exchanging. This contrasts with Dupire's description (1972: 80) of the situation in 1961, before the drought, when, although WoDaaBe women did not have enough milk to make butter, they could still barter curdled milk.

The milk and butter from animals allocated to a woman are her own property, as is the money earned from their sale. It is the woman who balances the conflicting milk needs of the calves, people in the household and sippal.

Decision-making about the quantity of milk taken for sippal is influenced by the ownership of animals within the household herd.[1] A woman will take least milk from her own alhalji, the animals that belong exclusively to her (given by her parents, purchased with her own earnings or offspring from her own haBBanaaji). Animals that she co-owns with her husband and that will be inherited by her children (senndereeji), she milks somewhat more. Her birnaaji, those animals she is allocated for milking from among the alhalji belonging to her husband, are milked even more. Animals in the herd belonging to Hausa (jokkere) are milked with the fewest scruples. A woman is unwilling to milk her own alhalji or senndereeji for sippal if her husband can purchase cereals by selling his alhalji. She does not want to threaten the well-being of her own and her children's animals while conserving alhalji animals belonging to her husband that could be given as senndereeji to a new wife.

Cereals were also obtained by women in the sample by exchanging tobacco with Tuareg. The WoDaaBe do not chew tobacco themselves. They buy it in the market and make up fist-sized bundles with a small piece of natron. In a Tuareg camp that has run out of tobacco but has cereals, WoDaaBe women can get through barter many times the amount of cereals that the tobacco is worth on the market.

There were few cases of sample households exchanging animals for cereals (hollore). This was common practice in the bush in the past but usually takes place on disadvantageous terms for the herder. Dupire (1972: 78) speaks of farmers travelling north to the pastoral zone to exchange their cereals

---

1. See table 4.2.2 above for the different categories of rights in animals.

directly with herders. She also mentions (1972: 25) that millet cost 50 percent more in the bush than at the nearest market. Although hollore is not frequent in the sample families, it is done occasionally by other WodaaBe in the pastoral zone. Sometimes animals are exchanged for a future harvest; the herder thus shares the risk with the cultivator. Hollore is less frequent now in the survey area because markets have shifted north. The sample families are closer to markets and do not have to accept the unfavorable terms of the exchange in the bush. Furthermore transporting cereals is now strictly controlled in Niger.

There were no cases of cereals obtained through the exchange of manure. The WoDaaBe are now well north of the agricultural zone. Although there are scattered fields in the areas they use (for example around Abalak, Mayata, Dakoro), where rainfall is low there is the danger that manure will burn the crops, not benefit them. As a result, farmers in these areas prefer not to risk manuring their fields.

The sample families do not make cheese or use the milk of sheep or goats for sippal; some Bii Korony'en do mix goats' milk with cows' milk for sippal.

Gifts of cereals occur mainly in the late transition and rainy seasons when there is increased circulation of food between households. When a woman has given birth, gifts of cereals are brought to her camp. Two sample households received small gifts of cereals from their father who was based in Tchin Tabaraden and several times had access to government cereal distributions.

The amount of cereals a household gets through barter depends mainly on the amount of milk it has available, and on the possibilities for exchange. Table 4.2.13 shows the amounts of cereals obtained by the sample households in the survey year through barter and gifts as well as cereal outflows. Barter takes place mainly in the cold season when farmers have most cereals after the harvest, and the WoDaaBe still have enough milk. Smaller amounts of cereals are obtained by barter at the end of the rainy season when household milk

supplies are high and some grain is available at around the time of harvest.[1] The sample households were near markets or the camps of cultivating Twareg throughout the year, so the amount of aippal undertaken was limited mainly by milk availability.

Table 4.2.13 WoDaaBe non-market cereal transactions

	Quantity transacted (kg/household) in season:				Year total
	rains	cold	hot	transition	
Received from barter	28	66	1	-	94
Received as gift	3	10	5	23	41
Given as barter, gift or loan	8	2	-	2	13
Net inflow	22	74	5	21	122

Note: Columns and rows may not add due to rounding.

The amount of cereals a household gets through barter, relative to cash purchases, depends on how near the camp is to market, the quantity of milk available, and whether there is some farming in the area. Table 4.2.14 shows the amount of cereals sample households got during the survey year from all sources, and table 4.2.15 shows the same data in percentage terms. Sample households, on average, acquired 953 kg of cereals from all sources (net of a small number of sales and gifts made) during the survey year, which, with a

1. The rainy season defined for analysis includes October when some harvesting has taken place.

mean household size in the 14 households of 8.9 people, amounts to 107 kg/person/year. However absences of household members on work migration meant that the real amount available per person actually present was somewhat larger, as discussed below.

Table 4.2.14 WoDaaBe sample: net cereal inflows from different sources (kg/household)

	Season				Year
	rains	cold	hot	transition	total
Purchase	104	241	219	263	831
Barter, gift etc.	22	74	5	21	122
Total	126	315	224	284	953

Tables 4.2.14 and 4.2.15 show how much the WoDaaBe economy has changed from before the 1973 drought, when Dupire (1972b: 12) could say that the milk-millet exchange was the basis of the traditional economy. WoDaaBe in the sample households purchase 87 percent of their cereals, and sippal barter brings in less than 10 percent only; at the time of maximum barter, in the cold season, cereals acquired this way are still less than one quarter of total seasonal inflows.

Table 4.2.15 WoDaaBe sample: proportion of net cereal inflows from different sources (%)

	Season				Year total
	rains	cold	hot	transition	
Purchase	83	77	98	93	87
Barter	17	21	-	-	9
Gift	-	3	2	7	4
Total	100	100	100	100	100

Table 4.2.16 breaks down total cereal inflows to sample households by type of cereal. The relative share of sorghum is stable through the year except early in the 1982 transition season when the price of sorghum was, unusually, slightly higher than that of millet. Since the WoDaaBe prefer millet, they had little reason to buy sorghum. The slight increase in the share of sorghum in the cold season was because of the larger amount of cereals (usually sorghum) obtained through sippal in this season. Rice replaces millet to some extent in the rainy season because of frequent camp movements and more guests.

Table 4.2.16 WoDaaBe sample: choice of cereals

	Type of cereal (% of total inflow by weight) in season:				Year total
	rains	cold	hot	transition	
Millet	29	44	43	71	50
Sorghum	45	47	45	25	39
Rice	24	10	12	5	11
Others	2	-	-	-	-
Total	100	100	100	100	100

Figure 4.2.14 summarizes total net cereal inflows to sample households. From July through October 1981, there is a normal pattern of high cereal inflows during the transition season, dropping off sharply during the rainy season because of high milk production. High cold season cereal purchases, combined with cereals obtained by barter, cause inflows to peak in December 1981. Cereal inflows drop a little in April and May because considerable absences on migrant labour at this time reduce food requirements in the camps.

Net cereal inflows per person for one year in the sample households, calculated on the number of people actually present in the camps rather than on the household census, total 119 kg. Since almost all migrants are adults, the remaining population is younger than average. Actual consumption is therefore more than 120 kilos a year for each adult equivalent person present.

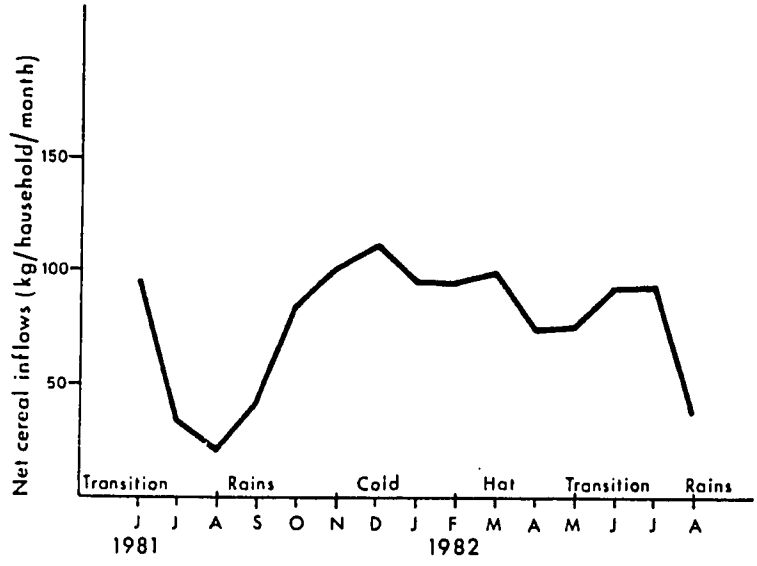


Figure 4.2.14 Net monthly cereal inflows to WoDaaBe households

This figure is close to the 124 kg/person/year reported by the INSEE/SEDES (1966: 187) consumption study in 1963 in the same area.[1] The INSEE/SEDES (1966: 159) budget study and Sutter's (1982: 35) study in 1977-1978 in the Tanout area found 135 kg and 160 kg respectively.[2] The nutritional survey carried out by the NRL project among the same WoDaaBe population as the present study estimated cereal consumption at between 129 kg and 178 kg/person/year (Loutan 1982a: 49-53).

---

1. These figures are for cereals without bran. The cereal figures in the present study, the INSEE/SEDES budget study and the Tanout atudy include the weight of the bran.

2. The figure from the Tanout study does not include cereals obtained from barter. The INSEE/SEDES budget study and Sutter's study are gross, not net inflows. The present study's figures are net of an average of 17 kg cereal outflow per household.

Tea and sugar

Tea drinking has become and important part of everyday life in WoDaaBe camps. It is a recent habit, acquired from the Twareg over the last 20 years as the WoDaaBe have moved into regions shared with Twareg. Most WoDaaBe men drink tea at least twice a day, and tea has become a necessity for social occasions. It is a stimulant in the extreme heat of the dry season, and also eases hunger. Tea and sugar are now often brought as a gift for social occasions replacing the traditional gifts of milk, millet or animals. Even people who do not drink tea usually buy and keep some for guests.

Tea is normally made after the morning and evening meals by the men in the camp and is sometimes shared with the women and children; women occasionally make tea for themselves. Three qualities of green China tea are available: reygeyga, the most expensive, tareygeyga, and innamelli, which is much less expensive than reygeyga but much less appreciated. Sugar is bought either in cubes or, in more concentrated form, as 2 kg loaves imported from France or Belgium.

In the sample households, tea and sugar accounted for 9 percent of total annual household expenditure. There has been a great increase from the early 1960s, when the INSEE/SEDES (1966: 183) consumption study found almost no consumption of tea and sugar among the Fulani in a region including the sample area.[1] Somewhat less tea is drunk in the hot and transition seasons, when there is less time and less visiting, than at other times of year. Expenditure on tea and sugar is 25 percent of mean sample household food expenditure compared to 4 percent of food expenses reported by the INSEE/SEDES budget study (1966: 158). The calorie contribution of sugar drunk by sample households in tea is not negligible. An approximate calculation suggests that 7 percent of total calorie intake for the sample population as a whole comes from sugar; for adult men, who drink most tea, the proportion is much greater.

---

1. In the Tanout area, Sutter (1982: 38) reported 9 percent of total WoDaaBe household expenditure on tea and sugar in 1977-1978.

Some WoDaaBe do not drink tea at all. Others, who normally drink tea, stop when they are far from markets in the rainy season and their supplies run out. A traditional infusion of plants, Cassia nigricans, called nyangal buubi in Fulfulde, is drunk by some WoDaaBe, but does not have the social importance of tea drinking.

Other foods

Apart from cereals, tea and sugar, other food purchases are small, amounting to only 7 percent of yearly food expenditures in the sample households. Dates, peanuts, salt and condiments are the main items bought. New foods, such as biscuits and bread, are beginning to appear. The WoDaaBe dislike cereals without sauce or milk, and in the dry season, when there is not enough milk to make butter, they sometimes buy cooking oil to make the sauce; when there is no milk at all, they occasionally buy powdered milk. Condiments for the sauce used to consist mainly of leaves of trees and shrubs gathered in the bush.[1] The WoDaaBe are now in an area where most of these plants do not grow, and although they find a few of the leaves they want, which they dry and pound, most condiments - leaves, peppers, spices (dow-dowa, sumballa), natron, dried tomatoes - are now bought. The sample households sometimes also bought tomato paste, onions and bouillon cubes for cooking.

The newer of these items, such as bread, biscuits, cooking oil, powdered milk, onions and bouillon cubes are not common among the WoDaaBe, and would not be found in the camps of groups who use the market less frequently than the sample families. The WoDaaBe do not chew kola nuts, nor do they eat fish. Meat was never bought by the sample households.

---

1. See Loutan (1982: 28, 37) for Fulfulde and Latin names of shrubs and trees whose leaves are used.

Table 4.2.17 WoDaaBe Sample - Seasonal cash expenditure on food

	Mean household expenditure in season:									
	rains		cold		hot		transition		Year total	
	CFA	(%)	CFA	(%)	CFA	(%)	CFA	(%)	CFA	(%)
Cereals	16,904	(53)	41,334	(71)	38,846	(71)	37,775	(70)	134,859	(68)
Tea and sugar	13,693	(43)	14,425	(25)	10,500	(19)	10,579	(20)	39,196	(25)
Other foods	1,223	(4)	2,396	(4)	5,373	(10)	5,357	(10)	14,350	(7)
Total food	31,820	(100)	58,155	(100)	54,719	(100)	53,711	(100)	198,405	(100)

Total food expenditures

Table 4.2.17 summarizes mean household food expenditures by season and figure 4.2.15 shows the same data graphically. The rainy season pattern is very different from the other three seasons, showing the importance of milk to household diet and budgets. The rainy season is the time of loweat expenditure on all foods except tea and sugar. In other seasons, overall food expenditures, at 18,000-20,000 CFA a month, are double the rainy season total, and their composition is quite constant from month to month. Tea and sugar, which are a quarter of the year's food expenditures, rise to 43 percent in the rainy season, due mainly to the smaller food expenditure total. Cereal purchases are 68 percent of annual household food expenditure, but fall to just over a half in the rains when milk is an important food.

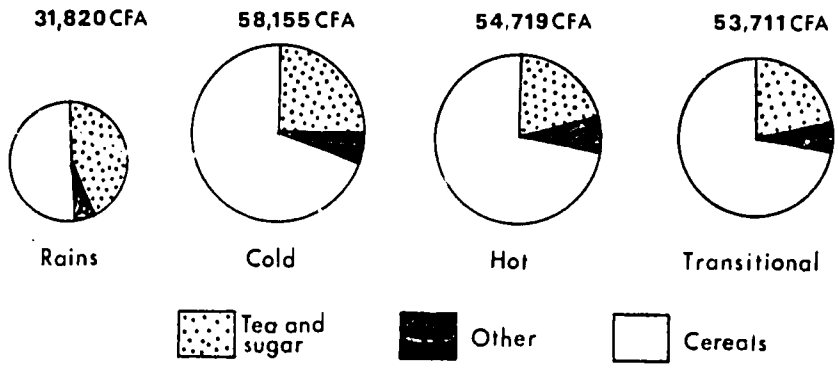


Figure 4.2.15 Seasonal expenditures on food by WoDaaBe sample households

Miscellaneous consumption expenses

Clothing

Clothing is a minor expense for the sample families, since the WoDaaBe make many of the clothes they wear. Although Twareg dress has been adopted to some extent by men, it is worn mainly on market visits; the loose light cotton Twareg clothing is ill-adapted to WoDaaBe everyday working conditions. The traditional leather breeches (dedo) worn by WoDaaBe men, and woven indigo wrap-around, knee-length skirts worn by women, both leave the legs free, are more durable and better resist Cenchrus biflorus burrs and thorns.

WoDaaBe men buy tanned sheep skins in the market and sew and decorate them as breeches for themselves and their sons.[1] They keep one pair for celebrations and one pair for daily use. Light cotton tunics made by tailors in the market are bought for normal wear. For celebrations, men, or sometimes their wives or female relatives, embroider bright intricate designs on heavier woven tunics. Turbans tied in the Twareg style are now worn regularly by men. These are generally cotton, rarely the indigo turbans worn by richer Twareg which can cost 50,000 CFA or more. Turbans are recent for the WoDaaBe, and older people sometimes laugh at the way WoDaaBe men now cover their faces and braided hair which are considered a sign of beauty. Turbans have been adopted from the Twareg, but are very practical in the dry areas the WoDaaBe now inhabit, where protection from the sun and dust is needed.[2] The WoDaaBe do not use the heavy wool hooded cape worn by Twareg and Arabs in the area, and they have little protection against the cold or rain apart from blankets wrapped over their shoulders; there are seldom enough blankets for everyone in the household. Mats or sometimes plastic sheets are used as shelter from the rain.

The WoDaaBe have distinctive leather sandals, worn by both men and women. All WoDaaBe know how to make these, but in each group there is usually a person who is more adept and makes sandals for others. This is never paid between between WoDaaBe[3] and is practically their only form of traditional artisan work. These sandals, attached differently for men and women, are considered a symbol of the identity of the WoDaaBe, which is indicated by one of their most solemn oaths: "In the name of the sandal made from cow's leather, the wisdom and the language of the Fulani".[4]

---

1. The only other ethnic group in Niger which uses these leather trousers are the Hawsa Azna.

2. There is also a Fulani tradition of using turbans: Usuman dan Fodio, at the time of the Sokoto empire, used the turban (jiifol) as the symbol of leadership when he appointed WoDaaBe chiefs.

3. This is similar to hair-braiding. There is generally a woman in each group, recognized as the best at this work, who does more than her share but is never paid by other WoDaaBe.

4. bark faDo nagge e pulaaku e fulfulde (Issa and Labatut 1974: 60).

To make the sandals, the WoDaaBe soften a piece of cow's skin by leaving it in sand moistened with cow's urine, and then beat it until it is supple; the skin is then cut to shape and straps attached. If no skin is available in the camp, one is bought in the market, and now, particularly in the east, sandals are sometimes bought ready made by Hausa. Twareg leather sandals are also bought, as are plastic sandals, sandals made from old tyres, or plastic shoes.

WoDaaBe women wear a heavy blue indigo woven cloth wrapped around their waists like other West African women; but unlike other Fulani nomads, they wrap it so that it only reaches their knees.[1] The cloth is woven in strips and imported from Nigeria. The WoDaaBe buy it in the market and women often embroider it with traditional designs. Young women make embroidered shirts of the same material especially for celebrations. Adult women did not wear tops traditionally but now buy second-hand blouses and jumpers in the markets. The lighter cotton print wrap-around skirts worn by sedentary women are also bought, but are always worn in the WoDaaBe's distinctive short manner.

Very little is spent on jewelry. The WoDaaBe buy beads in the market and make jewelry with these and metal and leather. However the heavy brass leg bracelets traditionally worn by young girls are now too expensive for most WoDaaBe.

Children are dressed simply: boys usually with leather breeches or a cotton shirt, and girls with little wrap-around skirts. They have little protection from the cold or rain.

Expenditure on clothing is shown in table 4.2.18. Expenditure in the cold season is double or more that in other seasons. Temperatures in the cold season drop considerably and the WoDaaBe have little protection from the cold or wind other than clothes or blankets. Overall expenditure on clothing and

---

1. During the Sokoto period Usuman dan Fodio forbade WoDaaBe women to wear these short skirts, but they held to this practice and have continued to do so.

blankets by the sample households was 6 percent of total annual cash expenditures. In 1977-1978 Suttter (1982: 34) calculated that 16 percent of WoDaaBe household expenses were for clothing and in 1962-1964 INSEE/SEDES (1966: 156) estimated 21 percent.

Other consumption products

Expenditure on other consumption products amounts to about 2 percent of average annual household outlays. Items such as flashlights, batteries, soap powder for washing clothes, sewing needles and razor blades are purchased in the market. Radios and cassette players are bought and sold between WoDaaBe. Medicines are bought in the market, or are obtained free from dispensaries. The WoDaaBe do not smoke cigarettes or chew tobacco, but buy tobacco in the market to barter.

Equipment

Equipment for animal husbandry and for the household accounts for 5 percent of household expenditures. Ropes are usually made by men from leather, bark or dum palm fibres, although the Forest Service now prohibits the use of bark. Woven plastic bags are now often bought in the market, undone, and the plastic threads twisted into cords. Hobbles for animals are made or bought. Rubber buckets to lift water are normally bought in the market by the sample households, although further west they are still made out of leather by the WoDaaBe. Drinking troughs for animals (old metal drums cut open by smiths) are now bought; in the past a hole was dug in the ground and lined with worn out leather breeches. Other equipment is bought, either in the market (wooden pulleys for wells, leather bags to carry water, plastic sheets for protection from the rain), or sometimes from Twareg smiths (camel saddles and blankets, leather camel bags, swords, lances and knives).

Women buy dum palm fibres to weave into calebash covers and to repair mats. Mats,[1] calebashes, mortars, pestles and Twareg beds (wooden feet and poles covered with mats) are all bought. Tents are used only by a few wealthy individuals.

Transport

Transport, although a minor expenditure in sample household budgets (3 percent), is probably over-represented. Bush taxis are used only very occasionally: from a local market to go south on migrant labour, or to carry millet from market to a point closer to the camp. A camel is sometimes rented from a Twareg for a few days. In the 1982 hot and transition seasons the sample families were unusually scattered, and the enumerators occasionally used bush taxis for some of the journey.

Miscellaneous cash payments

The WoDaaBe make occasional cash payments, to a Twareg smith for a saddle repair, to a marabout, to someone to take an animal to market; or to pay the costs of a naming ceremony.

During the survey year the WoDaaBe paid only arrondissement-level taxes of 350 CFA per active person. Animal taxes, formerly a large expenditure, were suspended in 1974. The sample families also paid no fines for crop damages. They are well north of cultivated areas, although there are scattered fields in the region they use and fines are often imposed for crop damages far north of the official legal limit of agriculture.

Table 4.2.18 summarizes miscellaneous consumption expenditures by sample households during the survey year.

---

1. WoDaaBe women used to make mats from bark (Dupire 1971: 76) but these are now usually bought.

Table 4.2.18 WoDaaBe sample: miscellaneous consumption expenditures

	Mean expenditure (CFA/household) in season:				Year
	rains	cold	hot	transition	
Clothing	5,271	14,766	4,239	7,271	31,548
Miscellaneous consumption goods	3,652	2,591	2,282	4,387	12,912
Equipment	4,046	8,618	7,414	7,386	27,664
Transport	-	1,607	5,000	8,400	15,007
Miscellaneous cash payments	429	764	214	71	1,479
Total	13,398	28,346	19,349	27,515	88,610

Animal production inputs

Animal fodder and salt

Six percent of average total household expenditure in the survey year was for animal fodder and salt. In the rainy and cold seasons households bought salt. The areas they inhabit in the rainy season do not have natural salt licks, and the salt animals need at this time of year must be bought. Less salt is given in the cold season. Expenditures during the hot and transition seasons were on animal fodder, mainly cotton seed bought in 50 kg sacks from the Livestock Service. More cotton seed was bought than normal during the survey year due to poor dry season pastures and a very late onset of the rains. Because of the state monopoly on cotton seed, there is little in the market when Livestock Service stocks run out.

The bran left when millet is pounded for cooking is also given to the animals. Bran can be bought in the market, usually from Hausa women, but its nutritive value is much lower than cotton seed. The animals must be trained to eat cotton seed by mixing it in the beginning with large amounts of bran;

these are gradually diminished until the cotton seed is left. Cotton seed is given in priority to milk cows and then to those animals (cennuDi) known to have difficulty getting through the dry season (Maliki 1981).

The sample families also bought some veterinary medicines from the Livestock Service, particularly vitamin A supplements.

Well-digging

The region inhabited by the sample families in the dry season has many low-lying areas where water is not far from the surface, and the sample families use shallow, hand-dug wells about three metres deep during most of this time. These wells must be dug at the beginning of each dry season as they collapse during the rains. The shaft is reinforced with grass, but sand falls from the sides as they are used, so they must be cleaned out every other day. As the dry season progresses, shallow wells sometimes dry out and new ones must be dug. Some WoDaaBe do not know how to dig these wells. In some places the soil texture makes well-digging more difficult or dangerous. And for some households, a labor shortage makes it impossible to water and pasture the animals and also clean out the wells at the height of the dry season when the camps are far from the wells. In such cases Twareg are sometimes paid either to dig a new well (1,000 to 3,000 CFA, depending on the depth) or to help with the digging, a two-person job. They are also hired to clean out wells, or more rarely to help water the animals when there is a severe labor shortage. WoDaaBe never pay other WoDaaBe for this work. Payments for well-digging occur almost entirely in the hot season.

Sample households made no payments for the use of wells, although in other parts of the pastoral zone access to water is a problem for WoDaaBe and would be a more substantial expense. The Bii Korony'en WeDDinde north of Tchin Tabaraden say "no water without money", and herders are often obliged to pay for the use even of public wells.

Table 4.2.19 summarizes expenditures on animal production inputs by the sample households.

Table 4.2.19 WoDaaBe sample: expenditures on animal production inputs

	Mean expenditure (CFA/household) in season:				Year
	rains	cold	hot	transition	
Animal fodder and salt	2,471	1,229	9,830	18,568	32,098
Well-digging	329	357	4,252	71	5,009
Total	2,800	1,586	14,082	18,639	37,107

Animals

The largest category of expenditure for the WoDaaBe sample households is animals, which were 41 percent of all expenditures. Purchases of sheep and goats account for only a small proportion of this, or 2 percent of total household expenses. The sample households have small flocks of sheep and goats, which are raised mainly for sale. When cattle are sold to meet large cash needs, for example for cereals, the money left is sometimes used to buy a sheep or a goat. Sheep and goats are also used as a store of small savings, particularly by women when they have earned money from the sale of milk or butter, or from work such as hair-braiding. Sheep or goats are sometimes slaughtered for a guest but this was done rarely by the sample households.

There were almost no purchases of sheep or goats by the sample households during the hot or transition seasons of the survey year when these animals are in poor condition. Purchases were in the rainy season, when both species gain weight rapidly and are often needed to slaughter for ceremonies, and

especially in the cold season, when the WoDaaBe are back in their dry season areas: cattle are sold, and after necessities such as clothing and equipment have been bought, money left over is often used to buy a sheep or goat.

Table 4.2.20 WoDaaBe Sample: expenditure on animals

	Mean expenditure (CFA/household) in season:				Year	
	rains	cold	hot	transition	CFA	(%)
Sheep, goats	4,214	6,179	500	893	11,786	(5)
Cattle	22,750	16,214	20,357	-	59,321	(27)
Camels	29,643	66,429	38,571	9,143	143,786	(65)
Others	1,471	714	2,457	1,429	6,071	(3)
Total	58,078	89,536	61,885	11,465	220,964	(100)
(%)	(26)	(41)	(28)	(5)	(100)	

Expenditure on cattle by sample households was high as table 4.2.20 shows; 11 percent of total annual cash expenses and 27 percent of expenditure on animals. This is surprising: as cattle raisera, the WoDaaBe might be thought not to have to purchase cattle. But because their herds are inadequate, the WoDaaBe are buying and selling cattle to maintain the desired age and sex structure in the herd, and also to realise profits by fattening animals for a short period.

Herds must have an optimal age and sex structure if they are to reproduce themselves well and provide a balanced flow of milk over time. A large proportion of adult females can provide milk and maintain reproduction. There must be young females whose ages are spaced so they will start calving as the calving rate of older females drops off. A mature male with the right

characteristics is needed for breeding and there should be younger males eventually to replace the stud bull. Ideally the herd should also have castrated males so that the reproductive animals in the herd will not have to be sold when cash is needed. The proper age and sex structure of the herd is maintained by selling categories of animals not necessary for reproduction, such as old females and adult males, in order to buy replacement animals, such as young females or males for fattening. The large amounts of money spent by sample households on animals may be a sign of poverty, in terms of animals owned per person in the household. If a household herd is sufficiently large, its normal pattern of reproduction, producing equal numbers of female and male calves, provides enough females for milk production for human consumption and barter, and for the future reproduction of the herd, and enough males for sale to meet cash needs. If the herd is too small to meet these requirements, animals have to be brought into the herd by purchase.

There are other reasons for cattle purchases. Animals with undesirable qualities are sold, and the herder tries to replace them by buying others. When young animals are used for slaughter, at a marriage for example, or as the gift to the father of a new wife, an adult animal is sometimes sold and two young animals bought with the proceeds so that one can be used and the other kept in the herd. And WoDaaBe households with spare cash are likely to invest in young males for short-term fattening, since the rapid rise in their value at relatively little risk or cost after they have completed their first year makes their purchase very profitable.

During the survey period, 22 cattle were bought by sample households: 14 were males under three years, 4 were males between 3 and 5 years, 2 were females under 4, and 2 were females between 4 and 9 years. Although the figures are small, it is clear that sample members are readily buying young males for short-term fattening, and also a smaller number of females for reproduction.

Approximately equal amounts of money were spent by sample households on cattle during the rainy, cold and hot seasons of the survey year; there were no cattle purchases in the transition season, which in 1982 was particularly bad. Mortality was high, animals in the market were in bad condition, and

herders were most concerned to keep alive those that remained. Households had to keep buying cereals during the transition season because the late rains delayed the usual increase in milk production.

Cattle purchases might be expected to drop during the hot season when the WoDaaBe are spending a large part of their cash income on cereals, but in the survey year, hot season cattle purchases were actually slightly higher than those in the cold season. There are several reasons for cattle purchases in the hot season. Most important, when a herder sells an adult animal to buy cereals he tries to reinvest whatever is left in a young animal. In the hot season, when animals in the market are in poor condition, a herder who has cash will sometimes try to take advantage of an animal's low price, knowing it will regain weight and value rapidly during the rainy season in a few weeks time.

Camels are an extremely large item of expenditure, amounting to 25 percent of average household expenses. This is a relatively new type of purchase for the WoDaaBe, who did not use camels before the 1930s, when they were further south and less mobile. Oxen were used to carry baggage, cereals could be bought or bartered close by, and the herders simply walked. Some older WoDaaBe do not know how to ride camels. But the WoDaaBe are now further north; the scarcer vegetation means they have to move more, and camels are well adapted to the area. The WoDaaBe now buy most of their cereals at market and, in order to avoid long absences from camp during the dry season, buy large quantities (usually 100 kg) each time. Only a camel can carry such loads. Changing prices have also made oxen more expensive and too valuable to be used for transport, whereas camel prices have decreased relative to cattle prices in the past sixty years.

The WoDaaBe do not breed camels, so they must be bought. Only an adult male camel is suitable as a riding or baggage animal, and these are expensive, at least 75,000 CFA. Because the WoDaaBe do not know how to break in camels they must buy them already trained by Twareg for riding and carrying baggage. This adds to the cost. Other animals are usually bought young and cheaply, but camels mature slowly and the work involved in caring for a single camel until it is ready to be ridden does not make investment in a young camel

particularly worthwhile. Further, a camel can be sold when a household needs cash urgently, to buy cereals for example, rather than selling immature male or reproductive female cattle. As soon as there is spare cash again, however, another camel is bought. There is therefore repeated buying and selling of camels, which makes them a disproportionately large item in the household budget. If camel sales and purchases are balanced, the net outlay is much smaller.[1]

Because camels are so expensive they are often bought and sold on credit. Partial payments are made throughout the year, which has probably skewed the seasonal pattern of camel purchases shown in table 4.2.20. The particularly high cold season expenditure on camels is probably however the result of the return of Twareg herders from the northern salt cure at that time. The Twareg need money then to buy cereals and other articles and are more willing to sell their camels at a lower price.

Donkeys have helped replace baggage oxen over the last 50 years and are now important for carrying domestic water from the well to the camp[2] and for transporting household baggage when camps move. Women usually also ride them to market. However, donkeys are not strong enough to carry large sacks of millet from market to camp, for which camels are necessary. The WoDaaBe buy few donkeys, as both males and females are kept, and a male can be brought from another camp if necessary. They do not have to be replaced often as their working life is from 10 to 15 years.

Horses are very occasionally bought by the WoDaaBe, mainly for prestige. During the survey year, one horse was bought, and later sold. Horses are expensive because they must be fed millet. They are however easier to ride, particularly for older people who are not used to camels. Unlike camels, they remain near the camp, and no time is lost searching for them. Donkeys and horses together were a minor expenditure, accounting for only 3 percent of animal purchases.

---

1. Average expenditure for the survey year on camels per household, net of income from camel sales, was about 34,000 CFA, or about half the price of a camel. So, on average, one out of two sample families acquired a camel over the survey year.

2. Before the 1920s WoDaaBe camps were closer to water.

Table 4.2.20 summarizes mean household expenditures on animals. Although the seasonal pattern is probably distorted by the irregularity of camel payments, the proportion of total expenditure on animals (41 percent) is important. A study in 1962-1964 found that only 8.8 percent of total cash expenditures by WoDaaBe were on animals (INSEE/SEDES 1966: 156). Sutter (1982: 33), summarising yearly expenditures in 1977-1978 by WoDaaBe in the Tanout area, put animal purchases in a miscellaneous category (including cooking and household utensils, water fees, field damages, flashlights, swords, camel saddles and harnesses, and jewelry), which together accounted for only 6 percent of total expenditure. This is not surprising as Sutter's fieldwork was done not long after a major drought, when animal prices are normally extremely high; indeed cattle prices in the Tanout area quadrupled between 1973 and 1974 (Sutter 1982: 46).

Table 4.2.21 WoDaaBe sample: main cash expenditures

	Mean expenditure (CFA/household) in season:									
	rains		cold		hot		transition		Year	
	CFA	(%)	CFA	(%)	CFA	(%)	CFA	(%)	CFA	(%)
Animals	58,078	(55)	89,536	(50)	61,885	(41)	11,465	(10)	220,964	(41)
Food	31,820	(30)	58,155	(33)	54,719	(36)	53,711	(48)	198,405	(36)
Animal production inputs	2,800	(3)	1,586	(1)	14,082	(9)	18,639	(17)	37,107	(7)
Miscellaneous consumption expenditures	13,398	(13)	28,346	(16)	19,349	(13)	27,515	(25)	88,610	(16)
Total	106,096	(100)	177,623	(100)	150,038	(100)	111,330	(100)	545,087	(100)

Table 4.2.21 summarizes main cash expenditures by sample households during the survey year and figure 4.2.16 shows the same data graphically. Total mean household expenditure drops somewhat during the rainy season, but the pattern Dupire describes, of a peak in purchases before the departure for the rainy season transhumance, followed by negligible cash purchases during the rainy season, has changed, at least for the sample households, which go to market throughout the year. Pressure for money to buy food now exists throughout the year, and even during the rainy season 30 percent of total expenditures are for food.

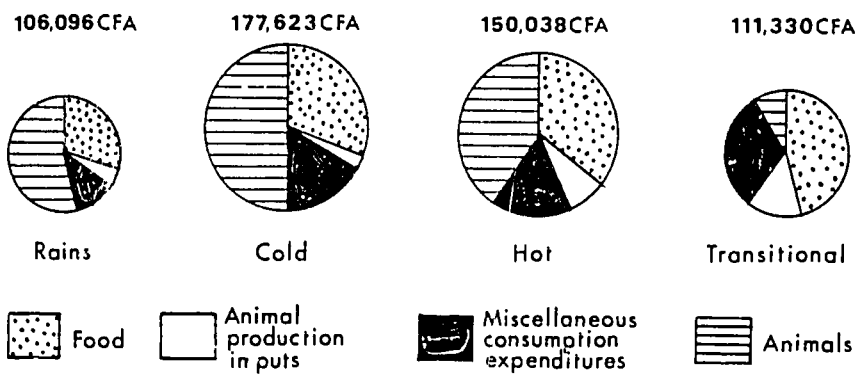


Figure 4.2.16 Seasonal total cash expenditures by WoDaaBe sample households

The cold season is the best time to sell animals. They are in good condition after the rains, and there are more buyers in the market when, after the harvest, farmers have cash to spend. The WoDaaBe therefore try to make as many of their purchases as possible at this time of year. But they cannot stock large amounts of cereals, and the proportion of their expenditure devoted to food is high throughout the hot and transition seasons as cereals become more expensive and milk production falls. Expenditures during the hot and transition seasons are mainly for food and animal fodder, which together represented 65 percent of total expenditure in the transition season.

Much of the miscellaneous consumption expenditure category is on clothing and equipment; over the year as a whole expenditure on non-essentials is very low.

The suspension of animal taxes makes it difficult to compare these 1981-1982 WoDaaBe budgets directly with other estimates of herders' expenditures. At the time of the SEDES study in 1963, taxes were 25 percent of total WoDaaBe cash expenditures (INSEE/SEDES 1966: 156).

(2) Income

Animals

Sources of income for WoDaaBe sample households were much less varied than expenditures. Ninety percent of mean total household income for the year came from livestock sales. Sales of cattle alone provided 65 percent of household income. The sale and barter of curdled milk and butter made only a small contribution to sample household incomes. The WoDaaBe do not cultivate and possibilities for salaried labour are small. As a result, sample households relied almost entirely on animal sales to meet their cash needs. Because WoDaaBe herds are small, it is important to look at animal marketing in some detail to see how households are attempting to obtain the necessary cash without irreversibly depleting their herds.

The sample families mainly used three markets for livestock sales: Tchin Tabaraden (Sunday), Abalak (Thursday) and Kao (Tuesday). Taza (Monday) generally has higher animal and lower cereal prices, but is further away and was used less often. There are no marked price differences between the three main markets, but prices vary unpredictably. If a herder has been unable to get what he considers a satisfactory price for an animal at Tchin Tabaraden on Sunday he will sometimes take it to Kao on Tuesday, for example. There is a possibility however that he will have to settle for the same price at Kao or return home with his animal unsold.

These markets are typically Hausa in organization. Licensed dillali negotiate the sale of animals and receive a fee (2,000-3,000 CFA for cattle) from the buyer. A small market tax (100-200 CFA) is also paid by the buyer. Some dillali move between the different markets of an area. Individual WoDaaBe usually use the same dillali each time they sell an animal; in fact most groups normally have a regular dillali all their members use. Nonetheless there is some competition among dillali for animals arriving for sale. The dillali provide lodging and often a meal for herders coming in from the bush to sell animals. They also give the seller a small present such as a sugar loaf. The dillali are a source of information for sellers about current market prices.

Buyers look over the animals offered for sale and then approach the dillali responsible for the animal they want. The dillali provides a guarantee to the buyer that the purchased animal is not stolen or diseased. This is important in a region where buyers and sellers come from long distances and do not have any contact outside the market.

Most dillali are Hausa, although a few, dealing mainly with camels, are Tuareg. There are a small number of FulBe dillali. The WoDaaBe complain among themselves about dillali profit margins and claim they cheat their clients, although empirical studies elsewhere suggest this is unlikely. Clients are of course free to change dillali if they distrust him, but the ethnic monopoly of the Hausa operates to the disadvantage of the WoDaaBe.

There are several categories of buyers: large merchants, often coming from Nigeria, buy a number of cattle at each market and usually hire a FulBe to walk them to more southerly markets, paying the herder a fixed rate per animal according to the distance. People investing in animals, herders, merchants and farmers, all make purchases of cattle. Sometimes the dillali himself buys an animal if there is no other buyer. Butchers buy mainly sheep and goats. Camels are bought singly by other herders or by farmers from the south for transport.

There is less demand for animals in the rainy season when sedentary people (both buyers and dillali who usually also farm) are occupied with their fields. Even richer farmers who hire laborers must supervise the work. There is less cash available to such people to spend on animals until after the agricultural year. Kao and Taza, close to the agricultural zone, are strongly seasonal markets with little activity during the rainy season. Tchin Tabaraden and Abalak are more typical pastoral zone markets that are active throughout the year since there are herders near them even during the rainy season, and improved roads have made access to these northern markets easier for merchants from the south. Rainy season purchases are mainly made by large merchants who have enough capital to be more independent of the agricultural cycle; civil servants with regular salaries also eat meat throughout the year, and the demand for meat from Nigeria is less seasonal than local demand. It is however after the harvest, when farmers have more time and money, that the markets become more active again.

The seasonal breakdown of numbers of cattle sold by the sample households during the survey year is shown in table 4.2.22. There were steady sales throughout the year with an increase during the cold season and a peak during the hot season when animals are sold to meet increased cereal needs. Some animals were also sold in this season that were about to die because of poor condition. Sales of older males were highest in the cold season, because they are kept for sale when they are in the best condition. Sales of young and old females were highest in the hot season; these animals are particularly vulnerable to bad conditions.

Table 4.2.22 Sales of cattle by WoDaaBe sample households, by age and sex category, by season during survey year

	Number of cattle sold in season:				Year	
	rains	cold	hot	transition	no.	(%)
Males						
< 3 years	8	7	7	6	28	(30)
3-5 years	2	1	4	2	9	(10)
> 5 years	1	6	2	3	12	(13)
Total	11	14	13	11	49	(53)
Females						
< 4 years	2	4	8	3	17	(18)
4-9 years	3	1	1	-	5	(5)
> 9 years	3	5	10	4	22	(24)
Total	8	10	19	7	44	(47)
Total males and females	19	24	32	18	93	(100)

Table 4.2.23 shows cash income from sales of all species by season. Sheep and goats together contribute only 8 percent to total animal sales. This contrasts with the situation described by Sutter (1978) in 1977-1978 in the Tanout area where sheep sales were 26 percent of WoDaaBe incomes from animals and goats were 8 percent. Following the drought, WoDaaBe households in the Tanout area were perhaps relying to a greater extent than now on sheep and goats to reconstitute their herds. Average cattle herd size in the present

study however was no larger than that in Sutter's study. Sutter's terms of trade calculations and the present study's animal and millet price figures indicate that the cereal equivalent for cattle was approximately the same in Tanout in 1977-1978 and Tchin Tabaraden 1981-1982. The cereal equivalent for sheep and goats however dropped sharply between the two studies.[1] It is thus not surprising that the sample households were relying mainly on cattle sales which provided 71 percent of the income from animal sales. Income from animals sales is concentrated mainly in the cold and hot seasons, and drops off in the transition season, due both to a fall in the number of animals sold and a drop in the average price.

Table 4.2.23 WoDaaBe sample: cash income from animals

	Mean cash income (CFA/household) in season:				Year	
	rains	cold	hot	transition	CFA	(%)
Sheep, goats	22,518	12,446	7,643	4,643	47,250	(8)
Cattle	78,250	124,786	137,036	60,607	400,679	(71)
Camels	20,358	39,429	50,357	-	110,143	(20)
Other animals	3,536	1,786	-	-	5,321	(1)
Total	124,662	178,447	195,036	65,250	563,395	(100)
(%)	(22)	(32)	(35)	(11)	(100)	

1. The amount of millet that could be purchased with the proceeds from the sale of an average sheep in 1981-1982 in Tchin Tabaraden was lower than any of the Tanout figures between 1934 and 1978. For goat-millet equivalents in the same period, the present study figues were lower than any years except 1934 and 1973. See Sutter (1978: 45-46).

Other incomes

Six households in the sample had incomes from salaries, all of them from outside the pastoral zone. Sample members braided hair, worked as watchmen or sold medicines, mainly in Nigeria. Earnings are low and were nearly balanced by the costs of transport, lodging and food. Migrant labor took place mainly in the cold and hot seasons when pastoral labor needs are high. Each of the six households lost over a person year (393 days average per household) because of migrant labor.

The benefits to households of migrant labor are of two sorts: earnings in cash or kind brought back, and, since migrants at the very least manage to feed themselves, a reduction in cereal consumption in the camps and hence a reduction in animal sales in the dry season.

Although the average cash earnings from migrant labor per household in the sample were small, amounting to only 4 percent of total annual cash incomes, for those households which did go on migrant labor earnings were more substantial, and constitued 14 percent of their total cash income; in one case, cash earnings from migrant labor amounted to 35 percent of the household's cash income over the survey year.

The value of cereal savings resulting from absences on migrant labor is also important. The cash equivalent of the amount of cereals that would have been consumed if migrants had been present in the camps was an average of 24,000 CFA for the year for each of the six labor-migrating households.[1] These savings are under-estimated; if the migrants were present they would be sharing available milk, and cereal needs of everyone in the camp would rise correspondingly.

---

1. Calculated as the number of person days of absence on migrant labor, times the mean daily cereal consumption of those who remained in the camps (which, since they include a large proportion of children, underestimates the savings from cereal consumption foregone by the migrants, who are all adults), valued at the seasonal cereal prices paid by sample households.

Other cash incomes are small. No sample households accumulated large amounts of butter during the rainy season for later sale. Dupire found this common in the 1950s and 1960s. The sample households' herds were not large enough for this sort of accumulation, and throughout the year camps were not as far from markets as the WoDaaBe Dupire studied. The WoDaaBe do not make cheese or spin cotton, unlike FulBe cultivators. None of the articles made by households (ropes, sandals, calebash covers, embroidery, jewelry) are sold. There was no cultivation by sample households and no cases of exchange of manure for cash or cereals; the sample households are too far north for manuring to be undertaken by farmers without risk.

Miscellaneous income for the sample families came mainly from the re-sale of purchased items, particularly radios, camel saddles and clothing brought back from Nigeria, and thus should be considered in part as earnings from migrant labor.

Table 4.2.24 summarizes cash incomes of the sample households in the survey year. The seasonal pattern is dominated by the pattern of income from animals, discussed above. Income from salaries from migrant labor, and miscellaneous cash incomes which were mainly from the sale of goods brought back by migrant laborers, peaked in the hot season, when most migrants return. Income from animal sales was also highest then.

Table 4.2.24 WoDaaBe sample: main cash incomes

	Mean cash income (CFA/household) in season:				Year	
	rains	cold	hot	transition	CFA	(%)
Animals	124,662	178,447	195,036	65,250	563,395	(90)
Salaries	286	179	25,929	-	26,393	(4)
Miscellaneous	3,357	8,990	14,536	7,178	34,061	(5)
Total	128,304	187,614	235,500	72,429	623,846	(100)
(%)	(21)	(30)	(38)	(12)	(100)	

(3) Cash flow

Table 4.2.25 summarizes annual seasonal cash incomes and expenditures for the WoDaaBe sample households, and figure 4.2.17 shows the same data graphically. Over the year as a whole, income exceeds expenditure by 79,000 CFA/household, which is more probably the result of some underreporting of expenditures than overreporting of income or real cash surplus. Seasonally, there is a strongly positive cash flow in the hot season, resulting mainly from the large animal sales at the start of the season, and a negative cash flow in the transition season, when households try to avoid animal sales because of low and uncertain prices, and difficult access to markets at a time when households are trying to make the most of the first rain storms. This pattern of negative cash flow in the transition season, and positive cash flow in the other seasons, was also true of the earlier period during which household budget data were collected, but which is not reported in detail in this chapter.

Table 4.2.25 WoDaaBe sample: incomes and expenditures

	Income and expenditure (CFA/household) in season:				Year
	rains	cold	hot	transition	
Cash expenditure	106,096	177,623	150,038	111,330	545,087
Cash income	128,304	187,614	235,500	72,429	623,846
Income minus expenditure	22,208	9,991	85,462	-38,901	78,759

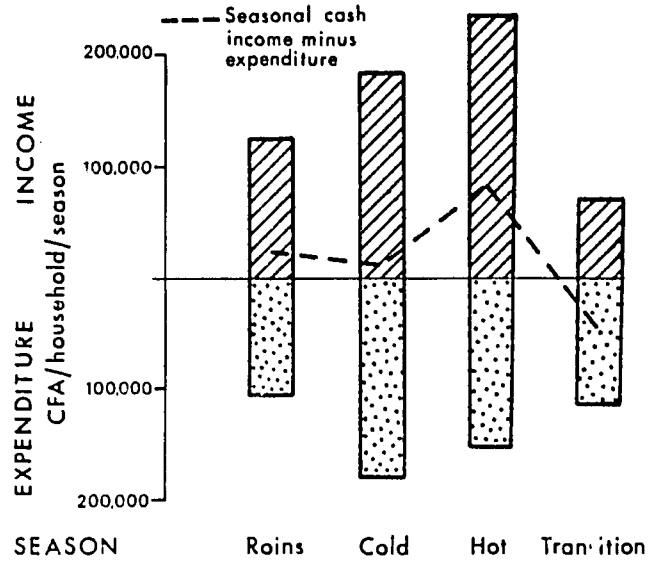


Figure 4.2.17 Seasonal cash incomes and expenditures by WoDaaBe sample households

(4) Non-market transactions

Non-market transactions play an important role in WoDaaBe household accounts. Barter, loans and gifts in kind entering sample households were worth 32 percent of mean annual household income from cash transactions, and those leaving sample households were worth 24 percent of mean annual household expenditures on cash transactions. These non-market transactions concerned chiefly milk bartered for cereals, animals exchanged for other animals, and loans of animals.

Cereal income through barter was described above. The sample households gave milk or tobacco in exchange for cereals. There were no cases of animals given by sample households for cereals although this was formerly a common practice. Animal were bartered for animals by sample members with other

WoDaaBe or other herders. Animal exchanges usually concerned different age or sex categories (for example, a bull for two young calves) or different species (for example, a camel for a cow and two sheep). Money was sometimes added to make the transaction equal (for example, a calf and 50,000 CFA given for an adult cow).[1] The WoDaaBe prefer to obtain their animals from other WoDaaBe so they can deal with animals whose pedigree and characteristics, such as milk production, reproduction, robustness and behaviour they know. There were exchanges of camels between WoDaaBe, and camels were also obtained by exchange with Twareg. Loans of female cattle (haBBanae), and sometimes sheep and goats, were made to and received from other WoDaaBe. Table 4.2.26 shows the value of these exchanges, loans and gifts of animals in relation to cash sales and purchases of animals. These transactions in kind are substantial: the value of animals entering sample households through transactions in kind is over a quarter of the cash income from sale of animals, and the value of animals leaving sample households through such transactions is almost half of cash expenditure on animals.

Many types of small transaction in kind were recorded. For example, WoDaaBe migrant workers in Nigeria received clothing as payment for traditional medicines and for hair-braiding. Sample households sometimes also made payments in kind, such as a blanket given to a marabout as payment for his services. Small gifts or loans of cereals were also occasionally made between households. Table 4.2.27 summarises all transactions in cash and kind, and figure 4.2.18 shows the same data graphically.

---

1. Cash added to transactions in kind were included in the cash income and expenditure accounts on animals for budget analysis.

Table 4.2.26 WoDaaBe sample: animal transactions in cash and kind

	Value of mean annual household animal transaction (CFA)			
	Income		Expenditure	
	cash	kind	cash	kind
Sheep, goats	47,250	14,000	11,786	12,593
Cattle	400,679	86,071	59,321	26,964
Camels	110,143	57,500	143,786	63,929
Other animals	5,321	1,250	6,071	2,321
Total	563,395	158,821	220,964	105,807

Table 4.2.27 WoDaaBe sample: relative value of transactions in cash and kind

	Value of mean annual household transactions (CFA)			
	Income		Expenditure	
	cash	kind	cash	kind
Animals	563,395	158,821	220,964	105,807
Cereals [1]	714	19,985	134,859	2,118
Other foods	2,811	5,855	63,189	12,650
Other products and salaries	56,928	15,658	126,074	10,659
Total	623,846	200,319	545,087	131,233

Note 1. Cereal income in kind = inflow of cereals to household; cereal expenditure in kind = outflow of cereals from household.

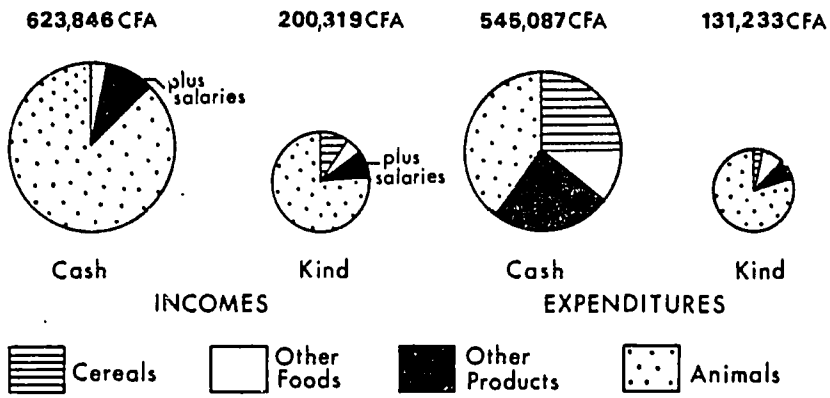


Figure 4.2.18 WoDaaBe annual incomes and expenditures in cash and kind

Table 4.2.28 shows the seasonal distribution of cash and kind transactions. Transactions in kind take place mainly in the cold season, and to a lesser extent in the rains, which are the times when WoDaaBe social life is at its most intense and camps are close together; this is also the period of cereal barter. There are few transactions in kind during the hot and transition seasons.

Table 4.2.28 WoDaaBe sample: seasonal distribution of transactions in cash and kind

	Percent of annual transactions by value			
	Income		Expenditure	
	cash	kind	cash	kind
Rains	21	21	19	25
Cold season	30	62	33	55
Hot season	38	8	28	10
Transition season	12	8	20	10
Total	100	100	100	100

(5) Cattle marketing

An analysis of the prices obtained by WoDaaBe sample members for the cattle they sold throws light on WoDaaBe market behaviour and on the downward spiral of poverty now facing many herders in the project zone. Although the number of cattle sales available for analysis from this source is very small, this is compensated to some extent by the known accuracy of the information on both prices and animal ages, something often absent from market records. The fact that these were the prices actually received and the animals actually sold by sample members also enables the information to be related directly to the discussion about the budgets, animal holdings and economic behaviour generally of sample households.

For the full range of data, covering the period November 1980 to September 1982 from all households sampled, a total of 134 cattle sales are suitable for analysis.[1] Grouped into age-sex categories, the figures show no sustained price trend over the analysis period, which enables them to be analysed as a single set. Table 4.2.29 gives the prices by age and sex category, and figure 4.2.19 shows the prices graphically.

1. Five sales were excluded because special circumstances, particularly disaster sales of dying animals at very low prices, which made them wholly unrepresentative.

Table 4.2.29 Prices obtained for cattle by WoDaaBe sample households, November 1980 to September 1982

age (years)	Males n	Males mean price (CFA)	Males (+ SD%)	Females n	Females mean price (CFA)	Females (+ SD%)
<1	16	19,547	(43)	4	33,125	(34)
1-2	28	25,723	(18)	7	37,071	(49)
2-3	10	44,025	(27)	8	48,938	(43)
3-4	12	73,000	(30)	4	37,500	(13)
4-5		-		3	48,500	(78)
5-6	3	118,333	(5)		-	
6-7	4	125,000	(14)		-	
7-8	2	150,000	(9)	3	128,333	(37)
8-9	2	110,250	(38)	2	80,000	(35)
9-10		-		17	75,294	(36)
> 10		-		9	52,389	(62)

Table 4.2.29 and figure 4.2.19 show the rapid increase in price, especially of male cattle, over first few years of their life. This is closely correlated with their rapid increase in weight during this time. Cattle mortality is especially high in the first year of life: the project animal production study, summarized in table 3.2.28 above, calculated calf mortality in WoDaaBe herds in the project zone to be from 30-40 percent which, although high because of the bad conditions of the preceding year, is not unusual in Sahelian conditions. Mortality declines substantially in the second and subsequent years, and adult mortality in normal years is probably no more than 2 to 5 percent per annum. When this is combined with the low marginal cost in labor and other inputs of herding additional animals, and the absence of economic cost to the herder of grazing land, it is clearly in the herder's interest to hold on to young male animals until they have achieved a substantial part at least of their maximum value.

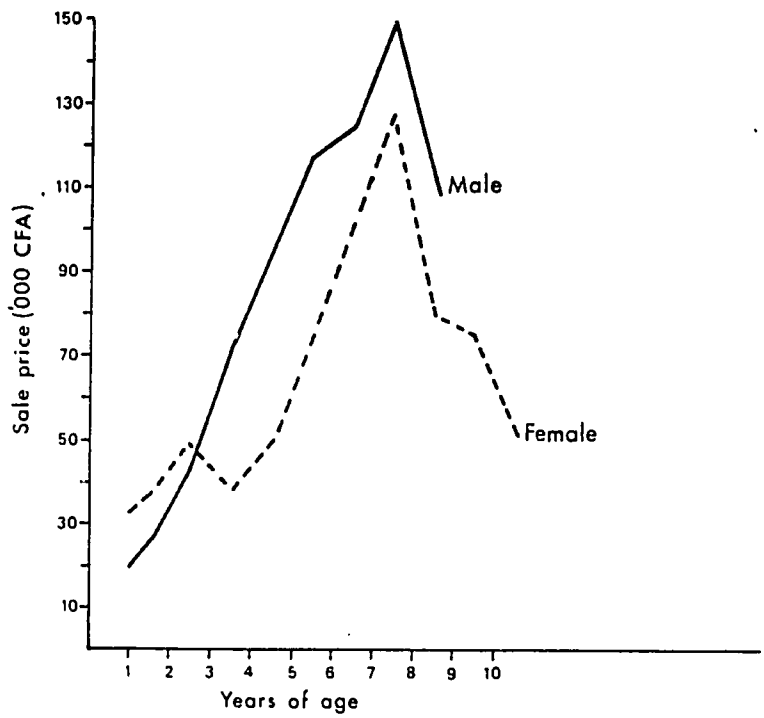


Figure 4.2.19 Mean price of cattle sold by WoDaaBe sample households 1980-1982

The optimal age at sale for male animals can be estimated with the data given in previous paragraphs and some simplifying assumptions. If WoDaaBe herders are maximising the economic benefits from raising male animals, they will sell them at an age which maximizes the value added by the animal's growth, discounted by (a) the cumulative risk of the animal dying, (b) the marginal cost of labor, water, pasture and other imputs, and (c) the opportunity cost of holding capital. Marginal labor costs for individual cattle are higher in the first year than later in life, but such costs are in general low, except for watering. For the purpose of the present calculation they may be ignored. Under current tenure, grass and most water have no

economic cost to producers. Other input costs are negligible. The choice of discount rate is somewhat arbitrary, since rural capital in the pastoral zone has little alternative use, and hence opportunity cost, other than in cattle, but for the sake of calculation it can be set somewhat high to compensate for the absence of labor costs. With these assumptions, the discounted future value of the animal is calculated by:

$$V_y = P_y . R_y . (1-r)^y$$

Where V = value of the animal in year y discounted to present
P = price of the animal in year y
R = mortality risk, expressed as cumulative survivorship to year y
r = discount rate, taken to be the opportunity cost of rural capital.

Mortality rates are assumed to be 35 percent in the first year, 5 percent in year 1-2, and 2 percent a year thereafter. The value of a male animal of different ages to the WoDaaBe producer is taken from figure 4.2.19. The discount rate is set at 20 percent. Table 4.2.30 shows the present discounted value to the herder of holding the animal to different ages.

Table 4.2.30 Present discounted value of holding male cattle

Age at sale (years)	Present discounted value (CFA)
1	10,400
2	13,888
3	17,958
4	20,300
5	20,431
6	18,229
7	16,148
8	11,996
9	7,610

Table 4.2.30 shows that, with the assumptions used, any additional time the herder holds onto the animal up to age 8 increases its value to him compared to the value at year 1. To maximize its value he should sell at age 5. Herders selling at age 1 will have to sell twice as many animals to meet the same income requirements as those selling at age 4 or 5.[1] The WoDaaBe themselves clearly recognise this since they believe that where possible a steer should not be sold before 5 or 6 years old, and preferably at 7 or 8 years (which, since animal ages are counted as the number of rainy seasons they have lived, most births take place before or at the start of the rains and the best sales are in the cold season, means 6 or 7 calendar years); they consider a herder who has to sell his steers before this a poor man, and one who holds onto his males longer, a stupid one (Maliki 1981).

Herders with small herds also have no incentive to sell female cattle, unless they are sterile, until the end of their reproductive life, around 9 or 10 years old at the earliest.

In the light of these considerations, it is economically rational for herders with adequate herds to meet their cash requirements by selling male cattle at a profit-maximizing age of around 5 years, and females at the end of their reproductive life at around 10 years, and this is the pattern of sales one would expect in a healthy WoDaaBe economy. Impoverishment of herding households would be indicated by a progressive reduction in the age at sale of males, and by the sale of increasingly young females.

It is possible to explore the sales patterns in a healthy WoDaaBe economy by computer simulation of cattle herd dynamics, and then to compare this theoretically optimal pattern of sales with the pattern actually observed in the field. Departures from the optimum is a measure of the degree of poverty: the greater the departure from the optimum, the greater the poverty. Swift (1979: 101-135) simulated cattle herd dynamics with technical

---

1. This conclusion is not changed by using a discount rate of 15 percent, nor by changing calf mortality to 20 percent. Using a 10 percent discount and 35 percent calf mortality shifts the age of optimal sale to 6 years.

characteristics like those measured for WoDaaBe herds in the project zone, with male sales rates close to those which emerge from the analysis above as economically optimal: 10 percent of each year's age class up to 4 years, 60 percent of the 4-5 year age class, 3 percent of each age class until 8 years, with all remaining males sold in the 8-9 year age class. There were female sales in the model until the 10-11 year age class, when all surviving cows were sold.

The model generatea the age-sex pattern of sales shown in table 4.2.31 which indicates what would be the age and sex of animals sold from a herd managed according to the relatively satisfactory (from a herdsman's point of view) criteria specified above, including especially the sale of most males at the optimal age, while recognising that a small number of males may have to be sold earlier, and that a small number of reproductive bulls or baggage oxen will be sold later. For comparison, table 4.2.31 also shows the age-sex pattern of cattle sales recorded in the WoDaaBe sample. Sales rates are shown as percent of total sales, and the WoDaaBe sample figures include all cattle sales from the full range of data available, covering just under two years.

Table 4.2.31 Age-sex structure of cattle sold by WoDaaBe sample compared to optimal sales from simulation

Males			Females		
age (years)	optimal sales (%)	sample sales (%)	age (years)	optimal sales (%)	sample sales (%)
< 3	18	32	< 4	-	19
3-5	27	9	4-9	-	7
> 5	12	11	> 9	43	22
	57	52		43	48
(n)		(65)			(59)

Total sales in the sample during the survey year were estimated at 22 percent, double the model's annual sales of 11.6 percent. As table 4.2.31 shows, sales from the WoDaaBe sample's herds were especially heavy in the category of young males (which made up 32 percent of total sales, compared to an optimal rate of 18 percent), and in young females (26 percent of sales in the sample were composed of females under 9 years, with 19 percent of heifers alone, compared to none in the optimal model). A small proportion only of males was sold in the optimal age category of 3 - 5 years (9 percent in the sample, compared to an optimum of 27 percent), and the sale of old females was scarcely more than half the optimum, due presumably to the scarcity of animals in this age class, given the high rates of sale of younger females.

The precarious position of most WoDaaBe sample members with regard to cattle sales ia even more apparent when the households are broken down into two strata, divided by a theoretical poverty threshold of 3 TLU per person. Households in both strata are poor, but those below the threshold are very poor indeed. Table 4.2.32 shows the age and sex composition of cattle sales for the two groups. Although the numbers are again very small, there are striking differences. Although the two households above the poverty threshold sold more females than males, they had a relatively balanced structure of sales by comparison to the optimal pattern, with quite a large proportion of adult males and a very large proportion of females past reproductive age being sold. The twelve very poor households on the other hand had few adult males or old females to sell; instead they sold a large proportion of males under 3 years and also a large proportion of young calves and heifers. This is clearly a strategy of last resort, since no herd can survive sales of this sort for long.

Table 4.2.32 Age-sex structure of cattle sales in two wealth strata in the WoDaaBe sample

	"Optimal pattern"	Sample households above poverty threshold		Sample households below poverty threshold	
	(%)	No.	(%)	No.	(%)
Males:					
< 3 years	18	2	12	38	36
3-5 years	27	1	6	10	9
> 5 years	12	3	18	11	10
sub-total	(57)	(6)	(35)	(59)	(55)
Females:					
< 4 years	-	1	6	22	21
4-9 years	-	1	6	8	7
> 9 years	43	9	53	18	17
sub-total	(43)	(11)	(65)	(48)	(45)
Total	100	17	100	107	100

Notes: Optimal pattern from table 4.2.31. Two households above poverty threshold; 12 below.

(6) Components of poverty

The age at which cattle are sold is an important index of poverty in a pastoral economy, but is not the only one. In order to understand the nature of poverty in the WoDaaBe economy more clearly, the household budget data are now disaggregated to look at some of the other main components of poverty. To do this, the 14 household production units are put into three strata based on livestock wealth. Several indices are calculated for each of these strata, as shown in table 4.2.33. Although the numbers in each strata are very small,

some clear and important differences appear. It should be stressed as before that even the two households in the top stratum are not wealthy: all the households in the sample are poor, but some are very much poorer than others.

The strata are divided on the basis of per capita livestock holdings (owned and loaned, but excluding jokkere) in categories of > 3, 3-2, < 2 TLU/person in strata I, II, III respectively. Sheep, goats and camels are included in these calculations, but are unimportant.

Table 4.3.33 Some components of poverty in the WoDaaBe economy

	Household strata		
	I	II	III
Number of households	2	6	6
TLU/person	3.6	2.3	1.3
TLU/household	26.9	20.2	12.2
People/household	7.5	8.8	9.5
Cash income/person (CFA)	96,780	76,059	57,035
Cash balance (CFA/person)[1]	31,965	10,395	1,268
Net cereal inflow/person (kg)[2]	161	110	89
Migrant labor (No. of households)	No	Yes (2/6)	Yes (4/6)
Cash income from salaries (CFA/person)	-	5,189	1,658
Entrusted animals (No. of households)	No	Yes (1/6)	Yes (1/6)

Notes:

1. Cash income minus cash expenditure.
2. Calculated on household census population, not people actually present.

Household size increases regularly in inverse proportion to livestock wealth, mainly because the process of formation of independent production units is delayed in poorer households because of lack of animals. The average household herd is of similar size in the wealthiest two strata, and only about half as large in the poorest stratum; since household production units are defined as groups of people living from a herd managed as a single unit, this suggests some management advantages, given WoDaaBe herding techniques, in a herd of around 20 TLU, or around 25 - 30 cattle when allowance is made for the household baggage camel and some small numbers of sheep and goats. It is likely that above this size there are enough animals for the process of new household formation to proceed faster; but below this number, pressure is exerted for unviable households to remain together to take advantage of economies of scale in herding and from pooling resources generally.

Cash income per person in the three strata shows a clear gradation from about 100,000 CFA per person in stratum 1 to scarcely more than half that in stratum III; cash balance (cash income minus cash expenditure) shows a similar pattern, with not insignificant cash surpluses in the top stratum, and almost none in the bottom one. Cereal availability per person also has a markedly skewed distribution, with annual net cereal inflow per person in the top stratum nearly double that in the bottom stratum. The population figures used in this calculation do not take account of absences on migrant labour, and so underestimate the amount of cereals available to each person actually present; what they do suggest is the impossibility of the full population of each household in the two poorest strata surviving on cereal inflows at present rates. This is discussed further later in this chapter.

The precarious position of households, especially in the two poorest strata, is clear from these indices; 100 kg/person of cereals a year is not enough for households to survive, especially as these very poor households are of course those with least milk. Table 4.2.33 also shows two of the strategies households in the two poorest strata resort to: migrant labor and herding entrusted cattle. The two households in stratum I were able to avoid recourse to either of these strategies which are considered degrading and undesirable by all WoDaaBe.

To sum up, table 4.2.33, together with the earlier discussion of age of sale of cattle, suggest some of the key components of extreme poverty in the WoDaaBe economy. Below a threshold of extreme poverty of around 3 TLU/person, equivalent to about 4 cattle/person when the necessary household baggage camel and a handful of sheep and goats are taken into account, WoDaaBe households are characterized by larger size (as nuclear families delay setting up independent production units in order to benefit from the economies of scale and specialization possible in larger units), lower cash incomes, and insignificant cash surpluses after essential expenses have been met; they are unable to buy or barter enough cereals for the whole household, snd are thus forced either to take in entrusted animals, or to go away as migrant laborers, or both. These households are not only selling very young male cattle, well before the age of profit maximization, but are also selling cows of reproductive age. These households are living on a precarious margin, and have no reserves to meet the commonplace contingencies of pastoral life; their prospects are bleak.

LABOR USE

So little is known about pastoral labor use that the studies on WoDaaBe labor were intended mainly to provide a quantitative description of how different categories of people - men, women and children - in WoDasBe society work, and the extent to which labor availability is a constraint on present production, or future potentials. The methods used and the sample studied have been described above. The data are presented for the full period of study, from March 1981 to September 1982, a period of 19 months. Labor hours are shown as daily averages per person in particular age and sex categories, based on measurements of all those present at any one time, aggregated into fortnights.

This section is laid out in the following way. First, the most important individual work activities of men, women and children are described and quantified; then major groups of labor tasks are summarized; finally all important work activities of men, women and children are summarized into yearly work totals. The analysis concentrates in the first place on men and

women aged 15 to 40 years, which is the time when people work most; activities do not change much after 40, but the number of people in this age class in the sample was so small that mean work hours were very dependent on changes in the number of people present in any fortnight. However, reference is made to this older group where appropriate. Children aged 6 to 14 years also work long hours in the WoDaaBe economy, and their labor is treated separately.

Men's work

Animal work

Sample households pasture their animals throughout the year. After the morning's milking, the head of the household takes the whole cattle herd including the calves a short distance from the camp for about an hour's grazing. They return to the camp where calves that are still suckling are separated and attached to the calf rope, and the main herd is then taken further from the camp for the day's grazing. The herder supervises the animals throughout the day and only returns to the camp with them in the late afternoon. After the herd has left the camp, the women untie the calves, which graze near the camp during the day and are tied up again just before the herd returns to the camp. Women and children watch over them while they go about their other activities in the camp.

Cattle are pastured by the head of the household, or a son if there is one in the family above 14 or 15 years old. Women can pasture cattle when the normal herder is away and there are no other men or boys in the camp to replace him. In these cases the women do only the minimum necessary; pasturing is difficult for them because they do not know how to call up the cattle. Pasturing is rarely done by someone from another production unit, nor are the animals readily put in another herd for a few days, because the animals must be accustomed to their herder. When families have to join together, because of labor shortages or insufficient herds, to form a combined production unit, and the animals are pastured and watered together, they need time to become accustomed to being managed in a single herd, and also, after a time together, to being separated again. In the sample during the survey period, there was only one case of two herds which were combined into one for several months each year during the dry season absence of the head of one production unit.

Figure 4.2.20 shows the seasonal distribution of pasturing work. Animals are pastured every day in the rainy season. They are supervised to make sure that they have the proper amounts of different varieties of grass, for example spending enough time on both dune and valley pastures. At this time surface water makes it possible for animals to graze and drink in the same places. They must be watched however so they can be pulled out if they get caught in the sticky mud common around pools in this season. Time spent on pasturing labor drops off sharply when sample members start using wells at the beginning of the dry season in October-November. The animals then are pastured only ever other day. On the alternate days they graze a small amount on the way to and from the well, but are not taken away from the camp for pasturing. This pattern lasts through the dry season, until it rains enough for them to leave the wells, and pasturing again is done daily. As figure 4.2.20 shows, adult men spend long hours pasturing, especially at the beginning of the rainy season when they take particular care with the sorts of grasses the animals are grazing; at the start of the 1981 rains, every man aged 15-40 years was spending on average 6 hours a day at this task.

Sheep follow the cattle herd when it is taken to grazing, but they are not taken for the short morning's pasturing. Goats are pastured separately, usually by a young boy. Donkeys and camels are hobbled and allowed to graze on their own. Pasturing work for these two species consists of no more than going off to bring them back to the camp. The camel's owner, a young or adult man, fetches it; this can take several hours each day. The donkeys remain grouped together and do not usually wander as far as the camels; they are checked on or brought back to the camp daily, usually by a young girl.

Each adult man in the sample spent on average 4 to 6 hours pasturing a day at the beginning of the rainy season when pasturing is most intensive. Although total time spent pasturing drops abruptly during the dry season, it requires an important amount of labour through the year, rarely falling below 1.5 hours per adult man a day. Men do most of this work, but regular help from women and children is necessary.

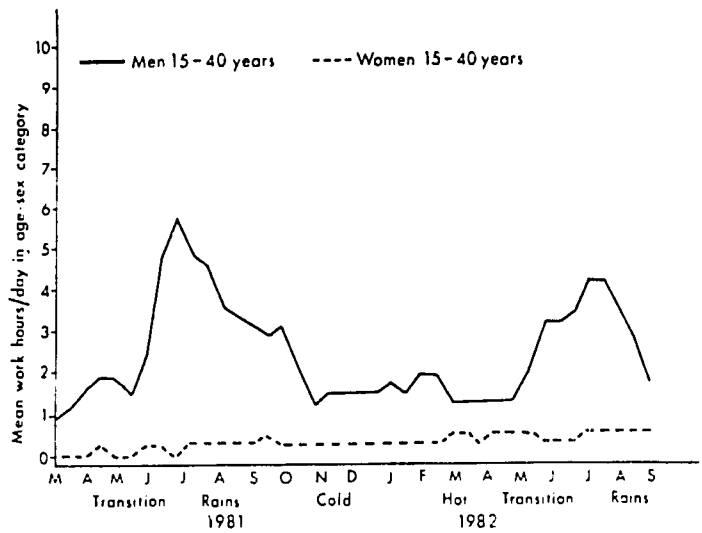


Figure 4.2.20 Seasonal distribution of pasturing labor (all species) by adult WoDaaBe men and women

Young and adult men do most watering of animals. The sample members mainly used shallow, about 3 m deep, hand-dug wells. These are dug and reinforced at the beginning of each dry season and must be cleared out every other day throughout the watering period. The well conatruction itself requires two men, one to dig and one to pull out the sand, so two herd owners often co-operate in digging several wells, which they then each use on alternate days. Sometimes Twareg are hired for this work if the soil makes well-digging difficult.

If the wells refill slowly, a young man sleeps beside them to keep others from using them at night, so there will be water in the morning when the herd arrives. If a household moves during the dry season to an area where it does not have wells, watering is done in the afternoon at the wells of other herders who have finished watering their animals, but normally the herd is brought to the wells in the morning.

Water is raised by hand using a rubber bucket; the herder empties the bucket a few meters from the well into a shallow metal basin used as a trough. Only a few animals are watered at a time and children keep the others back with sticks. After the entire herd has been watered, it rests. The herder waters the animals again briefly before returning to camp in the late afternoon. The time spent watering increases through the dry season as households move further from their water sources, and the herd returns to the camp later in the evening. As water becomes scarcer the herder must wait longer for the well to refill. At the height of the dry season sample members sometimes had to work throughout the night to get enough water for their herd.

Towards the end of the dry season these shallow wells often dry up. Some of the sample households used public water points: either cement wells or the boreholes at Akarana, Tchin Tabaraden and Dembutan. At the deep wells (approximately 30 m) the herder puts up his own pully on a forked stick. Donkeys or camels (the sample members did not have oxen) pull the water bucket. A child usually sits on the animal or walks beside it tapping it to keep it moving. The water bucket is then hauled by hand from the well opening to the trough. At boreholes no labor is needed because the water is pumped. The overall time involved in watering the animals is similar however, because at the end of the dry season pasture is exhausted around the boreholes, and camps are farther away. The sample households only used boreholes as a last resort; WoDaaBe dislike the confusion, disease risk and lack of pasture characteristic of boreholes, and would rather work harder to water their animals in better conditions.

Donkeys are watered separately by women and children when they collect water for the camp; this is usually at a different well from the one where the herd is watered.[1] Animals that are too young or ill to walk to the well are watered in the camp.

---

1. In these cases the time spent watering donkeys was recorded with collecting domestic water, as the two take place at the same time.

Figure 4.2.21 shows the time spent by adult sample members watering animals: this includes taking the herd to and from the well, raising water, waiting for the well to refill, directing animals used for traction, guarding the well, digging and cleaning wells. There is no watering labor at all for about three months of the year during the rains. At the end of the rainy season, small hollows where water can collect are scooped out on the edge of ponds that are drying in order to prolong their use. The sample families dug their wells in October and, at first, watered their animals daily. After several weeks, animals were watered every other day. The three to five hours shown spent watering by men every day in the dry season is an average of alternate watering and non-watering days; work hours on watering days are double the average. As figure 4.2.21 shows, watering labor increases progressively through the dry season; but falls rapidly to zero once the rains have really started.

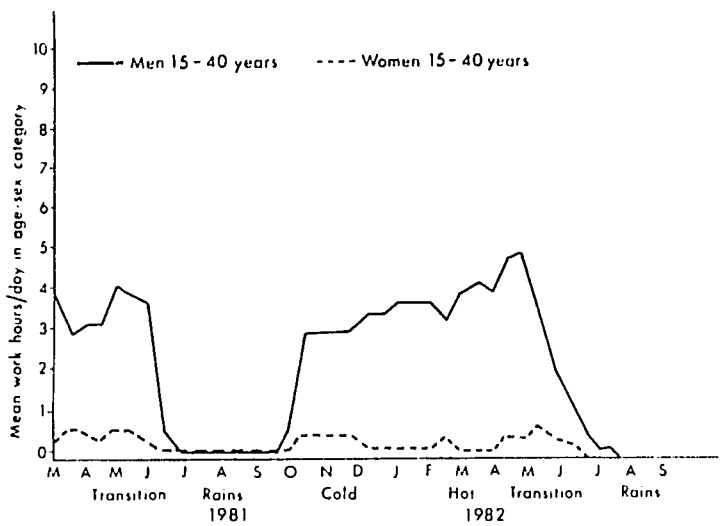


Figure 4.2.21 Seasonal distribution of animal watering labor (all species) by adult WoDaaBe men and women

Pasturing and watering are the two most time-consuming tasks in WoDaaBe herd managment, although there are many other less demanding jobs to be done. Figure 4.2.22 shows how the total labor allocation of adult WoDaaBe men to livestock tasks stays high and quite constant throughout the year, varying around 5 hours per adult man a day; there is a peak of 6.5 to 7 man hours a day in the transition period between the hot season and the rains, between May and July in both survey years, and a low point of about 3.5 man hours a day at the end of the rains and in the immediate post-rains period in October. The dry season is a time of prolonged high work hours; adult men rarely work less than 5 hours a day at herding from December until the rains are well under way in the following July. Pasturing and watering alternate with each other as the main activity with the main emphasis shifting from one to the other according to the season; watering is clearly much more energy-demanding than pasturing however, and is at its peak at a time when food is often scarce in WoDaaBe camps.

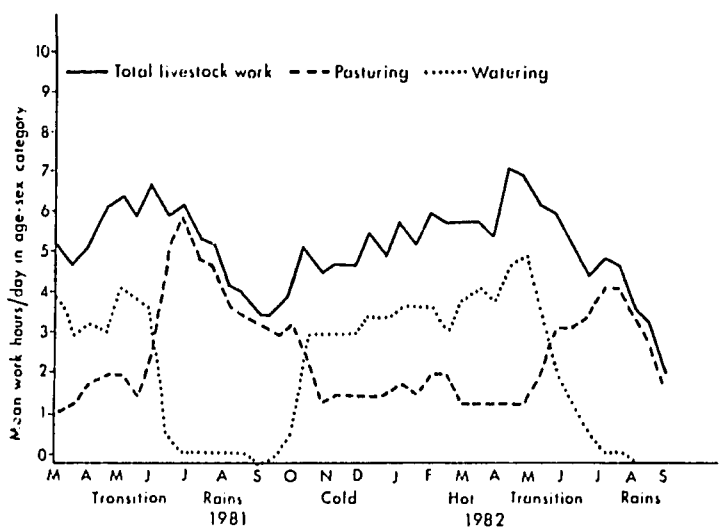


Figure 4.2.22 Seasonal distribution of work devoted to all livestock taska by WoDaaBe men aged 15 to 40 years

Other men's work

Men in the sample went to market regularly throughout the year, as figure 4.2.23 shows. This is an important activity for them, since they have to sell and buy animals, and buy cereals and other goods. Although women also go to market, men spend more time there than women, waiting to get a good price for their animal or to get enough cereals to make the trip worthwhile. Men also spend some time at the market going to the dispensary, dealing with administrative matters, and meeting other herders. This provides an important part of the information needed for effective pastoral management, about pasture and water, animal prices at different markets, and about events generally. Men in the 41 to 60 years age category spend more time than the younger adults at market. These older men are less active in herding,and spend more time in general in discussions, gathering information and making decisions.

The women in the sample also sold their own animals in the market, but more often bought household items or took their curdled milk or butter to sell or exchange for cereals.[1] Sample members normally spent two or three days at the market each time unless their camps were nearby. A herder with a single animal to sell often waits until others camped in the area also have animals to market so they can be driven there together. Taking a single animal a long distance in the bush is otherwise difficult and far more time-consuming.

Men also work hard when the camp moves. They help load the donkeys, and then drive the herd to the new camp, pasturing the animals along the way if the move is a long one; once there, they set up the calf rope in its new position. Other men's activities are less regular, although no less important. Looking for lost animals can be time-consuming; adult men (women and children are not sent off for long trips alone in the bush) sometimes had to spend a day at a time, and occasionally several days, looking particularly for lost camels. Donkeys also often stray, cattle are sometimes lost, and an

---

1. Bartering curdled milk, butter and tobacco for cereals (sippal) which is usually done in Twareg camps, was recorded separately from time spent going to the market (yahgo luumo). The WoDaaBe make a clear distinction between these two activities.

entire goat herd belonging to a sample household disappeared in a storm during the absence of the head of the household. Adult men also scout for new pasture. Normally each WoDaaBe group has a pasture specialist who spends more time than the others away from the camp looking at pastures, but this is an activity that most men occasionally devote time to. The men in the sample households also worked at making ropes and mending equipment like water buckets.

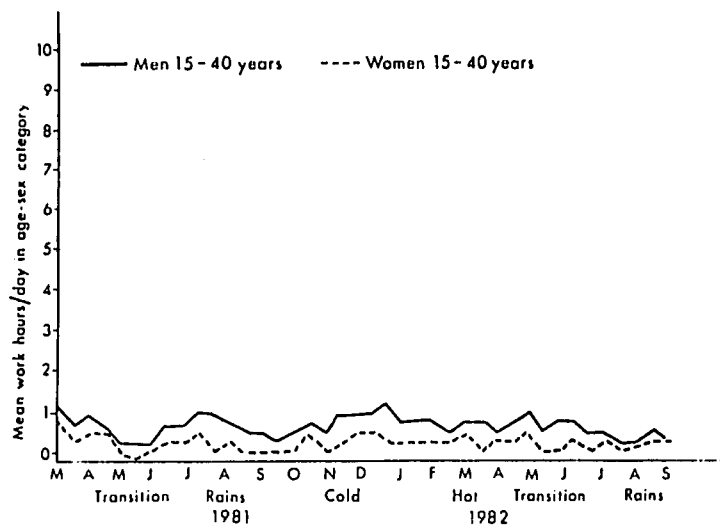


Figure 4.2.23 Seasonal distribution of time spent by adult WoDaaBe men and women going to market

Figure 4.2.24 brings together total work hours spent by adult men in both the 15-40 years and 41-60 years age categories on all activities connected directly or indirectly with economic production and essential maintenance: all livestock work, marketing, pasture scouting, moving camp, small amounts of artisan and domestic work; more social activities, such as attending ceremonies or visiting other camps for general discussions, are excluded from these totals, although they are important in the production system through the essential social links they create and maintain.

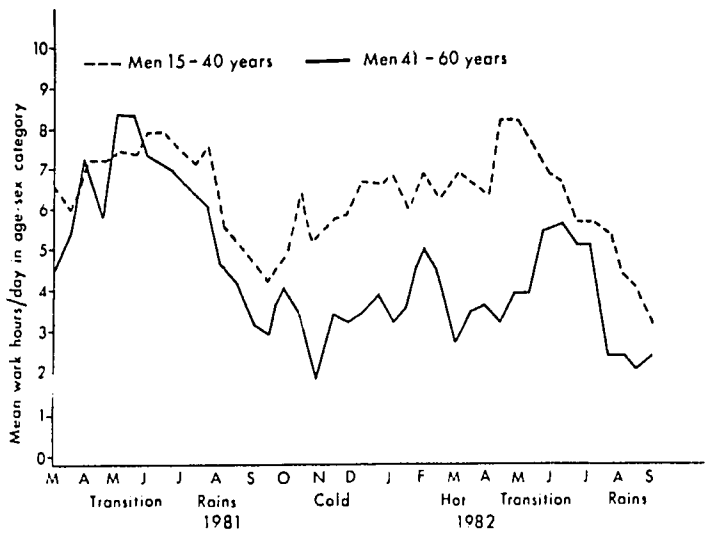


Figure 4.2.24 Seasonal distribution of time spent by adult WoDaaBe men on all productive activities

Men's work can be divided into three main periods. The period of least work occurs in the late rains and immediate post-rains each year, in September and October, although even during these two months adult men in the sample worked 4 to 5 hours daily at production and maintenance tasks. However the relative leisure of this season allows time to be devoted to social activities (visiting, courtship, ceremonies), which are concentrated almost entirely into this period; the most important and formal ceremonies take place during a three-day gathering of each lineage segment at the end of the rains.

During the dry season the WoDaaBe are scattered in dispersed household production units. Distances and hard daily work limit social interaction to a minimum. Labor requirements rise rapidly from the post rains low, through the cold and hot season. As figure 4.2.22 showed, watering labor is a major component of this work, with pasturing occupying an important place also; watering the animals every second day and walking long distances in the heat are both very hard work. By the end of the dry season in April and May, all adult men are working 7 hours a day at these tasks, and this period of long hours of hard work lasts for about half the year.

At the end of the dry season, as the first scattered rains fall, WoDaaBe men's labor hours increase. This is the peak labor period in the year, lasting about a month, depending on when the showers of the transition season turn into the sustained rains of the rainy season proper. During this time, adult WoDaaBe men work on average 8 hours every day, although the main tasks - pasturing, moving camp, with some residual watering when surface pools dry up before others fill - are lighter than those of the dry season. However in terms of pastoral output they are no less important. The transition season is the time of highest animal mortality, and of peak cattle calving; the animals are exhausted from the long dry season, and the rotting hay and new toxic plants of the transition season are especially dangerous; the unpredictable changes back and forth between a diet of fresh grass and dry hay are unsettling. On the other hand this is the moment when the animals can, if well managed, start their rapid growth which compensates for the dry season weight loss, and also when good management of the grazing herd can push milk production up rapidly.

Figure 4.2.24 shows that the seasonal pattern of productive work by older men, aged 41 to 60, is very similar to that of the younger adults, although the older men in general work less long hours. Men over 60 years, of whom there were only two in the sample, continue to work at all productive tasks, but the amount of work they do depends directly on the size of the production unit they belong to, and the work arrangements within it. An old man without sons in the camp to do herding work may find himself working as hard or harder than young adults. There were short periods in the sample when one old man, whose household included his two sons, one absent on migrant labor, the other

too young to take responsibility for the household herd, had to pasture and water the herd with little help, working up to 13 hours a day for sustained periods. The data show that in cases of this sort, households sometimes join together to capture economies of scale, but that quite often this is not possible, and that individual people may find themselves working extremely long hours as a result.

Women's work

Women's work is far more varied than men's work. Women make a relatively small but steady contribution to largely male tasks such as pasturing, watering and marketing. In addition they do domestic work and milking, in which men's contribution is negligible. There is a little cooperation between women; most of their work is done individually. Once a woman has constructed her own suudu shelter, she is helped only by dependent women and girls. Even co-wives have their own calf-ropes, separate cooking fires, milking calebashes and water buckets.

Animal work

Milking labour varies little seasonally but is a daily requirement. The women, helped by children, chase after the very uncooperative calves to catch them and attach them to the calf rope before the herd returns to the camp each afternoon. When the herd has gathered, a woman releases each calf and allows it to suckle its mother for about half a minute and then ties it to the cow's back leg. The woman milks into a special milking calebash held between her legs, measuring by the presssure of the spurts of milk how much if left for the calf. When she has taken enough milk, she releases the calf to suckle freely and unties the calf of the next cow to be milked. Some cows are known for their difficult characters and tendency to kick or butt with their horns when milked. Women sometimes tie the back legs of a cow together, or call a child to caress its vulva to calm it, and occasionally a man helps by attaching a rope around the horns of the cow to hold it still. When there is more than one wife in the family, each co-wife milks only the cattle allotted to her. After milking, each woman sets aside milk for herself, her own children and for barter, and takes her contribution of milk to the head of the

household who divides it for the meal. The calves spend some time with their mothers; later in the evening they are separated from the herd, which has gradually gathered in the corral, and are tied to the calf rope for the night, until the next morning's milking.

In the sample households, each milking took from half to three quarters of an hour, and was done mainly by adult women, although men sometimes milk if there is no woman present. When the cows are producing little milk at the height of dry season, all their milk is left to the calves; there were several weeks during the year when sample households did not milk at all, although some work with the young animals continues at this time. Figure 4.2.25 shows the seasonal distribution of milking labor, including the time spent catching and attaching the calves, by adult WoDaaBe women.

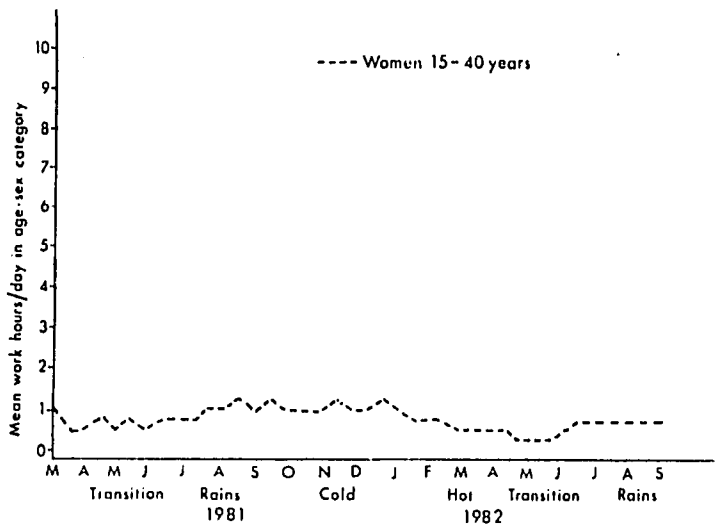


Figure 4.2.25 Seasonal distribution of milking labor by adult WoDaaBe women

Domestic work

Major tasks for women are pounding cereals and cooking. Women spend several hours each day pounding millet or sorghum, separating the bran, and pounding again until they have made a flour, which they mix with water and heat to make a porridge. They also pound leaves, salt and spices to make sauce. The women prepare one cooked meal a day, in the evening. What is left is eaten cold with milk the next morning; little is eaten during the day. Each adult woman prepares a meal separately for herself and her children and takes a contribution to the meal of the household's men. During the rainy season larger quantities of milk and more rice purchases reduce the amount of time the women spend pounding cereals.

Women, assisted by boys and girls, collect water in goat skins at wells or ponds to use in the camps for drinking, cooking, and watering very young or ill animals. Children are usually sent to bring the donkeys to the camp, and one woman from the household generally accompanies the children and donkeys to the well or pond. The amount of time spent collecting water increases in the dry season when the camps are further from the water points, water needs increase, and the women have to wait longer at the well. In the rainy season women and children fill the water bags at ponds while the donkeys drink.

Figure 4.2.26 shows the time spent by sample women cooking and pounding, collecting water and at other domestic tasks. Other domestic work is varied. Women collect wood for their fires throughout the year with no seasonal variation. Women make butter by rocking a calebash; making butter for a household takes several hours and is done every few days; for about four months in the dry season women do not make butter because they have too little milk. Cleaning calebashes and cooking utensils is a regular activity. Miscellaneous tasks include collecting leaves and fruits in the bush to eat, sewing and washing clothes. The women look after their children, helped by older girls, while they do their other work, often pounding cereals with babies on their backs.

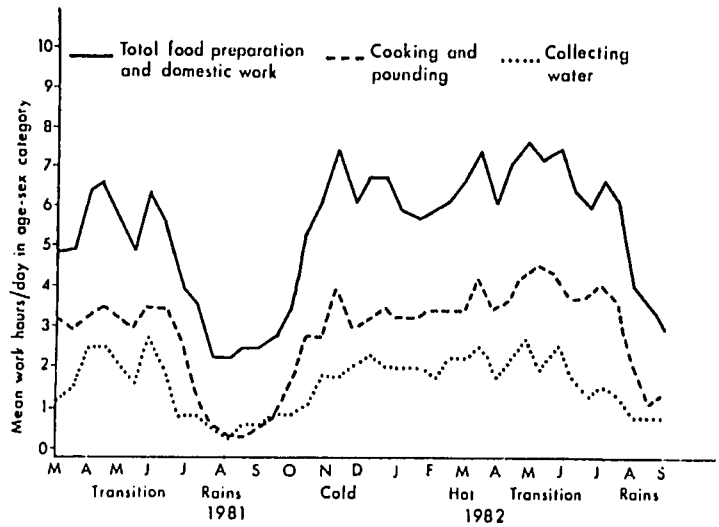


Figure 4.2.26 Seasonal distribution of domestic labor by WoDaaBe women aged 15-40 years

Adult women do most of the work involved in moving camp, although children and men help. On the days the camps move - once every few days in the rainy season and about once a month for the rest of the year - women spend most of the day at this. All belongings and equipment, everything constituting the camp, must be packed and loaded on donkeys: utensils, equipment, clothing, calebashes, mortar, pestle, bed parts, mats, water bags and buckets, ropes and children. A few items, for example sacks of cereals, are loaded on the household camel. The women with the donkeys then follow the main herd which has left earlier with the men. At the new camp site women collect branches to make the new shelter wall, clear the ground inside, set up the table for calebashes and utensils and the bed, and upack the donkeys. Figure 4.2.27 ahows the seasonal pattern: more time is spent moving camp in the rainy season, although it is an activity that requirea labor throughout the year.

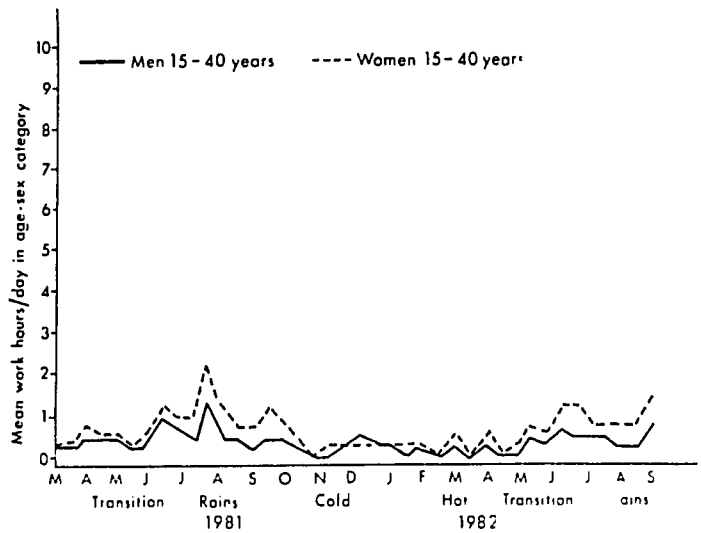


Figure 4.2.27 Seasonal distribution of labor moving camp by adult WoDaaBe men and women

Other women's work

Women in the sample households took curdled milk, butter and tobacco to Twareg camps to exchange for cereals. The women do this more frequently in the rainy season and particularly in the cold season; in the hot and transition seasons such exchanges are less attractive because camps are more separated, and there is less milk to barter. Miscellaneous household maintenance activities by women include mending mats and calebashes.

Figure 4.2.28 shows the seasonal distribution of women's total productive work. As with men's work, total women's labor hours drop in the rains to an annual low point of about 5 hours per woman a day, somewhat more than men are working in the same period. For women this ia also the time of most social activities. Women's total work rises again during the cold season, and stays high throughout the hot seaon, rarely falling below 8 or 9 hours per woman a day for the 15 to 40 years age class, and rising occasionally to over 10 hours. Women do not however share in the sudden peak in work by men in the

transition season; for them this is a time of slightly less work after the hot season peaks, due mainly to a reduction in the labor needed to fetch domestic water now that it can be taken from pools near the camp. However, a comparison with figure 4.2.24 shows that WoDaaBe women work more hours than men throughout the year.

Figure 4.2.28 also shows the seasonal distribution of work hours by the older group of women, although the small number of them in the sample makes the graph much more variable. The amount of work done by these older women, like that of the older men, depends very much on the composition of their household; in the hot season, when many people are away on migrant labor, older women often have to work very hard indeed.

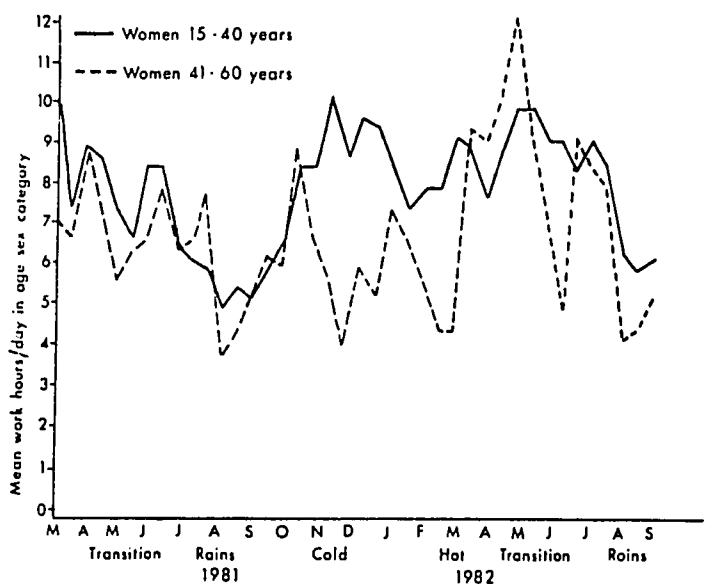


Figure 4.2.28 Seasonal distribution of time spent by adult WoDaaBe women on all productive activities

Children's work

Children make an important labor contribution in the sample households. Both girls and boys begin as early as six or seven years to collect firewood and help older children fetch animals, particularly sheep and goats, calves and donkeys. A child of ten can already be sent to bring the cattle back to camp if they are grazing nearby. As they get older, girls' tasks, like women's, are more numerous than boys'. The major work of girls between 6 and 14 years is collecting household water. Boys until the age of 9 or 10 also help with this. Girls assist women with pounding, but this is heavy work, and it is not until they are 13 or 14 that they can really pound properly. Both girls and boys collect firewood and help breaking and setting up camp; girls do more of this work than boys. Some pasturing is also done by girls, depending on who else is available in the household. In one sample household there was only one adult male and no boys over the age of three. The oldest girl was sent to fetch animals and even tended the cattle a little when they were close to the camp; this did not happen in households with boys. Girls under 15 do not milk, although they help separate the calves from the herd and attach them to the calf rope.

Boys' main activities are pasturing, particularly in the rainy season, and watering in the dry season. Before a boy is old enough (about 14 years) to take the cattle alone for the day's pasturing, he accompanies an adult man. Other boys tend small stock and calves. Boys spend most of their time watering throughout the dry season. They are not yet strong enough to draw water from the wells alone, but work hard helping walk the animals to and from the well, separating them and controlling them at the well, and driving the draft animals. Average person hours spent per day watering animals in the dry season was even higher for boys in the 6-14 year age group than for adult men. Older boys sometimes take to the market animals that are to be sold. They can help pounding cereals or milking when women are away from the household. Figure 4.2.29 shows the important contribution made by children, particularly boys, to the sample households' labor totals.

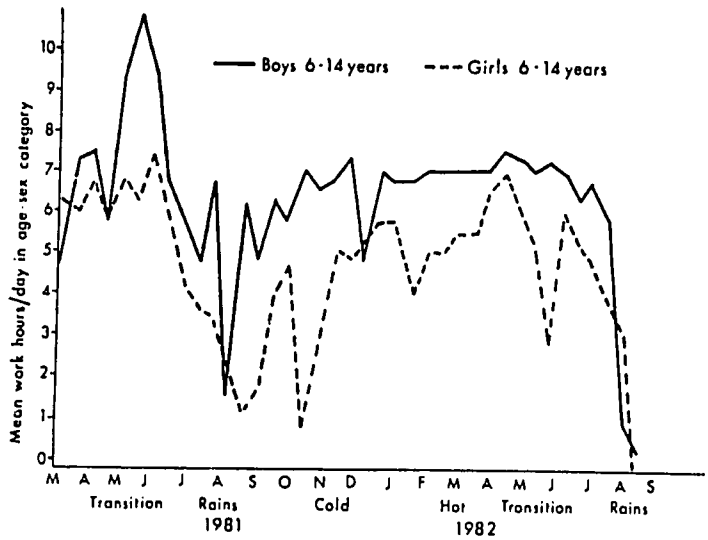


Figure 4.2.29 Seasonal distribution of time spent by WoDaaBe children on all productive tasks

Discussion

The figures presented above for WoDaaBe work give a clear picture of a labor-intensive economy. WoDaaBe men, women and children work long hours; although there is some reduction in mean labor hours in the rainy season, even then everyone is working several hours every day at essential tasks connected with the pastoral economy. At peak labor periods, WoDaaBe are working as hard as most Sahelian farmers, but they do not have the slack season characteristic of Sahelian farming, when less important maintenance tasks can be undertaken, when people can leave altogether on migrant labor, or can turn their attentions to other types of job.

Table 4.2.34 summarizes annual work hours at all productive and essential maintenance tasks by WoDaaBe men and women in different age categories. In each age category, women work longer hours than men, and even young children are working hours as long or longer than many Sahelian farmers.

Table 4.2.34 Annual labor hours performed by WoDaaBe men and women at different tasks

	Mean person hours/year					
	Men			Women		
	6-14 years	15-40 years	41-60 years	6-14 years	15-40 years	41-60 years
Livestock work	1,314	1,874	876	133	574	378
Food and domestic	224	298	489	792	2,040	1,582
Household maintenance and artisan	-	13	31	1	41	70
Marketing and camp movement	26	258	455	2	102	326
Miscellaneous work and travel	7	300	481	31	124	397
Remainder	8	76	218	14	43	546
Total	1,579	2,819	2,550	972	2,924	3,299

These WoDaaBe annual work hours totals, about 2,800 hours a year for adult men, 2,900 for adult women, and 1,579 hours and 972 hours for boys and girls respectively, are high in comparison to what we know of labor allocations in other Sahelian pastoral and farming economies. Comparisons however are not easy, particularly with farming. Although watering labor is more physically demanding than weeding or digging, pasturing a herd is much less hard work than most farm labor; the way the WoDaaBe do it, requires continuous presence, knowledge and judgement, but little physical effort apart from the long

distances walked. The WoDaaBe are working a great deal harder than the pastoral Twareg studied by Swift (1979), although differences in methodology do not allow the data to be compared directly. With respect to farmers, the WoDaaBe studied are working a great deal more than West African farmers who work 1,400-1,500 hours/year in the wetter areas down to 500-700 hours in the northern semi-arid borders (Cleave 1974: 31-65; Eicher and Baker 1982: 47: 99-100; Norman et al. 1981: 27-28; Norman et al. 1982: 114).

Four factors go some of the way to explain the high labor totals of the WoDaaBe. The first, typical of pastoral economies in general, is the fact that there is an important labor cost in simple maintenance activities for the herd throughout the year: unlike farmers and their field, herders cannot simply leave their herd to do something else for a few weeks. The herd needs constant attention, and one or more household members must be looking after it at all times. Put another way, there is no slack season in herding, and even in the late rainy season, when WoDaaBe herding labor drops considerably due to the abundance of grass and water, WoDaaBe men are still working several hours a day tending their animals.

A second factor is more specific to WoDaaBe methods of herd managment. The WoDaaBe manage their animals intensively, spending much more time with them than, for example, Twareg pastoralists in the same area. The Bororo cattle herded by the WoDaaBe respond well to intensive management; they easily walk long distances in search of good pasture. WoDaaBe herdsmen, as has been noted above, prefer the hard work of watering their animals at shallow wells, as long as pasture is better, to the ease of watering at boreholes, where pasture is bad, and where there is confusion and risks of disease. WoDaaBe are late-comers to the project area, and have had to fit into the interatices of an environment where powerful Twareg confederations already controlled the key waterpoints and pastures. It may be that a necessary cost of the WoDaaBe entry into this area has been a high degree of herd supervision and labor inputs generally to herding, and that the WoDaaBe have been able to accept this because it fits well with their specialist approach to cattle management and their commitment to and knowledge about herding generally.

Arising from this and closely related to it, is another reason for the high labor allocations in WoDaaBe herding. The WoDaaBe organize day to day production in very small, autonomous units. Potential economies of scale in pasturing labor are not captured to any great extent in everyday herding, and, for much of the year at least, it is doubtful whether the WoDaaBe techniques of intensive supervision of pasturing animals would allow any substantial economies of scale. The data suggest that the formation of independent production units may be delayed by insufficient herds, allowing large poor units to profit from economies of scale and diversify their activities, especially into migrant labor, but that once the herd has grown beyond the minimum need to support a viable independent production unit, however poor, such units form and manage their affairs separately from others as long as that is possible. Thus the WoDaabe commitment to spatial dispersion in search of the best available pasture, and the organization of day to day production activities at the minimum feasible structural level, necessarily reduce whatever possibilities exist for reducing labor input by capturing economies of scale. Watering, one of the main components of overall herding labor, is of course not subject to economies of scale, and the WoDaaBe dislike of boreholes (and their exclusion by mainly Twareg proprietors from any easier water sources) means that, as far as watering is concerned, they anyway have little alternative to a high labor allocation strategy.

Finally, as the household budget data analyzed above showed, the WoDaaBe are very involved in market transactions; they spend a lot of time at market, as well as travelling more generally. All pastoralists move around a great deal in search of information, which is one of the key management factors in a pastoral economy, and the WoDaaBe, as would be expected from their commitment to pastoralism, move around more than most. They send out pasture scouts, move camp more often than other Sahelian pastoralists, visit markets and other camps in search of news about pasture, water or prices, about whether cereals can be found at one market or salt for the animals at another. The way the WoDaaBe manage animals keeps households separated from each other in the bush, but they compensate for this by communication networks maintained by travel, which must be considered an important cost of production in the WoDaaBe system.

The labor data indicste that watering labor is a clear constraint on production, occupying most adult men and boys for several hours every second day during at least six montha of the year. Time spent watering is substituted for time spent pasturing, at a time of year when the WoDaaBe's specialized and knowledgable approach to grazing herd managment would be expected to reduce the rate of dry and especially transition season cattle weight loss. There is no obvious technical solution to the watering problem, although within the context of herders' associations the construction of new wells with improved water lift technology may be feasible, especially if the attribution of water rights reduces the crowding common at high capacity wells in the project area.

The WoDaaBe labor data do suggest two other development conclusions. First, the high labor allocations of the hot season draw attention to the advantages in economic terms of reducing migrant labor at that time. Policies and programs to reduce the need for migrant labor, such as credit for herd reconstitution and dry season cereal stocks, will make available more labor in the WoDaaBe economy at a time of year when demand for labor and thus its marginal return are high.

On the other hand, the high labor force participation rates by girls and boys aged 5 to 14 years make it likely that any program for formal education involving full-time school attendsnce will be met by considerable resistance, as it would threaten to remove an essential part of the labor force. Different approaches to education will be needed. More generally, any development proposal which requires a substantial labor input, such as haymaking, planting fodder trees or shrubs, or construction of earthworks for water harvesting, are also likely to be difficult or impossible to fit into the WoDaaBe labor schedule, unless substantial labor savings are made elsewhere first.

HEALTH AND NUTRITION

The well-being of herders and the productivity of their labor is strongly influenced by their health and nutrition. But little is known about the health and nutrition of any pastoral group in Niger: the dispersion and movement of nomadic camps leads herders to have different problems from sedentary farmers, and makes observation and measurement difficult. The few surveys carried out on pastoral nutrition and health elsewhere in the Sahel have tended to be during droughts or famines, when abnormally high levels of malnutrition are to be expected. Disease incidence among herders cannot be understood only by analysing statistics gathered at dispensaries, as herders' camps are usually too far from a dispensary for them to go there regularly.[1]

A medical and nutrition survey was undertaken by the project among a sample of WoDaaBe herders in order to provide baseline data on herders' health, food intake and nutritional status, and to answer the following questions: are there substantial seasonal variations in food intake, nutritional status and disease incidence among the WoDaaBe, of a magnitude that could reduce labor productivity or otherwise have a serious influence on the herding economy or herders' well-being? The research was policy-oriented, that is to say it was intended to enable more appropriate and cost-effective health interventions possible in the pastoral zone.[2] The following section summarises the detailed report of research findings.[3]

---

1. See chapter 6 of this report and Loutan (1982a: 117-125) for a survey of herders' use of health service facilities in the project zone.

2. Experimental interventions in public health arising from this research are described in chapter 8.4 of this report.

3. See Loutan (1982a) for a complete report and discussion of survey results.

Methods

From August 1980 to September 1981, 54 WoDaaBe households, totalling on average 366 people, were questioned (using a standard questionnaire) at 3-monthly intervals on food consumption, domestic water use, illness, work ability, and infant nutrition; standard anthropometric measures (weight, height and age) were also made. At each visit estimates were made of milk production from household herds and of the water available in waterskins at the camp. Participant observation and extensive discussions with WoDaaBe men and women provided qualitative information on perceptions of disease and health, and on medical and nutritional practices. The households (defined as the wuro, or unit living from a jointly-managed herd and sharing a common budget for major expenses),[1] were chosen non-randomly from among a group of related families within a single maximal lineage, an important criterion being that there should be enough social and geographic cohesion for the research team to find all the families on each visit.

Water

The most important factor in determining the location of a WoDaaBe campsite is the quality and abundance of pasture, and herders do not hesitate to camp far from a water point in order to take advantage of good pasture. This has a strong influence on the availability of domestic water. The health and nutrition survey measured seasonal changes in the distance between camps and their water supply. The results are illustrated in figure 4.2.30.

During the rainy season (July-September), camps are situated around ponds. More than 80 percent are set up less than 500 m from their water source, and the others are located at 1-2 km. As pastures close to water are grazed, the herders move further away. By November, 25 percent of the camps were more than 5 km from their water. This dispersal reaches its maximum in May and June, when 60 percent of camps are more than 10 km from water and some are up to 20 km from their wells. At the start of the next rains, ponds form, new pasture appears, and this centrifugal movement stops; camps are once more close to water.

---

1. See earlier discussion about the definition of the wuro.

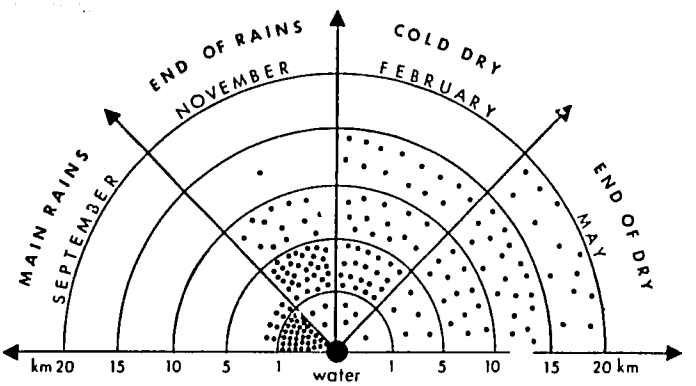


Figure 4.2.30 Seasonal changes in distance between WoDaaBe campsites and their water source

The long distances to be covered in the dry season between camp and water point impose great stress on animals and people and are responsible in good part for the herders' precarious life at this time. A person working at normal activities in shade temperatures of more than 40°C needs to drink 4 to 5 liters a day. Getting this water is a constant problem for the WoDaaBe.

The sources of water vary from one region to another and across the year. Near Tchin Tabaraden, in the area where the study was carried out, temporary sand wells are the major water source during the dry season; in other regions, shallow wells are replaced by deep traditional or cement-lined wells. Figure 4.2.31 shows how families in the sample got their water at different times of year.

During the rainy season (September) almost all the families drank pond water. From the cold season until at least February they used shallow sand wells. At the end of the dry season, many shallow wells are dry and herders used deep traditional wells or boreholes instead. In the survey year the rains started early, at the end of May. This enabled a quarter of the sample families to get their water from surface ponds which had already filled.

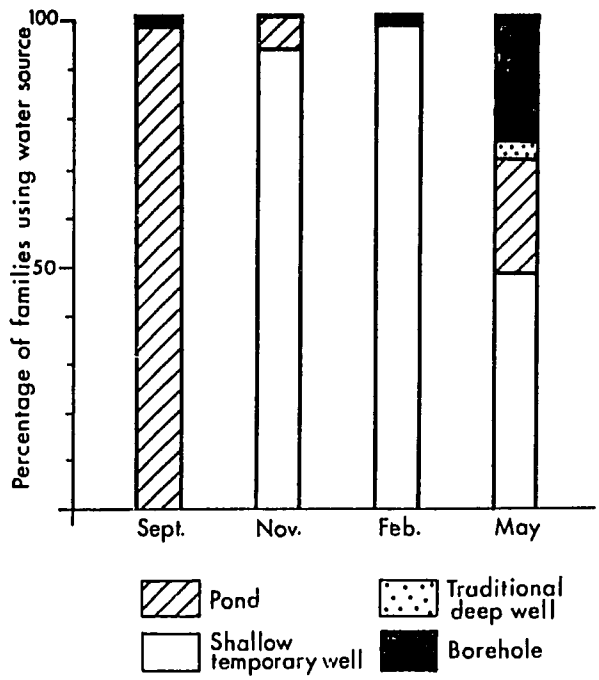


Figure 4.2.31 Seasonal changes in the water source used by 54 WoDaaBe families

Water from the shallow wells is often muddy, although it clears after a few hours of sedimentation. Though the WoDaaBe prefer the clear water of the boreholes, they are forced to drink water from shallow wells or ponds most of the time if their animals are to avoid the overused and degraded pastures around the boreholes. During the rainy season water comes exclusively from ponds. At ponds, animals come before people: cows get in the water and dirty it although sheep and goats drink at the edge. Women look for clear ponds and are often forced to travel a few extra kilometers. When they draw water, they choose the clearest place: among the weeds, or areas unaffected by animals. But quite often at the end of the rainy season the water is muddy and full of animal urine and excrement. Even though the WoDaaBe dislike drinking dirty water, they have no alternative. In the Dakoro area, some WoDaaBe decant water with leaves of Boscia senegalensis. Many filter pond water with cloth or

a rudimentary wicker filter to get rid of eggs and insect larva. However, as the camps are normally far from water sources, it is likely that contamination by human feces or domestic waste is much less frequent than in villages.

The availability of water in the camp for human use is influenced by several factors: the distance between the water point and the camp; the transport capacity of the family; and the number of young animals to be watered in the camp.

During the rainy season, when the camp is near a pond, the women get their water there several times a day, whenever they need, and water is unlimited. When the ponds are dry, the women must go to the wells, and the water brought back to the camp is limited to the household's transport capacity, that is the number of donkeys and waterskins. In the camp, the amount of water for human use also depends on the number of animals to be watered. In the dry season, young animals cannot cover the long distances from the camp to the well, so they stay in the camp and have to be watered there.

Table 4.2.35 shows the quantities of water available daily to each survey family at different periods of the dry season. This water has to meet all domestic needs including drinking, cooking and washing. The quantities shown in table 4.2.35 probably somewhat overstate the amounts available per person, since no allowance has been made for losses during transport and for evaporation, which is especially important in the hot dry season.

Table 4.2.35 Availability of water in WoDaaBe camps

	Nov 1980	Feb 1981	May 1981
Number of families	46	46	46
Size of families	7	7.1	7.3
Water brought back to camp (liters)	77.2	78.4	92.2
Total human consumption (liters)	65	52.8	52.9
Average individual consumption (liters)	9.3	7.4	7.3

The amount of water brought back to the camp each day varies little during the dry season. Between February and May, it increases only by a little over ten liters. The amount available per person diminishes between November and February and remains unchanged between February and May.

Water needs vary considerably by season. At the height of the dry season, people and animals are very thirsty. However, the amount of water brought back to the camp in May does not increase very much, and certainly not in proportion to the increased needs. This is because WoDaaBe households have a limited capacity to carry water, determined by a fixed number of donkeys and waterskins. In any case the extra water brought back to camp in May is destined for animals: the amount available for people is the same as in the cold season. In relation to their greatly increased needs, the water available per person in May is less than in November. Because of transport and evaporation losses, it is probably that each person does not have more than 5 liters at his disposal per day during the months of April and May.

In the camps, the water is kept in waterskins hanging from a tree. Some people pour part into clay or metal containers. The women conserve water as much as possible. Very little water is used for cooking. About 600 ml of water is needed to pound 2.8 kg of sorghum, plus 3 to 4 liters for cooking the paste and sauce, and 5 to 6 liters more to wash the calabashes, prepare a special dish for the children and make morning and evening tea.

People hardly wash in the camp. On waking, adults wash their faces, fore-arms, hands, and rinse their mouths. The real washing is done at the well or the pond. Children are also washed at the well; among the WoDaaBe children are washed once a day, although soap is rarely used. Detergents are used to wash clothes, also at the water point.

Food

The WoDaaBe generally eat two meals a day: a hot meal is prepared at night and the leftovers are eaten cold the following morning. The major staples of the diet are milk and cereals. Milk is drunk during or between meals each

day. Fresh milk is highly sought after and is the most prized food of the WoDaaBe, for whom it is the source of health and strength; a number of dry season diseases are attributed to lack of milk. Butter is cooked and eaten with the sauce of cereal dishes. However, the WoDaaBe do not make cheese and rarely eat it.

Millet and sorghum, bought in local markets, are the two cereals most commonly eaten. Generally millet is preferred to white sorghum and fonio. The WoDaaBe do not like the taste of red sorghum, to which they also attribute digestive troubles. Rice on the other hand is sought after but its high price limits consumption.

Meat plays an unimportant role in food consumption. Cattle, sheep or goats are slaughtered on special occasions such as the arrival of an important stranger or a ceremony, and also when an animal is going to die of weakness or disease. A variety of wild leaves are used to make sauces, and harvested wild products are eaten sporadically.

Tea has appeared in the WoDaaBe diet in the last 20 years. Introduced among the Twareg in Niger since the beginning of the century, sweet green tea has been progressively adopted by the WoDaaBe as the contacts between these two groups became more frequent. At present many WoDaaBe drink tea in the morning and at night, or when strangers arrive. Tea plays an important role in social relations and contacts between people, and its energy value, through the large quantity of sugar it contains, is significant.

In famines, the WoDaaBe have few replacement foods. Fonio is normally eaten as a dry season staple. Cram-cram (Cenchrus biflorus) and Tribulus terrestris seeds and the fruits of Boscia senegalensis are also eaten, as well as the heart of dum palm roots (Hyphaene thebaica) in the southern part of the pastoral zone. In times of extreme destitution people have been known to pound calabashes or cook pieces of leather.

With the numerous trips that men and women make to cities in the south in order to sell traditional medicines or to work plaiting hair, eating habits are changing graduslly. Macaroni, bread, rice, canned tomato sauce, bouillon

cubes, onions, biscuits and sweets have appeared in the diet. Some people buy powdered milk during the hot season, but the majority do not like it and blame it for intestinal troubles. Canned foods, fish, fresh fruit and vegetables are not eaten. The WoDaaBe are in general very conservative about eating and do not voluntarily try new foods.

Food availability varies seasonally. During the rainy season and the months that follow, when milk production increases due to improved pasture, the WoDaaBe mainly consume milk, although some millet may be eaten if a family herd's milk production is insufficient. As the dry season advances, milk production steadily diminishes, until it is negligible or zero from March to June. Table 4.2.36 shows seasonal fluctuations in the availability of milk in the nutrition survey's sample of WoDaaBe families.

Table 4.2.36 Seasonal variations in milk available to WoDaaBe families

	Average quantity of milk (liters) obtained per family per day (1980-1981)			
	November	February	May	September
Number of families	48	49	51	44
Mean family size	7	7.1	7.3	7.5
Milk obtained (l/day/family)	9.6	4.7	2.7	18.2
(standard deviation)	(± 4.6)	(± 2.5)	(± 2.6)	(± 1.1)
Milk available (l/day/person)	1.37	0.66	0.37	2.43

Source: Loutan (1982a: 55).

Nutrition of new-born and young children

During the first two days of life, the new-born child drinks cows milk; his mother is not thought to have enough milk during that period. On the third day, the mother extracts a few drops of milk which she lets fall on the previously heated blade of an axe. If the milk is white and flows on the iron, it is considered good. From that moment the mother starts breast feeding the infant who drinks the colostrum, and is fed on demand. If the milk is not good or insufficiently abundant, some women resort to a healer who prepares a solution in which the breasts are bathed and massaged. She is made to drink an infusion of various plants (dibehi, burungel be'j bagahi, and sabarahi)[1]. The bark of bulbi (Acacia Seyal) infused with cooked millet husks (nyaande) also stimulates lactation. During the period when milk is inadequate, the child is given pure cow milk or milk mixed with water. Sometimes another woman breast feeds the child, but this is rare.

The infant does not drink water before he or she is two months old. The first food given in addition to maternal milk is cow's milk. Goat milk is drunk only when there is a shortage of cow's milk, for example in the hot season. The Dubanko'en WoDaaBe never drink goat milk because they think that it gives leprosy. Sometimes the Gojanko'en drink it, watered down to avoid the sore throat they believe it causes. Cow's milk is first given around the ninth month, unless maternal milk is inadequate, in which case it is given earlier. Cereals are not given until the infant has teeth.

Weaning is done by preventing the child from sucking and generally takes place when the mother is two or three months pregnant. However, it cannot be done during the two forbidden months (lebbi haramji) which follow the Tabaski feast.

---

1. Probably Acacia laeta, Dactylotenium aegyptium, Cadaba farinosa and Guiera senegalensis. See Peyre de Fabregues (1979).

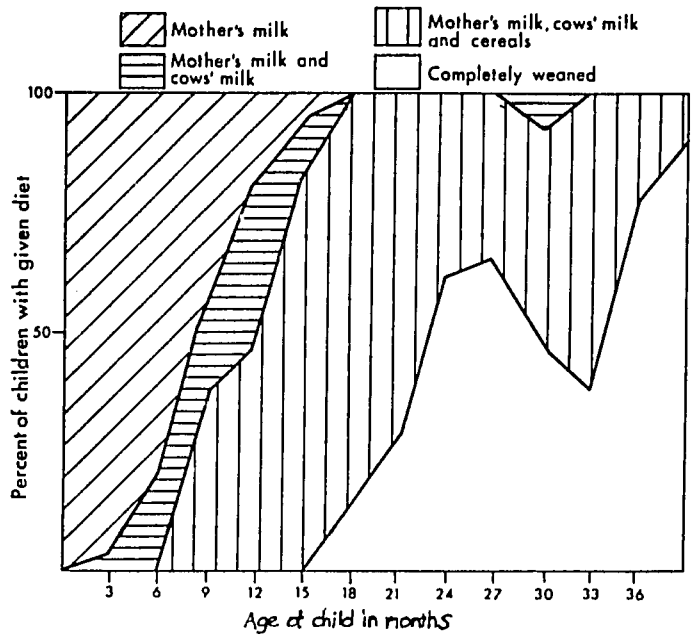


Figure 4.2.32 Food of WoDaaBe children under 3 years

Figure 4.2.32 summarises 279 longitudinal observations on child nutrition, and shows the proportion of children of a given age with each type of diet. Cow's milk is introduced from the third month; by the ninth month more than 50 percent of infants drink it in addition to their mother's milk. Cereals are introduced as early as the seventh month, and at one year, 50 percent of infants eat cereals. Only half of the children are weaned at the age of two years. The transition to adult food is very slow: the child is not subject to a sudden change of diet at weaning, since family meals have enough proteins from milk. This may be contrasted with many farming societies where the weaned infant shifts suddenly from a milk diet to a cereal diet with lower protein and energy value due to the way dishes are usually cooked.

Nutritional status of children

The two main anthropometric indices used here are weight/height and height/age. The ratio weight/height is an indication of acute malnutrition, in other words a nutritional deficiency which started a few weeks before. The child's weight decreases because of loss of fat and muscle without any change in height. The measure has the advantage of being independent of age among children under 5, which is particularly useful when the exact age cannot be determined. A child with a weight/height index of less that 80 percent of the reference is suffering from acute malnutrition or wasting.

When a child is subject to nutritional deficiency for a prolonged period, his growth is slowed and his height no longer increases normally. A below average height/age indicates chronic malnutrition. To calculate this ratio, it is necessary to know the exact age of the child. A child whose height/age is below 90 percent of the standard is considered to suffer from chronic malnutrition.

Table 4.2.37 shows, in a group of 29 children followed throughout the year, the number in each weight/height class in relation to the standard. It shows the incidence of various degrees of acute malnutrition in this group of children at each visit.

Table 4.2.37 Seasonal changes in prevalence of acute malnutrition among 29 WoDaaBe children under 5 years

Percent of standard weight/height	Number of children				
	August 1980	Nov.	Feb. 1981	May	Sept.
> 100	1	1	1	0	0
90 - 99	9	13	11	9	12
80 - 89	14	13	14	15	14
70 - 79	4	2	2	5	3
60 - 69	1	0	1	0	0
< 80 (percent)	(17)	(7)	(10)	(17)	(10)

The same values are shown in figure 4.2.43 and compared with the rates of prevalence of acute malnutrition calculated in a larger group of children (an average 62 children) measured during each visit to the camp. The average age of the children at the first visit was 27 months.

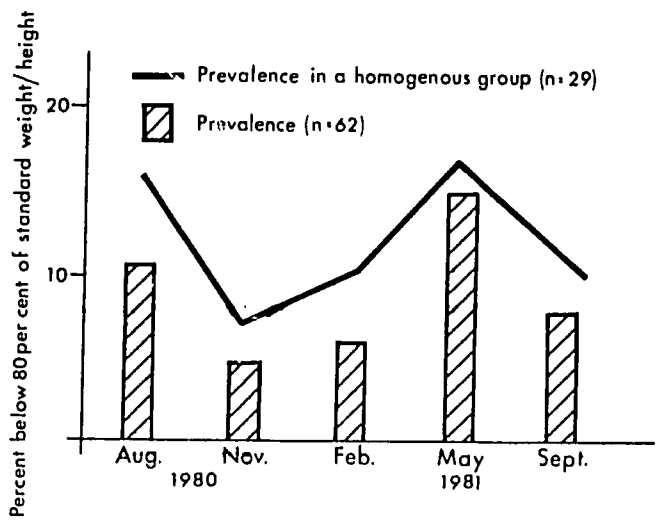


Figure 4.2.33 Prevalence of acute malnutrition in two groups of WoDaaBe children under 5 years

The seasonal variations in the two sets of incidence rates are similar and show an increase of acute malnutrition in the dry season followed by a gradual decrease during the rainy season, which continues until the cold season (November). The sample is too small to show more than the trend in that age group, which cannot be confirmed statistically. The rate of acute malnutrition, that is less than 80 percent of standard, varies from 7 to 17 percent during the year.

Table 4.2.38 shows variations in the prevalence of stunted children, indicating chronic malnutrition.

Table 4.2.38 Seasonal changes in prevalence of chronic malnutrition among 30 WoDaaBe children under 5 years

Percent of standard height/age	Number of children				
	August 1980	Nov.	Feb. 1981	May	Sept.
> 100	4	4	3	4	4
90 - 99	13	15	17	17	17
80 - 89	13	11	10	9	9
< 90 (percent)	(43)	(37)	(33)	(30)	(30)

Although seasonal variation is much less than in the case of wasted children, since this measure is an indication of chronic malnutrition, some reduction in prevalence appears to have taken place between the first and last measures. It is unlikely that this represents a slow recovery from an earlier unfavorable year, since recovery from a low weight/height ratio takes years, not months. Given the size of the sample, this decrease is not significant.[1]

However, each child taken separately follows the same pattern throughout the year, and it is rare for a child to shift categories. In fact, the increase in height is not particularly influenced by seasonal factors. It is more a measure of the adequacy or inadequacy of food consumption over several years. The average number of stunted children over the year is high: one child in three.

A more sensitive measure of the fluctuations in nutritional status during the year is obtained by calculating the gains in weight of the children at intervals of three months. This is shown in figure 4.2.34.

1. The difference between the percentages of August 1980 and September 1981 is not significant on Rosenbaum's normogramme (Swaroop 1968).

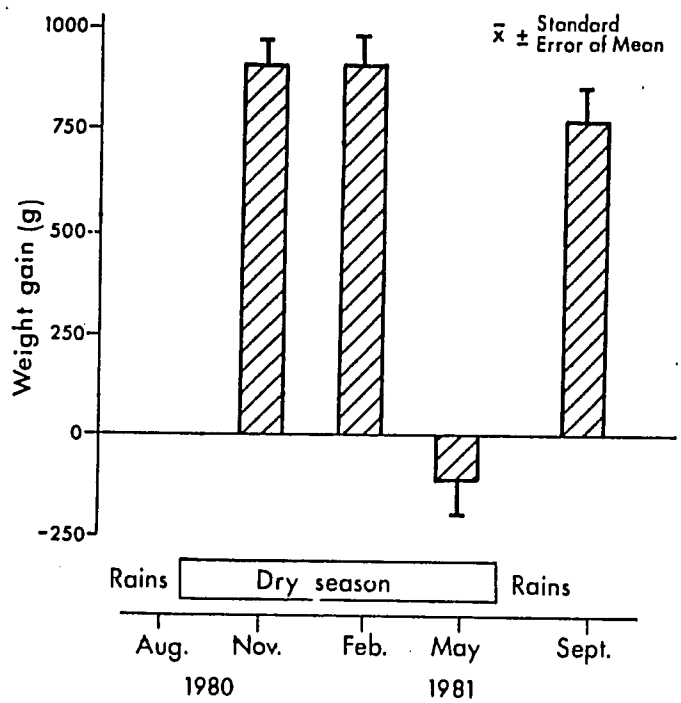


Figure 4.2.34 Weight gain in 32 WoDaaBe children ages 1 to 5 years by trimester

These gains were measured in a group of 32 children, aged between 1 and 5 years, kept under observation for a year. Younger subjects were excluded because the gain in weight is much faster in the first year during which the child's weight normally increases threefold; between 1 and 5 years the yearly gain is on average 2.1 kg. This allows comparison of the weight gains of children of different ages in that group. In the WoDaaBe children measured, the tendency is for weight gains which are more or less regular, with a pause during the hot season: from February to May, the children on average lose weight. During the rainy season, the gain in weight resumes. The sample's average yearly gain of 2.4 kg is comparable to standard values.

Waterlow (1973) has proposed a classification of different types of malnutrition in terms of weight/height and weight/age indices. This classification differentiates cases of chronic malnutrition (stunted children) from acute malnutrition (wasted children). It allows the identification of children at high risk among whom an episode of acute malnutrition is added to a state of chronic malnutrition. Table 4.2.38 gives the classification

Table 4 2.38 Malnutrition: Waterlow's diagram

		Weight/height (percent of standard) > 80%	< 80%
Weight/age (percent of standard)	>90%	Normal	Wasted
	<90%	Stunted	Stunted and wasted

Table 4.2.39 shows changes in the distribution of 29 WoDaaBe children during the year according to this classification.

Table 4.2.39 Seasonal changes in prevalence of different forms of malnutrition among 29 WoDaaBe children under 5 years

	August 1980	Nov	Feb. 1981	May	Sept
Normal	15	17	16	15	17
Wasted	1	1	3	5	3
Stunted	9	10	10	9	9
Wasted and stunted	4	1	0	0	0

There is a slight increase in wasted children in May but the number of stunted ones remains stable all year. In August 1980, 4 children suffered from both forms of malnutrition at the same time without it being possible

clearly to establish the cause. This time of year - the start of the rains - is a moment of particular stress in all Sahelian pastoral economies. It is interesting to note that these 4 children at risk recovered spontaneously during the following months. Since the sample was the same at each visit, the changes could not be attributed to deaths or to births.

The extent of malnutrition was also determined by the reduction of arm circumference and the loss of subcutaneous fat. The percentage of chidren in the sample with skinny arms, that is below the cut-off point defined as 82.5 percent of the median reference standard, varied between 7 and 20 percent during the year. Apart from a slight (not significant) reduction during each rainy season, the values were similar. There are no important seasonal variations. On the other hand, measurements of skin fold showed a sharp loss of fat in May ($P<0.01$), which confirms the increase of acute malnutrition in that season.

Special attention was given to pretibial oedema which is a major manifestation of kwashiorkor. No cases were observed.

These observations on children's nutritional status show that although over the year children put on weight normally, there are seasonal fluctuations, with weight losses for many children during the dry season. As a result, there is an increased proportion of wasted children (weight/height below 80 percent) at that time. This loss of weight is due to a significant reduction of subcutaneous fat (skin fold below 60 percent). In August 1980, four children suffered from acute and chronic malnutrition, probably from causes in the months before the survey; however, in the critical May period, there was no sign that other children passed into this high risk category. These seasonal changes in children's weight can therefore be considered acute malnutrition which only leads to real chronic malnutrition if the critical period is extended.

The increase in acute malnutrition observed at the end of the dry season results from the interaction of several factors. Some are the general dry season stresses on all herders: heat, food shortages and lack of water. But there are also particular stresses on children in the dry season. In May men

and women work harder. The great heat and distance to water increase their work time and effort. Even though children under 5 do not do household chores, they are affected by the stress on their parents, who have much less time to look after them. Women can no longer prepare extra meals for their children, and they pay less attention to them. This is reflected in their hygiene. Milk is scarce; millet paste eaten without milk is less digestible; food quantity and quality is reduced. In addition, women who are working hard may have a reduced amount of breast milk, which also contributes to infant malnutrition.

The greater frequency of some diseases in this season also plays a part. The relationship between infectious diseases and malnutrition is well known. Measles and whooping-cough are frequently responsible. When water is short, diarrheas are an important cause of acute malnutrition. In May the prevalence of diarrheas among WoDaaBe children rises and may contribute to the increase of acute malnutrition observed at that period; during the cold season the majority of children suffer from respiratory diseases. Quite often the children suffer from a chronic cough which lasts from then until the dry season. This weakens the children and makes them less able to resist later disease attacks, especially diarrheas.

Surveys of Sahelian pastoral children are scarce. Table 4.2.40 compares the results of this survey with other Sahelian surveys of farmers and herders. All of the surveys of herders' children were undertaken during the 1973 drought, among populations much affected by starvation or living in rehabilitation camps. The values observed are not therefore indicative of the nutritional status of these populations under normal conditions. Malnutrition rates recorded in these drought studies are higher than the values recorded in this study.

Table 4.2.40 Comparative nutritional status of herders' and farmers' children in several Sahelian countries

	Survey year	Weight/height (percent of population below 80 percent of standard)	Population	Age	Source
Northern Mali	1976	18	farmers	0-5	(Benefice et al. 1981)
Upper Volta	1978	16	farmers	0-5	(Benefice et al. 1981)
Northern Cameroon	1978	1.4	farmers	0-5	(Office of Nutrition 1978)
Niger	1980	8.6	farmers	0-5	(USAID 1981)
Niger	1981	12.4	herders	0-5	(this survey)
Upper Volta[1]	1973	38	farmers	0-9	(Seaman et al. 1973)
		49	herders		
Mauritania[1]	1973	8	farmers	<6	(Greene 1974)
		16.6	herders		
Mali[1]	1974	10.7	farmers	<6	(Kloth et al. 1976)
Niger[1]	1974	11.4	farmers	0-10	(Kloth et al. 1976)
Niger[1]	1974	11.9	farmers	<6	(de Ville de Goyet et. al. 1977)
		1.9	herders		
Chad[1]	1974	22.5	farmers		(Kloth et al. 1976)

Note:
1. Survey undertaken during the 1973-74 drought.

Other surveys have been undertaken among Sahelian farmers in recent years, but all these studies are cross-sectional, that is to say they consist of a single set of measures at a given moment; none follows a group of children for several months in order to observe seasonal variations. An example is the

survey undertaken among farmers' children in Niger in 1980 in the arrondissements of Filingué and Ouallam (USAID 1981). The prevalence of acute malnutrition was 8.6 percent and is similar to 12.4 average of all the values observed among herders in the present study.

However, it is well below the 17 percent prevalence recorded among herders in May and August. The Filingué and Ouallam measures were taken in July, at the beginning of the critical rainy season period which is for farmers the equivalent of the hot season and the start of the rains for herders. It is possible that a survey in September at the end of the difficult season for farmers, would show an increase of malnutrition among the farming children. Chronic malnutrition measured by height/age affected 17 percent of the children observed in Filingué and Ouallam. These values are below those recorded among the herders of Tchin Tabaraden in the present survey.

The conclusion of this survey is that WoDaaBe children in the study area are nutritionally at risk. Although the quality of their diet is good, containing animal proteins, milk and cereals, and the weaning of infants is progressive, covering a year or more, WoDaaBe children are subject to seasonal stresses resulting from the herders' way of life, especially a sharp reduction in the quality and probably the quantity of food intake at the end of the dry season. This, coupled to an increase of diarrhea observed at this time, results in nutritional stress: the frequency of observed acute malnutrition more than doubles between (from 7 to 17 percent) November and May, and probably does not decline again until towards the end of the rainy season.

Nutritional status of adults

An adult does not grow any taller and so his weight is no longer influenced by growth. Weight loss in an adult indicates an imbalance between energy needs and actual intake, and, among people who are not obese, indicates a nutritional deficit. Measuring the weight of adult men and women at regular intervals permits identification of critical periods in the year. In the present survey all men and women aged 18 and over were considered adults. Only data from men and non-pregnant women measured five times during the year were analysed. To obtain each individual's real weight, 1.5 kg of clothes was systematically subtracted from each measured weight.

Table 4.2.41 and figure 4.2.35 show the variations recorded during the year. The general tendency in seasonal weight variations observed, shown in figure 4.2.35, has two phases: a peak in February and an abrupt drop between February and May. There is a gradual increase in weight during the rainy season that continues into February. Between February and May, the mean weight loss for men is 3.1 kg, for women 2.4 kg, a reduction of 5 percent and 4.5 percent respectively. The average height of men was 176.1 cm, that of women, 164.6 cm. Of 55 men measured between February and May, 10 lost more than 5 kg. Three lost 8 kg, a 13 percent reduction in their body weight. Although women lose less weight than men, they recuperate less rapidly during the rainy season.

Table 4.2.41 Seasonal weight changes in adult WoDaaBe men and women

	August 1980	November	February 1981	May	September
Men (n=32):					
Mean weight in kg (± SD)	56.2 (±6.8)	58 (±6.9)	58.4 (±7.5)	55.3 (±7.2)	56.7 (±6.5)
Mean of difference since previous measurement (kg)		+ 1.7*	+ 0.5	- 3.1**	+ 1.4*
Height in cm (± SD)	176 (±5.2)				
Women (n=30);					
Mean weight in kg (± SD)	51.2 (±7.6)	50.9 (±8.0)	52.3 (±8.9)	49.9 (±8.3)	49.9 (±8.8)
Mean of difference since previous measurement (kg)		-0.3	+ 1.5*	- 2.4**	0
Height in cm (± SD)	164.6 (± 6.8)				

* $p < 0.05$; ** $p < 0.001$

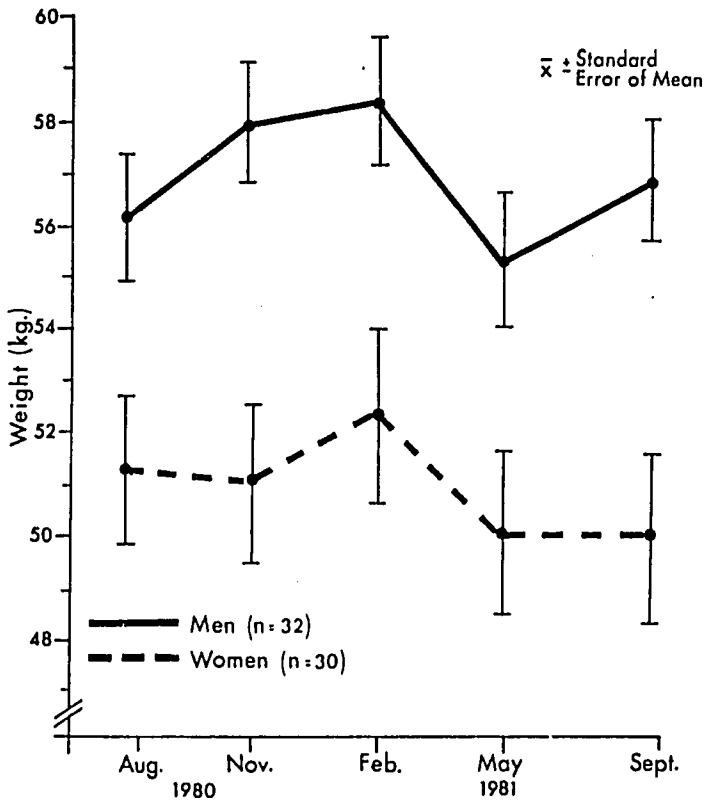


Figure 4.2.35 Seasonal changes in the mean weight of adult WoDaaBe men and women

These figures clearly demonstrate the stress to which adult herders are subject through the dry season and the start of the rains, from March to August, and later in the case of women. The rapid and considerable weight loss after February is the result of the interaction of several factors. For adults, the hot season is the period of greatest work and physical activity. It is a time of long walks between camp and well, and of long and exhausting work: the animals drink more because of the heat, well water becomes scarcer and men have to work for hours in the sun in the middle of the day. When the

rains arrive in June and July, conditions do not improve at once, and indeed for a time may even get worse. The camps start to move frequently in search of new pasture and ponds, imposing particularly heavy demands on women. Food is uncertain.

Among adults sickness plays a less important role than for children. Although there is an increase in diarrhea in May, the proportion of people who declared an illness of some sort (53 percent of the population aged 5 years and over) and persons confined to bed (32 percent) at least once during this period do not reach the maximum values observed in the cold season. May's values are below the annual average. Early in the rains new diseases, especially malaria, become important, and are responsible for a substantial reduction in work capacity.

Human physical activity and environmental constraints increase in the dry season to the point where food intake is no longer sufficient to cover these needs. Milk is almost totally lacking. The food base is millet or sorghum paste. As herders are not used to eating this dish without mixing it with milk, it is less appetizing, less digestible, and leas nutritionally balanced. Intake of calories is not sufficient. At a time of increased needs, herders eat food of lower quality than at other times of year, and in quantities which do not adequately cover their increased needs.

Economic factors also intervene. Terms of trade deteriorate for herders during the hot season. The price of cereals increases, at a time when the sale price of animals, emaciated in this period, diminishes. Herders reduce their expenditures and limit their puchases of cereals as far as possible. Access to markets is also more difficult. Camps are not necessarily farther from markets, but camels and donkeys, which carry the sacks of cereals, are weak and are less able to make the long trip. Herders try to limit their trips to market as much as possible. This situation continues until well into the rainy season, when milk production rises and herders' dependence on cereals diminishea.

Some of the links between the different factors involved in WoDaaBe herders' weight loss at the end of the dry season are illuatrated in figure 4.2.36. In the hot season, energy requirements increase, both due to

environmental stress and to increased work, but there is reduced energy supply caused by reduced and less varied food intake. The observed weight loss results from this imbalance. This weight loss probably continues until well into the start of the rainy season. The very frequent movements which herders make with the early rains in their search for new green pastures, associated with unsufficient food intake and new illnesses, prolongs this imbalance. It is only when the rainy season is well underway that movements become less frequent, since pasture becomes abundant; from then on, people begin to recuperate. Although the majority of cows calve at the beginning of the rainy season, the WoDaaBe do not milk them before the appearance of new pasture, in order to give the calves the maximum chance of survival. This practice, which is justified in terms of the future of the herd (and those who depend on it), postpones the time when milk again becomes an important part in food supply. In 1981, it was only in the middle or end of July that women stopped pounding millet and that milk became the only food.

The dry season weight loss among adults is rapid. By contrast, recuperation is slow and extends over seven months, up to February. It is particularly important in the months that follow the rainy season (September to November). During the rainy season, the exclusively milk diet of the herders largely covers protein needs, but it takes 4 to 5 liters of milk a day to meet the caloric needs of an adult man. Such large quantities cannot be drunk easily; in any case in many families they are not available. With the introduction of cereals in September, the diet becomes richer, leading to more rapid recuperation.

Several studies carried out in West Africa in farming communities show similar seasonal weight variations but at different seasons. In the Gambia, Fox (1953) recorded a loss of more than 2 kg among adult men and women between the months of July and November, during the period of major farming activities.

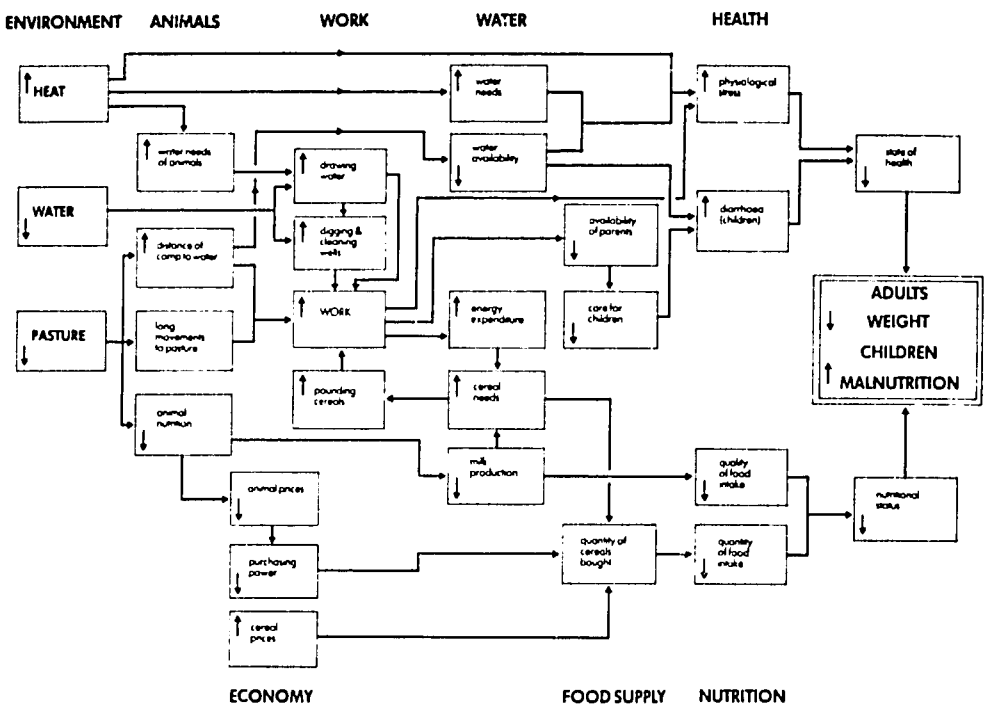


Figure 4.2.36 Factors causing WoDaaBe adult weight loss and child malnutrition at the end of the dry season

Similar weight variations have been recorded among farmers in Ghana (Hunter 1967), Upper Volta (Brun et al. 1981) and other African countries (Longhurst and Payne 1979) Weight losses take place at the time of hardest agricultural work before the harvest when food reserves are also low. At this time, daily energy expenditures of men rise by more than a third, as shown by recent work among Mossi peasants in Upper Volta (Brun et al. 1981) a country with climatic conditions similar to those of Niger. In the period of little agricultural activity (March April) the needs are 2,410 kcal/day for men and 2 320 kcal/day for women; in August, during cultivation, needs increase respectively to 3,460 kcal/day and 2.890 kcal/day. Herders' energy expenditure has not been

measured. But the weight losses recorded at the height of the hot season, when drawing water is at a peak, indicate that their expenditure is similar or greater to those of Mossi farmers at the height of the farming season.

Traditional medical practices

The WoDaaBe have a relatively well-developed system of identifying and treating illness. Loutan (1982a) lists 24 common illnesses recognized by the WoDaaBe, with the perceived symptoms and causes, and typical treatments; these illnesses include malaria and other forms of fever, colds and respiratory problems, joint pains, three types of venereal disease, skin and eye infections, four types of diarrheaa, smallpox, night blindness and measles. Of these, a visit to the dispensary is thought useful by the WoDaaBe mainly for malaria, joint pains, venereal diseases and measles. Usually a sick person tries traditional remedies first for most illnesses, and if these are not successful after a few weeks he may then visit the dispensary.

The "traditional" WoDaaBe disease classification given by Loutan (1982a) does not correspond in all cases to a "modern" classification, but there are several points of interest. For example, among the WoDaaBe (as well as the Twareg and other Sahelian societies), a simple form of vaccination or variolation against smallpox has until recently been practiced widely; of the WoDaaBe over 20 years of age interviewed in the study, 80 percent had vaccination scars, and 80 percent of these scars were from traditional variolation. Variolation was certainly an effective immunization against smallpox. Night blindness is treated by eating liver, which would effectively provide vitamin A. Unlike some Sahelian pastoralists, WoDaaBe mothers give water to children with diarrhea, and this would reduce the danger of dehydration. On the other hand, some of the treatments listed are apparently of little efficacy or may even be harmful.

Knowledge of WoDaaBe understanding of diseases and their treatment as well as the concept of health and disease in general is important in formulating a health care program in the pastoral zone since in many cases it will determine the acceptibility of "modern" treatments and the ease with which notions of public health and preventive and curative medicine can be taught to the herding population. The example of variolation against smallpox or eating liver as a cure for night blindness are useful bridges between traditional and modern approaches. Use of WoDaaBe terminology and classifications will in particular facilitate the integration of new information with traditional knowledge and

practices in the training of WoDaaBe paramedics (see chapter 8.4), and the example of variolation should be used in vaccination campaigns, for example against measles or tetanus. The fact that mothers continue to give water to children with diarrhea is important and should be encouraged; it could become the basis of an oral rehydration program.

Disease

The survey included questions on the frequency of illnesses since the researcher's last visit, accidents, number of days of debility due to illness, and trips to the dispensary.

The most frequently reported illnesses among subjects over 5 years old were in order of importance: fever, cough, bone-joint pains, diarrhea, and skin diseases and wounds. Table 4.2.42 and figure 4.2.37 show the prevalence (number of episodes of illness in the three preceding months) and seasonal variation in these common health problems.

Table 4.2.42 Prevalence of the most frequent complaints among WoDaaBe aged 5 years and older (1980-81)

	August		November		February		May		September	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Number of subjects	343	(100)	324	(100)	320	(100)	343	(100)	278	(100)
Subjects sick	200	(58)	192	(59)	213	(67)	183	(53)	163	(59)
Episodes of all illnesses	269	(100)	241	(100)	268	(100)	240	(100)	214	(100)
Fever	108	(40)	75	(31)	17	(6)	21	(9)	58	(27)
Cough	2	(1)	24	(10)	145	(54)	35	(15)	30	(14)
Rhumatisms	52	(19)	32	(13)	22	(8)	40	(17)	27	(13)
Diarrhea	23	(9)	15	(6)	14	(5)	39	(16)	24	(11)
Dermatitis, wounds	13	(5)	14	(6)	21	(8)	17	(7)	13	(6)
Other	71	(26)	81	(34)	49	(18)	88	(37)	62	(29)

Source: Loutan 1982a : 88

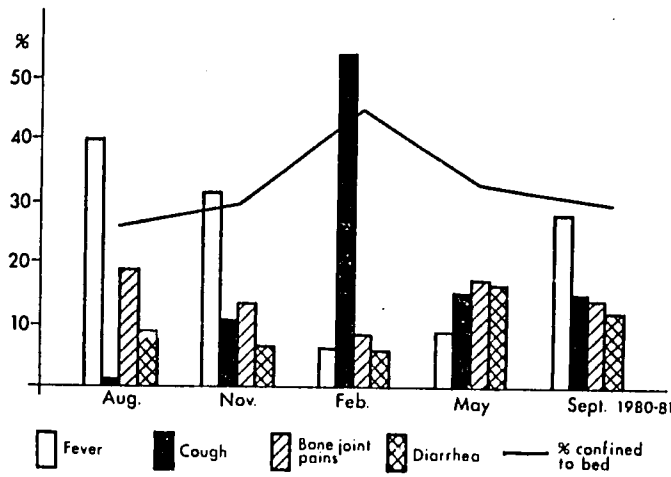


Figure 4.2.37 Seasonal variation in the prevalence of the four commonest illnesses among the WoDaaBe (percent of illness events in preceding 3 months)

Fever - presumed to be mainly malaria - predominated during the rainy season and the months that follow, accounting for 30 to 40 percent of all reported illness events, then dropped during the cold and hot seasons. Cough had a maximum prevalence during the cold season, making up more than 50 percent of all complaints. Bone-joint pains were present all year but were most common in May and August; this was a major cause of incapacitation. Diarrhea was most frequently reported in the hot season due probably either to specific viral infections at that time, or to increased transmission due to reduced water availablility. There was no significant seasonal variation in the overall number of illnesses reported during each period; an average of 59 percent of all subjects reported having been sick at least once in the course of three months preceding each visit. However, the rate of incapacitation due to illness did vary across the year; as figure 4.2.37 shows, the rate of incapacitation peaked in the cold season when 45 percent of people of work age (12 years and older) were confined to bed at least once, 64 percent of these cases due to cough.

Disease patterns in children under 5 years old correspond closely to those reported for adults, as can be seen in figure 4.2.38. Fever was dominant during the rainy season, responsible for 50 percent of all child illnesses in August; cough was present all year, although it peaked in February, when it accounted for 60 percent of child illnesses. With the heat and water shortages of the hot, dry season, the prevalence of diarrhea increased, from 12 percent in November to 44 percent in May; this may be related to the observed increase in acute undernourishment in children during this period. Skin diseases were most widespread in the cold season. In general, as with adults, the cold season seems to be the worst time of year for child health: only 8 percent of children under 5 years of age were not sick, compared with 32 percent in September.

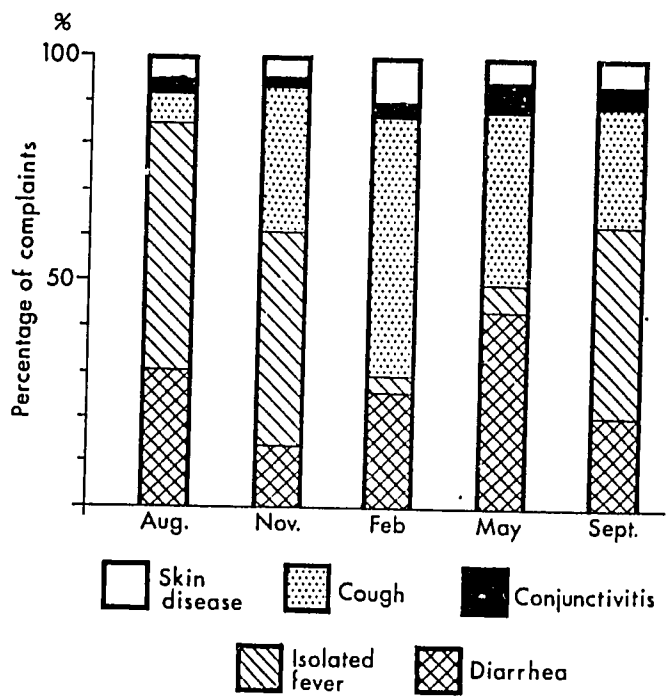


Figure 4.2.38 Seasonal prevalence of the five commonest illnesses of WoDaaBe children aged 0-5 years

Other important diseases among the WoDaaBe, some of which are directly related to herders' close contact with animals, are as follows:

Vitamin A deficiency. Vitamin A deficiency causes night blindness (danndumi) in both animals and people. With the steady disappearance of green pastures from September to March, animals' intake of provitamin A decreases, leading to weaker concentrations of vitamin A in their milk and thus vitamin deficiency in herders. Night blindness particularly affects pregnant and breast-feeding women; all 12 women in the sample who complained of night blindness in May 1981 were in one or other of these categories.

Malaria. Most of the cases of fever reported in the zone are presumed to be malaria. Malaria is a particular problem during the first camp movements of the rainy season, causing some incapacitation at a time when labour needs are high. During the rest of the year, malaria is rare, since mosquitoes disappear when surface water dries up. This may create particular problems for herders. For about 10 months of the year they are not subject to any immunogenic stimulation from repeated Plasmodium reinfection, and thus reach the following rainy season with reduced defences, making a malarial attack more likely. It is however possible that their increased milk consumption in the rainy season compensates for this increased vulnerability, since research suggests that a milk diet reduces Plasmodium reproduction (Hawking 1953).

Tuberculosis and brucellosis. It is at present difficult to estimate the incidence of these two diseases in herder populations as no serological studies have been conducted and the Medical Centera in the project zone are not equipped to diagnose these diseases. Nonetheless, studies conducted elsewhere in Niger as well as the prevalence of symptoms characteristic of brucellosis (prolonged, recurrent febrile states) and tuberculosis (chronic

cough) suggest that these are present in pastoral populations though presently undiagnosed and untreated.[1] With both brucellosis and tuberculosis, the milk of animals affected by these diseases in likely to be the major source of contamination.

Venereal diseases. Gonorrhea, venereal and endemic syphilis are present in the WoDaaBe population in the project zone although it is difficult to estimate their importance; serological field research is needed. The dispensaries report a high incidence of venereal disease among herders, although their records probably overstate the importance of this problem as it is one of the few for which herders are likely to go to the dispenaary. But this does not make cures necessarily easier. Since herders cannot make frequent trips to the dispensary, it is difficult to follow through with treatments that require repeated visits such as the penicillin injections necessary to cure gonorrhea and syphilis. Moreover, since symptoms usually disappear after the first injection, the incentive to return to the dispensary to complete the treatment is reduced, and the disease, when treated partially, may become chronic. Introduction of a high-dosage single treatment would contribute to the eradication of venereal diseases.

Conclusion

Although the health research described in this section concerned the WoDaaBe, most of the findings are probably generally applicable to Twareg and other herders in the pastoral zone; despite the fact that each group has unique characteristics, herding techniques, habitats and diets, they are all subject to the same important environmental and economic influences.

---

1. The annual BCG vaccination campaign does include vaccination against tuberculosis, but the level of coverage is very low (about 10 percent of children under 15)

Project human health research suggests that disease and seasonal nutritional deficiency are important influences on herders and the herding economy. Pastoral production systems, like any other, rely on the working capacity of herders. Usually each member of the production unit has a specific function necessary to the continued viability of the unit. In the WoDaaBe economy, labor inputs to herding and other productive tasks are especially high, but all pastoral economies (unlike Sahelian farming economies) require year-round work with the herds; although cooperation in herding and economies of scale can provide some relief, herders cannot afford much inactivity due to illness. So the relatively important level of labor loss per family caused by health problems has important implications for the productivity of the individual herding unit and the pastoral economy in general. Labor loss is particularly acute in the cold season, when the rate of incapacitation due to illness is highest, and in the hot, dry season when environmental and nutritional stress is greatest. This latter period is the moment of greatest labor requirements, and an early priority of primary health care should be to address the diarrheas and associated problems of this season.

ECONOMIC TRANSFORMATIONS

There have always been variations in the organization of production between different WoDaaBe sub-groups and between those using different geographic areas, but since the drought these differences have become accentuated. Lacking cattle herds sufficient to meet their needs, WoDaaBe have had to turn, in a more permanent way than in the past, to a wider range of economic activities to supplement their livestock-raising. Economic processes now under way appear to be fundamentally different from the irregular variations of the past, and are thus of particular importance for development planning.

Different ecological units and different socio-political groups can be associated with types of organization of production, but neither factor is determinative. Both interact with a series of other factors to influence the economic strategy adopted by a particular WoDaaBe group. Some of the most important of these factors are the degree of loss of productive capital during the last drought (which determines to a large degree present herd sizes and structures), species composition of the group's herds, proximity of markets and villages, the historical experience of the group, and its cohesiveness.

(1) Types of WoDaaBe production system

Geomorphological variations

The ecological units within the project zone have been briefly described in chapter 2.2. The WoDaaBe themselves define five major geomorphological categories, each of which is characterized among other things by the presence of particular plant species and different degrees of accessibility to water. In order of preference, these units are: the jeynngol, or valleys and dry river floodplains, the katar, a mixture of clay plains and undulating plateaux, the fello, an area of high plateaux cut by valleys, the wamnde, a mountainous region, and the Yolde, an area of hills and stabilized dunes. The different units can be associated with different types of livestock-raising

strategies, but their characteristics influence, rather than determine, the organization of production of the WoDaaBe groups using them.

Groups that habitually use areas of plateau (fello)[1] during the dry season benefit from the high quality and large variety of plant species that grow in this terrain (including Zornia glochidiata, Tribulus terreatris, Hyparrhenia dissoluta). There is little Cenchrus biflorus, a species of poor nutritive value that tends to dominate many areas of the project zone. WoDaaBe consider the presence of many different plant species important to the well-being of their animals. Of the species the WoDaaBe list as most sought after by their cattle (see Maliki 1981), three grow abundantly in the fello: Sporobolus festivus, Cymbopogon proximus, Aristida funiculata. The browse is also particularly good (Acacia ehrenbergiana, Acacia raddiana). A further advantage of the fello are the trees and shrubs (Maerwa crassipholia, Boacia senegalensis) that the WoDaaBe identify as helping to prevent night blindness (caused in their animals by vitamin A deficiency).

These advantages must be balanced with the lack of water characteristic of the fello. Only deep wells or boreholes reach the water table and most herds are obliged to cover long distances to reach the wells dug in the river beds bordering the fello. Inflammation of animals' feet is a common ailment in the fello due to the distances and hard ground surface. The system of pasturing in the fello involving long treks to water requires more labor than in other ecological areas, where the distances between pasture and water are shorter. Increasing the relatively high labor requirement of herding in the fello in comparison to other ecological units is the fact that the animals in the herd are easily separated by clumps of thick trees and gradually wander off separately if not constantly supervised by the herder.

The fello constitutes a natural dry season reserve. Because its hard flat terrain has no depressions in which water collects, the surface water pools used by herders in the rainy season do not exist in this area. The WoDaaBe move out of the fello during the rainy season and when they return

---

1. tadressi in Tamasheq

after the end of the rains they find ungrazed, untrampled pasture of high quality and varied species composition ideal for the dry season. In a year of poor rainfall, the benefits of the fello pasture are outweighed by the difficulty of access of water, and the WoDaaBe must consider a move to a different area for the dry season. In the fello after a moderately good rainy season (in terms of distribution as well as quantity) the long distances to water points at the end of the dry season seriously reduce milk production.[1] The WoDaaBe groups in this area are thus more dependent on purchases of cereals at this time than groups in other areas (if other factors, such a number of milk cows per person are equal).

In the fello the range of additional economic activities available to WoDaaBe herders is limited. High labor requirements for the supervision of the herd during pasturing and accompanying the animals to the wells, as well as watering at deep wells, limit the number of people who can leave the camps to engage in non-pastoral work during the dry season. The absence of villages in the fello removes the possibility of exchange of milk products for cereals with sedentary people or other activities of WoDaaBe women (mending calebashes, braiding hair) common elsewhere. The absence of Twareg camps in the fello also limits the exchanges between the two groups that are frequent in other areas. The fello does not accomodate the system of livestock-raising of the Twareg who camp near water points and send their animmals off to pasture, as opposed to the WoDaaBe who camp where their animals pasture and then lead them to the water points every two days during the dry season.

WoDaaBe who use the fello recognize that although its advantages with respect to pasture benefit their herds, possibilities for other economic activities are limited. One strategy adopted to deal with this situation is herd splitting. An example of this technique is the strategy of the Bii Korony'en Koron who use the fello east of Abalak (see figure 4.2.39) during the dry season. Part of the household accompanied by some milk cows and small ruminants move south of the fello to the area around Mayata. Here cereals

---

1. In November 1981 camps in the fello east of Abalak were already up to 10 kilometers from the watering point.

can be obtained through exchange of milk products in the villages rather than by the sale of animals whose condition (and thus price) is poor in the latter part of the dry season. Other basic necessitities are more easily obtainable, and the women can obtain millet or earn money by mending calebashes or braiding hair. While the household benefits from being closer to villages, most of the animals remain in the fello with some members of the household and benefit from its superior pasture. During the dry season the pasture in the area around Mayata is better for small ruminants due to the presence especially of the fruits of creeping plants (Cucurbitacea, like Citrullus lanatus). Also sheep cannot keep up with the pace of a herd of cattle during the long treks to watering points, and the WoDaaBe prefer to separate the two species in the dry season. Goats pasture separately with little supervision throughout the year. During the dry season the Bii Korony'en Koron and Gojanko'en Gawwanko'en in the area around Mayata add goats' milk to cows' milk in exchanges with the sedentary population.

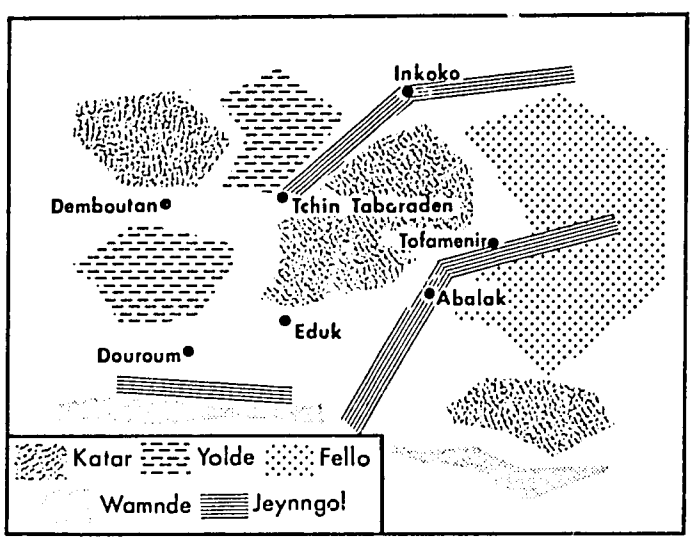


Figure 4.2.39 Geomorphological units according to the WoDaaBe in the Tchin Tabaraden/Abalak area

Herd splitting involves more cooperation in herd management. Often the herds that remain in the fello have several owners and are grouped together under the management of one or two herders who combine the animals of relatives.

The second geomorphological unit defined by WoDaaBe herders is the Yolde, an area characterized by hills and stabilized dunes. Water is rare, accessible primarily through deep wells. The quality of pasture is poor (mainly Cenchrus biflorus) and there are few shrubs or trees for browse. However at the end of the dry season when the animals are weak and badly in need of fresh pasture, the sandy terrain of the Yolde allows rapid green growth immediately following the first scattered rains.

It is only later that fresh green shoots are able to pierce the hard clay surface of what the WoDaaBe call the katar. This low-lying geomorphological unit is characterized by a mixture of clay plains and rolling plateaux. Once green growth has begun in the katar, its abundant water accumulating in numerous small depressions allows the animals to graze and drink almost simultaneously. They rapidly regain strength, weight and higher levels of milk production. In the region surrounding Tchin Tabaraden (see figure 4.2.39) there are both Yolde and katar. The WoDaaBe in this area use a strategy of seasonal movements between these two ecological units to take full advantage of the characteristics of each.

Herds grazing in the katar tend to stay grouped together and in addition, due to the abundance of water, labour requirements are not demanding.[1] WoDaaBe families in this area are more able to send a member away to earn money if this is necessary. There are also many possibilities for exchanges in villages with sedentary people or in Twareg camps (particularly with Twareg cultivating around Sarsadan, Durum and Segat).

---

1. However at the beginning of the growing season the herder must supervise his animals carefully to keep them from grazing the new growth of some species found in the katar (Gisekia pharnacioides, Zornia glochidata, Peristrophe bicalcyculata, Tribulus terrestris), since at the beginning of their growing cycle these species are toxic. One herder in the study lost 14 animals from his herd of 30 cattle because they grazed toxic shoots at the start of the 1981 rains.

Dry river floodplains (jeynngol) are the areas preferred by the WoDaaBe. Water is abundant and easily accessible even in the dry season with shallow wells. The grasses found in the jeynngol are of good quality (Schoenefeldia gracilia, Sporobolus helvolus, Dactyloctenium aegyptium, Sorghum aethiopicum, Eragrostis tenella). Furthermore the WoDaaBe say that the same species of grass growing in the jeynngol as compared to another area has more "strength": animals pasture for short periods of time and are quickly satisfied; calves weaned in the middle of the dry season do not suffer too much. This may be explained by the soil fertility of the jeynngol.

However the benefits of the jeynngol attract many herders and the WoDaaBe will choose another area if they feel that there are already too many herds. Because of the attractiveness of the jeynngol, the grass is usually well grazed and trampled by the latter part of the dry season.

The fifth geomorphological unit identified by the WoDaaBe is composed of hilly areas (wamnde). Here water collects in ravines and small valleys making it a good area for dry season use because of water accessibility. The grass species found are of medium value (Eragrostis tenella, for example, but also some Sorghum aethiopicum). Hard, rocky terrain inflames the animals feet. The presence of predaters, particularly jackals, means that small ruminants must be watched attentively and they must be protected at night.

The preferred model production system and departures from it

The characteristics of each geomorphological unit strongly influence the livestock-raising strategies adopted by the groups using it. However there are many cases of different WoDaaBe groups using the same area and nonetheless organizing their production system completely differently. These differences are influenced but not determined by the characteristics of different socio-political groupings; even within lineages, segments (taare) frequently have entirely different ways of organizing production.

What the WoDaaBe of the project zone do have in common is a mental model of an entirely livestock-based economy by which all their needs are met either directly from their herds or indirectly from the sale or exchange of animals and their products. When they have the animals to make this possible, this is

the system they practice. Before 1968 other economic activities were infrequent exceptions.[1] After the drought, in 1974, those groups of WoDaaBe which had among them a sufficient number of animals, so that loans and redistribution within the duDal and taarde could provide each family with a viable herd, returned to a fully pastoral existence. Despite this, WoDaaBe households that are able to meet all their needs either directly or indirectly from their herds are now rare exceptions.[2]

The impact of the drought should not be oversimplified. It was a turning point for the WoDaaBe, but this was not because of the drought alone but because other changes, many set in motion before the drought, have contributed to making the WoDaaBe economy more vulnerable to the effects of such a disaster. Furthermore, alternatives to herding that they had turned to temporarily in the past are no longer effective mechanisms for a gradual return to a herding-based economy.

The preferred production system

The WoDaaBe describe their ideal economy as one based entirely on livestock-raising. There has always been an interdependence between the WoDaaBe and agricultural groups, but it is possible for a herd under Sahelian conditions to provide sufficient milk and animals for a family to procure those things it does not produce through exchange or sale of livestock and their products.

---

1. See Dupire (1962: 126-7)

2. Rapidly increasing cash needs and changed consumption patterns have played a role in this process but have not fundamentally modified the economy of the WoDaaBe or broken down group cohesion in the way they have for example in Hausa society, as described by Raynaut (1976: 279-306 and 1977: 160-171).

The basic subsistence strategy of the WoDaaBe requires a herd large enough to feed all the members of the household dependent on it, and an age/sex distribution within the herd which ensures reproduction. If these conditions are met, the WoDaaBe live almost entirely on fresh milk during the rainy season. During the first part of the dry season, when they are closer to markets and villages, and when milk production begins to diminish and milk sours more quickly, they supplement their diet with cereals obtained through exchange of curdled milk and butter. During the latter part of the dry season, further diminished milk production limits possibilities for exchange and consumption. Animals are sold at this time in order to buy cereals. Animals are also sold (particularly at the end of the rainy season and in March and April) to maintain the desired species composition and herd structure (for example, an old non-productive female will be sold to buy a heifer), and to get cash to buy things like tea, sugar, mats, cooking utensils and clothes.

If this system is to continue however, animal sales (or losses due to disease or drought) can not go beyond a certain threshold. A minimum number of animals with a particular age/sex distribution is necessary for the herd to reproduce itself. If this minimum is not maintained, animal births will not keep up with sales and deaths, and milk supplies will be insufficient for consumption needs, forcing the household into greater dependence on cereal purchases. This means selling off more animals, and a vicious circle of declining production potential is created.

To avoid this happening, or as a consequence of its occurence, the WoDaaBe have different strategies depending on whether losses occur mainly at the household or group (duDal or taarde) level. In the case of the loss of an individual household's herd, animals from the duDal or taarde are loaned or given to enable the household to remain within the pastoral economy. The traditional system consists of female animals (haBBanaaji), loaned until they have produced three offspring that become the property of the borrower. Milk cows are also loaned to cover short-term subsistence needs. By these mechanisms the household is gradually able to become an economically self-sufficient unit again.

Temporary and permanent economic alternatives

In the case of large-scale loss (for example the rinderpest epidemic of 1890 or the 1969-73 drought) of the entire duDal or taarde's basic animal capital beyond the point where its resources are sufficient for individual households to rebuild viable herds, the WoDaaBe are obliged to resort to economic activities outside the pastoral economy. The three main activities in the past were gathering wild foods,[1] handiwork for sedentary people (in particular mending calebashes), and agriculture.

The surplus earned from these activities was re-invested in livestock (first in small ruminants and then cattle) and groups were able to rebuild herds adequate for their subsistence. In the space of 10 to 15 years after the rinderpest epidemic they had again become fully pastoral.

After the last drought (1968-1973) herds were again reduced beyond the point at which mechanisms within WoDaaBe society could provide animals for households whose herds had dropped below subsistence levels. WoDaaBe unable to live entirely from herding resorted to three main economic activities after 1973: migrant labor, cultivation, and guardianship of herds belonging to non-WoDaaBe (jokkere). The first two are activities outside the pastoral economy. Guardianship allows the WoDaaBe to continue herding in the pastoral zone but involves a dependence upon outside groups (either sedentary people or Twareg herders).

Estimates are difficult to make but it seems likely that the WoDaaBe presently in Niger lost more animals during the rinderpest epidemic at the end of the last century than they did during the 1969-1973 drought. However the WoDaaBe have found it far more difficult to rebuild viable herds since 1974. Agriculture, migrant labor and guardianship of other peoples' herds have kept herders with insufficient herds alive, but have not made it possible for WoDaaBe households to rebuild their herds to self-sustaining levels. Rather

---

1. After the rinderpest epidemic of 1890 WoDaaBe groups in the Dallol Bosso around Dosso collected the roots of the dum palm (Hyphaene thebaica) which they ate themselves and also sold.

than being temporary activities leading back into the pastoral economy, a more permanent mixed economy is being created in which income from non-pastoral activities is essential to the economic viability of WoDaaBe production units.[1]

The dum palm roots which provided supplementary food and a small income after the rinderpest epidemic are not found in the project zone. The WoDaaBe presently in the project area left Sokoto and southern Niger at the turn of the century. Because of increased population density and cultivation in these southern zones, gathering was not available to the WoDaaBe as an alternative economic activity in 1974.

After the last drought many WoDaaBe herders who lost large numbers of animals turned to cultivation as they had done after the rinderpest epidemic. With very few exceptions however, these efforts were quickly abandoned and did not provide a surplus that could be invested in livestock.[2] The land available to the WoDaaBe for cultivation in 1974 was not as fertile as that open to them at the turn of the century, and being much farther north, rainfall was also much less. Their lack of agricultural skills resulted in unsuccessful efforts to cultivate in the more arid regions.

---

1. This is not an indication of the breakdown of traditional animal redistribution mechanisms. HaBBanae loans among WoDaaBe are still frequent, and have enabled many families to survive since the drought. However the duDal and taarde must have a minimum animal capital to be able to provide all of their component households with viable herds.

2. It is not necessary for agriculture to provide an actual marketable surplus for it to be an effective mechanism for aiding the return to pastoralism. If losses have not eaten into the nucleus of animals necessary for a herd to reproduce itself, agriculture can provide cereals for consumption so that a herder is not obliged to sell animals to obtain cash to buy these cereals; he can then retain intact his reproductive capital. After the last drought many herders were obliged to sell all their remaining animals to buy cereals, since the attempts of the WoDaaBe at cultivation did not even produce yields sufficient to avoid the sale of their remaining animals.

The third main non-pastoral activity resorted to in the past, small tasks performed for sedentary people, remains an important economic activity. Its scope has in fact increased. In the past WoDaaBe women did this sort of work in nearby villages for a small sum of money or in exchange for cereals, but the situation is quite different now. As described in the following section, during the dry season there are now large number of WoDaaBe households where several people leave to earn money in the countries along the West African coast. The money earned selling medicines and magic amulets, working as watchmen or braiding hair enables a few members of the family to subsist during the dry season when milk in the camps is rare and millet costly. In some cases migrants return with enough money to buy cereals and clothing, reducing the need to sell animals. At the very least, these migrants are usually able to feed themselves while they are away, and they thus reduce the household's need to sell an animal to raise cash to buy an equivalent amount of cereals.

The point to be made here, however, is that WoDaaBe do not have the marketable skills to earn enough money to invest in animals and rebuild their herds to a viable level. Migrant labor is not a temporary resort to a non-pastoral economic activity that helps the herder gradually return to self-sustaining pastoral production. The number of WoDaaBe obliged to leave the pastoral zone to obtain money because of insufficient herd size is increasing, not decreasing. According to the WoDaaBe, until the last drought, they did not know the towns and villages in which they now work.

Herding animals belonging to other people (merchants, civil servants, farmers, Twareg) was not common before the drought, but has now become widespread throughout the project zone.[1] This permits WoDaaBe to remain in the pastoral zone even if their own herds are insufficient to meet their

---

1. Dupire (1962: 139 and 126-7) describes the system of remuneration for herding services habitual in the 1950s, but says that cases of WoDaaBe working as herders for others were rare. The WoDaaBe themselves say that before the drought they occasionally herded animals belonging to sedentary people out of friendship, but that now they are obliged to do so out of necessity.

needs. The arrangement gives them milk, but not money to meet their cash needs or animals with which to rebuild their herds. They work as herders for other people only when the milk production of their own herds is insufficient. But they must still rely on their own herds to meet all other needs. Therefore this alternative - like agriculture and migrant labor - does not give them the means to return to the purely pastoral economy they aspire to. It is only this type of production system that permits them to put into practice the herd management techniques they know to be most efficient.

Variations between WoDaaBe groups in the organization of production

The range of economic alternatives available to the WoDaaBe to increase the income derived directly or indirectly from their own herds is limited. However, the choices made and the ways in which they are combined vary widely from group to group. A series of factors influence the strategies adopted.

At the level of the individual household, the most significant factor is the labor available, and its distribution in age/sex categories. This is largely determined by the household's stage in its developmental cycle.

Although different households adopt different strategies, at the group level (duDal or taarde) there are similarities in the way production is organized. The strategies adopted by different WoDaaBe groups are influenced by several inter-related factors, the most important of which are geographic location, historical experience, the level of animal losses suffered during the drought, group solidarity and mobility.

The first, geographic location, includes the ecological characteristics of the region the group habitually uses, its proximity to markets, the possibilities for exchange of milk products for cereals (sippal), and the possibilities of herding animals belonging to non-WoDaaBe (jokkere).

Given the large number of factors influencing the organization of production there is wide variation between WoDaaBe groups. We will use three criteria to examine these variations: proportion of total revenue derived from livestock-raising; relative proportions of milk, cereals and meat consumed; and proportion of total income derived from the market.

Proportion of gross revenue derived from livestock-raising

Less than 10 percent of the WoDaaBe in the project zone derive their revenues entirely from their own herds. These revenues include sale or exchange of milk products for cereals and sale or exchange of their animals for those items they do not produce themselves or for other animals.

The WeDDinde segment (in the area between In Waggar and Inkoko) of the Bii Korony'en Koron lineage provides an example of this sort of system. In 1972, soon after the rainy season (October-November) about 40-50 WeDDinde families (roughly a quarter of the group) left Tillia for the south, and as a result they largely escaped the drought losses of other WoDaaBe herds. Those WeDDinde who remained behind lost nearly everything. Although three quarters of the WeDDinde suffered heavy losses, the fact that a core of families had been able to save their animals was enough for the system of animal redistribution gradually to build up the herds of the entire segment to levels large enough to live on. WeDDinde families do not herd jokkere, practice migrant labor or cultivate. Some WeDDinde women exchange tobacco for cereals with Twareg, but the money used to buy this tobacco in the market comes from the sale of their animals.

About 30 percent of the WoDaaBe in the project zone are able to meet their needs without recourse to revenues that do not come directly or indirectly from livestock. Of these only one third, or 10 percent of the WoDaaBe in the zone are able to maintain this system without herding jokkere.[1]

---

1. It is important to make a clear distinction between haBBanaaji and jokkere. HaBBanaaji are female animals loaned between WoDaaBe until they have given birth two or three times. The off-spring are the property of the borrower. These loans are usually reciprocated. It is not only relatively wealthy WoDaaBe who initiate loans. Those with small herds also give haBBanaaji as much as possible because they create social ties and provide security against risk. Jokkere are animals (male and female) belonging to non-WoDaaBe that are herded by the WoDaaBe without compensation other than the milk of those animals in the herd that are lactating. This arrangement, disadvantageous for the WoDaaBe, is an indication of the inadequacy of the herds of those groups that take on jokkere.

The Aadiranko'en segment of the Njapto'en, who are in the area between Tchin Tabaraden and Kao, are an example of a group that herds large numbers of jokkere. Not all WoDaaBe groups that have insufficient hords of their own are able to adopt this alternative. This depends upon the migration routes followed by the group in question, the contacts they have had in the past with sedentary people, and the region in which they are presently situated. In the project zone there are more WoDaaBe seeking animals to take care of than there are owners looking for herders. A sedentary owner is unwilling to entrust his animals to someone he does not know. The Yaamanko'en Sompo'el of the area around Tamaya, where there are no villages, arrived less than ten years ago from the east (the region around Amoulas, north-east of Dakoro, which is also uninhabited by sedentary people). The Sompo'el do not have the long-standing contacts with sedentary people that could give them access to jokkere. Since their own animals are insufficient for their subsistence a large proportion of the Sompo'el leave the zone during the dry season for salaried labor.

WoDaaBe groups who cultivate fields to supplement their livestock-raising are rare. The Yaakubalde segment of the Njapto'en have been cultivating in the area of Durum and Segat since they arrived there around 60 years ago. A few families of Gawwanko'en cultivate at Ikaddu. East of Dakoro there are around ten families of the JaaYiwol segment of the Bii Hamma'en who have been cultivating since the drought. These cultivating WoDaaBe sow their fields at the time of the first rains, and do the first weeding before leaving with the rest of the group to take their animals on the rainy season transhumance. They return to harvest after the rains. In a good year if a household has sufficient labor to sow a large enough field and not too many consumers, it can avoid buying millet until around May (assuming that it has enough milk cows).

Thus only about a third of the WoDaaBe in the project zone live entirely from livestock-raising and only a tenth from animals that they own. Agriculture plays a negligible role in supplementing incomes. It is upon migrant labour that the WoDaaBe are becoming increasingly dependent. In the great majority of households one or more members leave the camp during the dry season to earn money.

In some cases the women simply go to nearby villages where they mend calabashes or braid hair for sedentary people. This is the case of the BiBBe Denke in the area south of Tanout, and the Njapto'en in the Tchin Tabaraden area. People in other groups go further: as far as Dakar and Abidjan to sell medicines, to Nigeria to work as night watchmen for houses or shops. Women earn money braiding hair in all the coastal countries.

The groups that depend most heavily on this seasonal labor are the Sompo'el and Laamre segments of the Yaamanko'en (of the area around Tamaya), two of the segments of the Kasawasawa that are in the area between north of Dakoro and Tchin Taborak (Gemeneewol, the western Taanira'en Dey), and all seven segments of the Bii Hamma'en (in the area north of Dakoro). Up to 50 percent of the cash incomes of these groups comes from migrant labour. However the Donoyamdi, eastern Taanira'en Dey and eastern Gajabanko'en segments of the Kasawasawa (all located around Aderbissinat) also herd female camels, in addition to the male transport camels owned by most WoDaaBe. The extra milk provided by their camels reduces the need of these groups for cereals and thus their need for cash. Their camel herds also demand more labor which means that the groups cannot easily send people away to work. Camels have different labor requirements for pasturing than cattle, and a group that has both species must have enough labor to herd them separately.

Most of the WoDaaBe in the project zone can be situated between the two extremes: the WeDDinde's complete reliance on their own herds and the heavy dependence upon migrant labor of some segments of the Kasawasawa, Yaamanko'en and Bii Hamma'en. An example of this intermediate category are the Gojanko'en of the area around Tchin Tabaraden. Roughly 35 percent of this group's revenues comes from migrant labor. A combination of migrant labor and the herding of jokkere, illustrated by the household production sample, is a common strategy of WoDaaBe families. Most of the Bii Hamma'en, the Njapto'en and the Yaamanko'en pursue both activities.

Relative contributions of milk, millet and meat to diet

Another indication of variation between WoDaaBe groups in the organization of production are the relative amounts of milk, cereals and meat they eat.

These estimates must be made according to season. The desired pattern has been outlined above. Obviously the major constraint to the preferred model of high milk consumption, supplemented by cereals in the dry season, is the number of milk cows per person. Even within a single herd the animals in lactation can vary largely from year to year, making a household more or less dependent on cereals. Generally speaking a household with many milk cows for each consumer obtains millet to add variety to its diet and to serve to guests. Households with medium-sized herds eat less millet. The cereal consumption of households with a small number of milk cows per person is higher because they are obliged to compensate insufficient milk supplies with millet.

Other factors however are also important. This can be seen by a comparison of two groups which have roughly similar average herd sizes. Both the Cahidooji and the Gojanko'en herd jokkere and depend to a comparable extent on supplementary income from migrant labour. However the Cahidooji live almost entirely on milk during the rainy season while the Gojanko'en continue to buy cereals at this time (although their cereal consumption is certainly less than during the dry season). For about three months during the rainy season the Cahidooji do not use markets at all whereas the Gojanko'en make market purchases throughout the year. This can be explained by the far greater mobility of the Cahidooji. During the rainy season they move continually, covering about 150 kilometers from the area in which they spend the dry season. The Gojanko'en on the other hand remain within a radius of 40 kilometers from Tchin Tabaraden throughout the year. The milk production of the Cahidooji animals is considerably higher than that of the Gojanko'en animals because of the variety of pastures the Cahidooji animals are able to graze. The Cahidooji move their camps constantly to the areas where their animals pasture, whereas the Gojanko'en remain within a relatively restricted area and take their animals back and forth between pasture and camp. These two different patterns of herd management significantly affect milk production and mean that the Gojanko'en eat more cereals in relation to milk throughout the year than do the Cahidooji.

Meat consumption in all WoDaaBe groups is limited. An animal is slaughtered only on specific occasions. Three bulls are slaughtered over a ten year period by the family of a man for his future wife, according to the rules of the koobgal, marriage by betrothal. Either a bull or a ram is slaughtered for the te'gal marriage by consent betweeen two adults. A bull is sacrificed for the first born child, and either a bull or ram for each successive child. Animals are also slaughtered in honor of guests. If an animal is sick or has been wounded the WoDaaBe try to slaughter it before it diea (otherwise they do not eat the meat). They often first try to exchange it for a healthy animal with someone who muat slaughter an animal for a marriage or the birth of a child.

Animals are thus slaughtered and meat consumed to meet social obligations that do not vary much from group to group. A greater availability of meat, as in the case of a group that owns more animals, does not mean that meat consumption increases. There is however a high seasonal variation in meat consumption because it is during the rainy season that social obligations are usually met. The meat of animals slaughtered for marriages and births ia shared according to strict rules by the members of a segment (taarde) and it is during the rainy season that this group gathers together. The more cohesive the group, the more there is sharing of meat, and there is likely to be more shared meat consumption in a segment characterized by more group solidarity. When a bull is slaughtered to meet the marriage obligations but eaten by a few households isolated from the rest of the segment, much of the meat spoils or is given away to nearby Twareg.

The Bii Nga'en (between In Waggar and Ingal) is a lineage characterized by a high level of cohesiveness. But even within lineages striking differences can be identified. Two segments of the Bii Korony'en Koron surveyed in 1981 illustrate how different practices can be: the Bii Korony'en Koron WeDDinde slaughtered their animals for marriages and births when the group was camped together for its annual gathering, and shared the meat, while a group of Bii Korony'en Koron Dassasu on several occasions slaughtered animals in recognition of these events without informing other members of the segment camped in the same region.

Proportion of gross household income derived from the market

A third major criterion for identifying variations in the ways of organizing production on the part of different WoDaaBe groups is the proportion of gross household incomes that comes from the market, through the sale of their animals and the sale or exchange of other goods.

The sale of livestock is the primary source of market revenues for the WoDaaBe. They also sell skins, curdled milk and butter (although these last two items are usually exchanged for cereals rather than sold). Only two WoDaaBe groups in the project zone, the BiBBe Denke and the AlamoYYo, make cheese. These groups generally exchange their cheese for cereals but sometimes it is sold.

Cereals represent one of the major items that the WoDaaBe purchase on the market, and the varying need of different groups to purchase cereals affects the number of animals they sell.

Some of the factors that determine the relative need of different groups to purchase cereals have been mentioned above. Higher mobility resulting in higher milk production reduces cereal purchases. A higher number of lactating animals per consumer also reduces dependence on cereal purchases. This operates at the group level by the redistribution of milk between households through the practice of baDal described earlier. When more milk is available, the amount of cereals consumed by households goes down. More cereals can also then be obtained in exchange for curdled milk and butter, which reduces the need to sell animals in order to be able to buy cereals.

The role of this sort of exchange (called sippal by the WoDaaBe) in their economy is often underestimated. Its importance depends not only on the availability of milk but on the proximity of farmers (either Twareg or Hawsa) with whom to exchange. In groups where WoDaaBe women practice sippal frequently, they sometimes not only meet the totality of their cereal needs during the first part of the dry season, but are also able to put aside cereals for the period when reduced milk production makes this exchange impossible. They can thus avoid buying cereals until the last two months before the rains. Increasingly, WoDaaBe women are receiving money for their milk products although exchange for cereals is still the norm.

The KuBanko'en segment of the Bii Hamma'en who are in the area around Mayata and In Tawila are an example of a group that practices sippal frequently. Their proximity to villages makes this easier. Women of the other Bii Hamma'en segments (in the area north and northeast of Dakoro), when asked why they do not practice sippal, simply say that it is not their tradition (instead they leave their camps in large numbers for work in southern cities and towns). The KuBanko'en followed migration routes different from the other Bii Hamma'en segments into their present location. This different historical experience is often revealed in practices that set them apart from the rest of the Bii Hamma'en.

Another form of sippal is the exchange of tobacco for cereals. WoDaaBe women buy tobacco on the market and by exchanging it in the bush with Twareg farmers they are able to obtain quantities of cereals that are several times the market value of the quantity of tobacco they give in exchange.[1]

Reliance on cereals can also be reduced slightly in those areas where there are wild plants (such as Citrullus lanatus, Leptadenia hastata, Tapinanthus globiferus) that the WoDaaBe eat. This gives them the variety in their diet that they look for in cereals.

However the amount of cereals purchased can not be directly linked to livestock sales. It is accurate to say that low milk supplies in general mean more cereals purchased. But low milk supplies are due to a small number of animals per person. Groups with small herds can not sell animals indefinitely to meet their cash needs; beyond a certain point herd reproduction will not keep up with sales. Therefore the marketing of livestock is often supplemented by migrant labour.

---

1. In the Durum area in December 1981 WoDaaBe women were exchanging with Twareg a quantity of tobacco worth approximately 60 CFA for millet worth approximately 250 CFA.

Changing consumption patterns also have an effect on the need for cash and thus the marketing of animals. Groups like the Gojanko'en and the Bii Hamma'en who frequent markets more than other WoDaaBe groups make more purchases of items like tea, sugar, radios, rice and clothing. Part of the money for these purchases comes from migrant labor, but the higher cash needs of these groups also result in more sales of livestock.

(2) Migrant labor

It has been argued in previous sections that the main constraint to household viability, in terms of the WoDaaBe preferred model of a purely pastoral production system, is the lack of sufficient animal capital. Because of this, households must resort to strategies that are less efficient in terms of labor use, less productive in terms of livestock-raising on the aggregate level, and more environmentally destructive. A further consequence is the beginning of a process of social destructuration that is likely to increase the effects of all the above.

The major strategy used by WoDaaBe with inadequate herds is seasonal migrant labor. They are clearly aware of its detrimental effects, and repeatedly say that it is a hardship that they resort to only out of necessity. Households with adequate herds do not send members away for seasonal labor, and when other alternatives are available the WoDaaBe adopt them.

As outlined earlier, a function of the WoDaaBe partilineage, especially the duDal and taarde, is to give its members access to the necessary means of production. Access to land is determined largely through access to water, and is organized by duDal or taarde ownership of deep wells or cooperation among duDal members in digging and sharing shallow wells. Redistribution of animals within the duDal or taarde through allocation, inheritance, loans and gifts ensures viable household units to the extent possible given the group's total animal capital. The individual production unit must then make decisions and allocate resources to balance its labor and consumption needs.

The last drought revealed the increasing economic vulnerability of most WoDaaBe in the project zone, and since 1974 most groups have not had the animals necessary to provide, through traditional allocation and redistribution mechanisms, their individual component households with a herd sufficient for independent pastoral production. Currently then, most households must deal in some way with consumption needs that are greater than the herd can meet. Not many alternatives are available to them. The WoDaaBe have adopted two principle ways of supplementing their incomes in cash and kind: seasonal migrant labor and herding cattle whose owners belong to other ethnic groups (jokkere).

Extensive surveys and fieldwork enable a rough estimate to be made of the proportion of WoDaaBe households in the project zone which have to resort either to migrant labor or to herding jokkere cattle. This is shown in table 4.2.43 and illustrated in figure 4.2.40.

Table 4.2.43 Estimated viability of WoDaaBe households in project zone

	Percent of households with:			
	Viable owned herds	Unviable owned herds with		Total
		no jokkere	jokkere	
No migrant labor	10	-	25	35
Migrant labor	-	40	25	65
Total	10	40	50	100

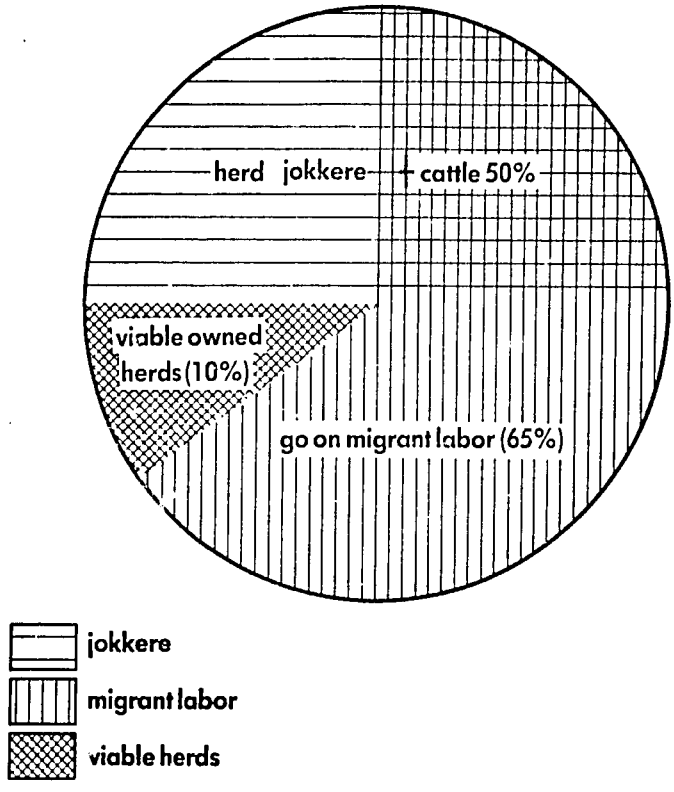


Figure 4.2.40 Estimated viability of WoDaaBe households in project zone, and alternative economic strategies (percent of households)

To understand why WoDaaBe decide to go on migrant labor rather than take on jokkere, why seasonal labor has not enabled individual families to build up adequate herds, and most importantly, what the long term implications of seasonal labor migration are, it is necessary to examine in detail the dynamics of labor use, consumption needs and herd production within the individual household production unit.

Labor, consumption and production within the herd management unit

Given a herd too small to feed the household dependent on it, migrant labor might seem the ideal solution, reducing the number of people to be fed and perhaps providing some supplementary income. However small herds do not imply surplus labor. Furthermore the WoDaaBe leave for varying periods of time but always during the dry season which is the period of peak labor demand. A model proposed by Dahl and Hjort (1979:25-28) demonstrates the first point and explains the apparent contradiction of the second.

WoDaaBe labor use has been discussed in detail above, and some key features may be summarized here. The important point for the present discussion is the disaggregate nature of labor requirements. Even a small herd requires several people to care for it; different tasks must be carried out by different people independently. Cows and calves must be kept separate. While at least one person waters or pastures adult animals, another must keep an eye on the calves that remain near the camp. Someone else must fetch water by donkey for the family's drinking and cooking needs, and this is sometimes an all day operation. Camels and donkeys, necessary for transport, graze separately from each other and apart from the cattle herd, and must be looked for if they are not to wander off and get lost or stolen. Sick animals need special attention as do sheep or goats, with different watering and grazing needs. Someone must tend the children, collect wood, pound millet and milk the cows if the herders are to eat. Pastoral labor requires many hands even if the tasks are sometimes not as physically taxing as agricultural labor. Once minimum labor needs are met, because of considerable economies of scale, a larger number of animals can be cared for by the same number of persons. If the size of the herd goes beyond a certain threshold however, it must be split into two separate management units and labor needs again go up considerably; this gives a step-like pattern to the labor requirements of increasingly large herds. The number of people that can be fed by the herd however is more directly proportional to the size of the herd. These relationships are shown in figure 4.2.41.

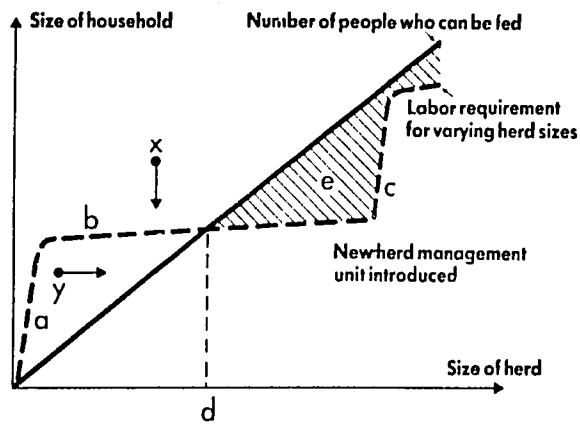


Figure 4.2.41 Relationship between household size and herd size in the WoDaaBe economy

(Adapted from Dahl and Hjort (1979:26). Points E and D added. Shaded area indicates viable household production units.)

Many WoDaaBe families find themselves in a situation where the size of the herd, and thus the food it supplies, is inadequate to support the number of people needed to maintain it. Outward migration, while reducing the number of mouths to feed and the need to sell animals for food, also reduces labor available for herding and the viability of the unit. It is during the dry season, the time of greatest labor demand, that food shortages occur because of diminished milk production and the high price of cereals.

When asked why they leave during the dry season when there is the most work, the WoDaaBe themselves say that it is because of lack of food. They explain that even if the migrant is not able to bring back money he can avoid selling animals (further reducing his herd) in order to eat. In the rainy season, they point out, the group is together and there is sufficient milk so that even someone who is poor can get enough to eat. The WoDaaBe household budget studies, reported above, confirm this point of view. In the sample production units, direct savings attributable to cereal consumption foregone

as a result of the absence of migrant laborers were 24,000 CFA/household in the survey year; as figure 4.2.19 showed, this was the value of a 1-2 year old male or female calf.

WoDaaBe households with insufficient labor for even a minimum herd and insufficient food production to feed its members (point Y in figure 4.2.41) generally remain associated with a father or brother. These are often households in the early stages of their developmental cycle, whose children are too young to work.[1] If their herd were of sufficient size they could take on additional labor (a younger sibling, niece or nephew). When it is not, they combine their herd with that of a father, brother or other relative, and migrate during the dry season. There is always the hope on the part of the migrant that he will earn enough money to buy some animals and gradually increase his herd to a viable level. But he will at least reduce the need to sell the animals he does have. It is obvious that families in this category do not have the option of taking on jokkere as their labor is already below the minimum.

In the household budget study sample of 14 WoDaaBe households, six out of the seven households that have combined herds send members away for dry season labor. The seventh combined herd is managed by a household in which food and labor needs are balanced. Two other households have insufficient herds but enough labor to send members away for salaried labor (reducing X to slope B on the labor line in figure 4.2.41) and take on jokkere (moving the size of the herd beyond D). They are thus simultaneously reducing the number of people to be fed to the minimum necessary to maintain the herd and raising the number of animals so that there are enough to feed the people present.

---

1. Minimum labor requirements are not absolute numbers but are affected by the age and sex composition of the family. The division of labor among the WoDaaBe is flexible: in cases of labor shortage a girl (as young as seven years old) will do some pasturing, women will take the animals to water, young boys or men will pound millet or milk cattle. However such shortages are limitations to the efficient operation of the pastoral enterprise.

However the slope of the line indicating the number of people that the herd can feed is modified if the herd includes jokkere animals. The household only has the use of the milk of the lactating females among the jokkere. Because he is not the owner, the head of the household can not sell jokkere in the dry season when there is no milk and he needs cash to purchase cereals. Although labor requirements remain the same, the number of people who can be fed is reduced, as shown in figure 4.2.42.

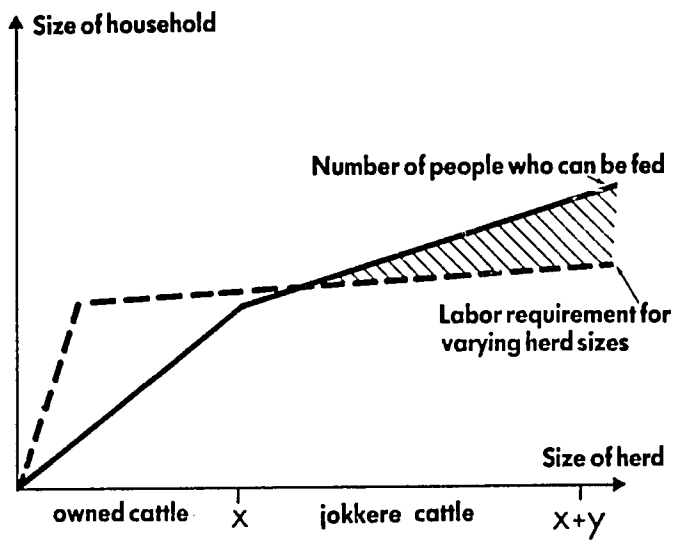


Figure 4.2.42 Changed relationship between household size and herd size when herd includes jokkere animals

Not all WoDaaBe have access to jokkere. If a household with adequate labor (at point X in figure 4.2.41) is not able to obtain jokkere, it is obliged to send even more people away for migrant labor, making the unit doubly unviable as labor falls below the minimum (level B) necessary to manage the herd. A household in this situation then has no choice but to combine its herd with that of another household.

A factor not evident from the figure are the age and aex categories of labor concerned. An important aapect of labor migration is that it removes juat thoae categories most important to pastoral production. Although children have a significant role from a young age (as early as 5 years), and even men and women above 60 continue to work in those families where there is not enough labor in younger age categories, the fact that migrants are between the ages of 15 and 55 increases the detrimental impact of absences.

Theoretically there could be households with more than minimum labor and a herd large enough to support it (in area E in figure 4.2.41), which could send people away for migrant labor to earn extra money to buy more animals, without affecting herd management. The fact that this does not often happen underlines food shortage as the primary cause of migrant labor. There are relatively few WoDaaBe families in this category (in area E). And, empirically, when a family has more than the minimum labor force, and a sufficient herd for subsistence, or an inadequate herd but enough labor to take on jokkere, its members do not regularly migrate. Before the drought, when herd sizes were on the whole sufficient, WoDaaBe did not migrate in large numbers.[1] The WoDaaBe do not earn enough from migrant labor to make the hardship worthwhile. Extra labor can be put more profitably into better management techniques or social contacts that reinforce the long-term security of the system. We discuss this point in more detail below.

Migrant labor as a continuing phenomenon

In the urban economy, the WoDaaBe do not have skills that allow them to find jobs other than as menial laborers: working as watchmen, selling traditional medicines, magic charms and philtres, repairing calebashes, braiding hair. As a result, they do not earn enough to solve the problem that caused them to leave in the first place: an inadequate herd. Rather than serving as a temporary stopgap, migrant labor has become an annual necessity for many WoDaaBe.

---

1. There have always been and continue to be people who leave for adventure and not out of necessity. These are isolated cases, usually young people, and they make only occasional trips.

Some can earn large sums of money in a short time by selling traditional medicines and philtres. But these earnings have to be balanced against transport costs as it is in Abidjan or Lagos that they can get the best prices for their medicines. When the expenses of living outside the household in a foreign city are added, as well as the high risks of theft, illness from unfamiliar food, and problems at borders, there is usually little or no money left when WoDaaBe migrants return to their camps. The household may also have additional expenses due to the migrant's absence: sometimes Twareg have to be hired to help with watering and cleaning out the well while a son is gone, for example. Often the migrant has borrowed money for transport before leaving and this must be repaid. The rest covers normal cash expenses such as clothing, cereals and other food, and supplements for the herd (cotton seed, animal salt). Radios or swords from Nigeria are sometimes brought back and occasionally sold in the bush at higher prices. Out of 13 migrants interviewed who made a total of 21 trips between January 1981 and June 1982 (each trip taking between a month and four months), only one bought an animal (a one year old bull) with her earnings. There were five cases of migrants who came back from a trip with nothing, and in several cases animal sales were made not long after the migrant's return.

The alienness of the WoDaaBe in the coastal countries causes them problems of language (even in Nigeria, since many WoDaaBe speak only limited Hawsa) and other difficulties, but it operates to their advantage in one way. Apparently WoDaaBe and Twareg are sought after as night watchmen in northern Nigeria because they are thought to be ferocious (due to their turbans, swords and general strangeness). WoDaaBe however speak of being afraid of being attacked by thieves and having to reimburse from their pockets anything that is stolen. Because of this they often work in pairs or even groups and divide the salary.

Migrant labor was not a significant phenomenon for the WoDaaBe before 1973. Dupire, who did fieldwork amongst the WoDaaBe in the 1950s and 1960s, only mentions women repairing calebashes for nearby sedentary people, or at times of greater need, pounding millet in neighboring villages (1962: 126). The WoDaaBe maintain that they did not know the towns and cities of the south

before the drought. However even before the drought, changes were taking place that help to explain the extent of the losses the WoDaaBe suffered between 1968 and 1974, and their inability since then to reconstitute viable herds. The continuing need for WoDaaBe to engage in migrant labor can be explained not only by migrant labor's negligible contribution to herd reconstitution but also by the slow expansion of cattle herds under Sahelian conditions. Annual growth rates solely through biological reproduction, where the herd is simultaneously being exploited by the sale of males, are estimated to be at best around 3 to 4 percent (Dahl and Hjort 1976: 66). At this rate, and other things being equal, the reconstitution of the pre-drought number of productive females in a herd that suffered a 60 percent loss in the last drought would take 26 years. In addition, these growth rates are if anything reduced by the effects of migrant labor itself on herd management. Furthermore the possibility of substantial new losses always exists. In 1981-1982, a year when dry season pastures were poor and the rains started late, a group of Bii Korony'en Yisaw families (in th area southeast of Abalak) lost 50 percent (average per herd) of their reproductive females. Many of this group's herds were already insufficient before 1981: 50 percent of the male household heads and 47 percent of the adult women have been leaving regularly for dry season migrant labor since the 1973 drought, making on average more than 2 to 3 trips per person in the past 6 to 7 years. It was not seasonal migration of course that caused 1982's losses. But the large-scale losses that occurred during the 1968-1974 drought, when combined with a complex of other factors, have lead WoDaaBe such as these into an increasingly precarious situation which migrant labor has not remedied, and indeed now perpetuates.

Types and location of salaried labor

The WoDaaBe do two sorts of salaried labor. Among the BiBBe Dennke, the Cahidooji, the Njapto'en and some segments of the Kasawsawa, older women (45 - 55 years old) go to sedentary villages during the dry season where they mend calebashes and braid hair.[1] This is a practice that began well before the

1. There are reduced possibilities for mending calebashes as metal bowls are used increasingly. However WoDaaBe women are in demand for braiding hair as recent styles among women in the towns and cities resemble the traditional style used by the WoDaaBe.

drought. BiBBe Dennke women go to Tanout and Zinder, the Njapto'en to Tahoua and the villages of the Ader, the Cahidooji to Niamey, and the Kasawsawa to Maradi and Kano. Their earninga are used for regular cash expenses (cereals, condiments, clothing, mats, calebashes) or to accumulate money for the larger expense of buying a daughter's household affairs.

In 1974 when animals died in large numbers, a widespread strategy among the WoDaaBe was to gather the remaining animals together under the care of one member of the group who stayed in the pastoral zone, while the others went south and lived as best they could (some cutting wood or hay and selling it in towns, others living from government aid or the generosity of sedentary people). Most stayed several years and then gradually filtered back to the pastoral zone, many returning to the south each dry season.

The experience of this period immediately following the drought reinforced among younger WoDaaBe the connections their parents' generation had with the farming zone of Niger and northern Nigeria, which they left only at the end of the last century.[1] The south remains a reference point for them. This may explain why the WoDaaBe go south to look for work rather than north as do many Twareg. Although some WoDaaBe work in Arlit, WoDaaBe do not go to North African countries.

Young men find work as watchmen in northern Nigeria, earning an average of 20,000 CFA to 30,000 CFA a month, which is often divided between several people. Others go as far as Lagos, Abidjan and Dakar selling traditional

---

1. The traditional medicines (for both humans and animals) the WoDaaBe use still are based largely on plants found south of the pastoral zone. Groups such as the Jiijiiru retain ties with Jiijiiru who stayed in Kabi.

medicines, braiding hair or mending calebashes.[1] WoDaaBe from the project zone go to all the coastal countries from Cameroon to Senegal with a preference for Guinea (because of the large Fulfulde-speaking population) and Abidjan. According to one informant a woman can earn between 15,000 CFA and 25,000 CFA a month braiding hair in Sokoto. Traditional medicines and magic charms can fetch high prices. For example in a city like Bamako a BoDaaDo can earn between 100,000 CFA and 125,000 CFA in a month selling medicines (according to the same informant). It is in Abidjan or Guinea, followed by Senegal and Mali, that prices for medicines are highest. But there is another reason for these long distances. A BoDaaDo is ashamed to be seen by other WoDaaBe who consider work other than herding degrading. This may explain why WoDaaBe usually go to other countries despite the transport costs, rather than staying in Niger.

The extent of migrant labor

The numbers of WoDaaBe involved in seasonal migrant labor vary widely from group to group. The extent of migrant labor within a group is affected primarily by the level of animal losses sustained by the group during the last drought, and the availability of other alternatives, such as herding jokkere and the exchange of curdled milk and butter for cereals.

Examples of WoDaaBe groups whose members leave in the greatest numbers for salaried labor are the Bii Hamma'en in the Dakoro area, the Bii Korony'en Yisaw around Abalak, the Jiijiiru in the Tanout area, and the Yaamanko'en around Aderbissinat and Tamayo. Many Bii Hamma'en Doosewol east of Abalak have jokkere in their herds; the Doosewol women do a lot of salaried labor, but the men leave rarely. The Bii Korony'en Koron, the Kasawasawa Gajabanko'en and Tanir'en, the Njapto'en and the BiBBe Dennke are the goups that have the smallest number of people leaving Niger for dry season salaried labor.

---

1. Although prostitution is never mentioned as a source of income, a BoDaaDo interviewed who has travelled widely in all the coastal countries says that prostitution among young WoDaaBe women occurs in cities that are sufficiently far away so that reports do not reach the women's groups.

Although comprehensive statistics are not available, extensive surveys by the project give an estimate that about 65 percent of WoDaaBe households in the project zone have members who engage in migrant labor (see table 4.2.43 and figure 4.2.40).

The Gojanko'en in the Tchin Tabaraden area, when compared to other WoDaaBe groups, can be taken as an example of those groups that rely to a moderate extent on migrant labor. Fifty-four Gojanko'en households (Ute'en BaleeBe and Ute'en woDeeBe) totalling 397 individuals were surveyed between 1980 and 1981. Sixty-four people left the pastoral zone at least once for migrant labor during this period. This is 16 percent of the population surveyed, and is also an average of more than one migrant per family, with attendant consequences for household labor organization. The effect of migrant labor on herd management is emphasized by the age and sex breakdown of migrants in a smaller sample of 15 households (belonging to the same segments of Gojanko'en). Out of 32 men and 37 women between the ages of 15 and 60 in the sample, 8 men and 8 women, or about a quarter of the adult labor force, left for migrant labor at least once during a 12 month period.

Implications for development

Herd management strategies

Seasonal migrant labor is an attempt by the WoDaaBe to compensate for herds too small to live from. The loss of labor that this entails is a strain on the viability of individual production units and on the collective use of resources. The WoDaaBe are obliged to alter their management strategies when they have labor shortages. This has an immediate effect on the production from individual herds and on the domestic economy, and also longer term consequences that increase the riskiness of livestock-raising by WoDaaBe in the pastoral zone. Without some intervention the result can only be even smaller individual holdings and increased migrant labor.

Minimum labor needed for a given herd size must be defined with caution. Facing a labor shortage, a household can continue to care for its herd by adopting makeshift practices that merely keep the operation going. If more

labor is available, these makeshift practices can be improved upon but there still may not be sufficient labor to adopt risk-avoidance strategies that strengthen the long-term viability of the household and are essential under conditions as uncertain as those in the Sahel.

Dry season watering is a major labor constraint, requiring the work of several strong adults. The WoDaaBe choose their water points carefully, taking into consideration the quality of the water and the condition of surrounding pasture. If there is insufficient labor however, they have no choice but to use boreholes, where water does not have to be drawn, or the rare surface water that remains during the dry season. The WoDaaBe do not like to do this. They consider the water from boreholes bad for the health of their animals because of its high temperature.[1] Furthermore pasture around boreholes is heavily grazed and trampled because of the concentration of animals the boreholes attract. The WoDaaBe say that watering at surface pools after October is bad for the health of their cattle because the water is cold, and becomes increasingly polluted during the dry season.

If an animal is sick or weak and unable to keep up with the herd, it may have to be abandoned when the household moves camp if there is not someone who can remain behind with it. There has to be a household member available to look for animals - or even a whole herd of sheep or goats - that wander off if they are not to be lost permanently. The household head can go to market and leave his camp without a herder, but in this case he has to return quickly. Cattle have to be watered every other day in the dry season, and in the rainy season, when camps are closer together, animals can easily get mixed in with those of another herd or follow the more mobile FulBe herds that come into the project zone from southern Niger at this time of year. At the beginning of the dry season when the FulBe are returning to their villages, the animals of a BoDaaɔo who is away from his camp for several days at market could be half

1. There are exceptions. For example the WoDaaBe describe water from the borehole at Dembutan, west of Tchin Tabaraden, as salty and good for their cattle.

way to Madaoua on his return if there is nobody to look after them. This means that if the family members he has left in his camp are already fully occupied, while others have left for migrant labor, he is unable to spend enough time at market to wait for a good price for his animal. He may go to the closest market even if he knows that animal prices are better at another, or avoid a trip to market altogether by selling an animal in the bush at a low price. If he needs millet he cannot wait to buy it at the OPVN, and must instead buy in the market at higher prices. A herder in this situation is more likely to keep his camp relatively close to a market and is thus unable to take advantage of better pasture elsewhere.

Herd splitting is a management strategy that has to be abandoned when household labor is diverted from herding to salaried labor. Some WoDaaBe groups (for example some Kasawasawa and Bii Korony'en) separate lactating females from the rest of the herd and part of the household stays with them near a market or village. This has several advantages. The cows do not have to cover long distances for water and their milk can be exchanged with sedentary people for cereals. WoDaaBe women can earn money or millet by braiding hair or mending calebashes in the village. Other members of the household take the bulk of the herd farther north where there is more pasture. Dry season animal sales for millet purchases are thus reduced.

Labor shortages mean combined herds, greater concentrations of animals, less mobility, and not making use of the best water points or pasture. The effects of any of these show up immediately in decreased milk production and gradually in reduced animal health, nutrition and fertility.

There are also risk-avoidance strategies that can not be undertaken without sufficient labor. Abandoning these strategies may not have immediately obvious effects, but will reduce the long-term economic viability of a household and increase its vulnerability in a bad year.

For example, species diversification provides a more regular milk supply and reduces the danger of loss of an entire herd from one disease. Goats and camels are more resistant to poor conditions than sheep and cattle, and sheep and goat herds expand more rapidly after large losses than cattle and camels. The different grazing and browsing patterns of the different species enable a herder to make maximum use of an area. However because of different grazing and watering requirements, more people are needed to tend a herd made up of different species, and species diversificiation is impossible if members of the family are absent.[1]

There are other less tangible factors. A herd owner must have time for visits and discussions in other camps, at water points or at the market. These contacts are important sources of information about pasture conditions, and establish and reinforce social ties upon which a herder must rely at times of loss. Because of the distances involved, social interaction requires absences from the camp which inadequate labor prevents. But if information about pasture is not gathered, the herd suffers. The period just after the last rains (October-November) for example is a time when extensive travelling and exploring should be done to evaluate pasture conditions and decide where the herd is to spend the dry season. These decisions about dry season strategy have to be made sufficiently early. Once the herd is weakened it can no longer move long distances if pasture is exhausted. But many households do not have the labor to gather this information, because of absences on migration.

In addition to the strain labor shortages cause within the herd managing unit, they have important effects on overall resource use. When herds have to be combined or animals are concentrated around boreholes and markets because of herding labor shortages, pasture and water are being used in an unecological manner. As a result, small herds do not mean a more productive

---

1. An elementary ethnic division of labor can sometimes be identified due to the conflicting labor requirements of herding different species. There are many cases of Twareg entrusting their cattle to WoDaaBe while the Twareg tend their own camels or work outside the pastoral economy. But the Gojanko'en Gawwanko'en have camels that they give to Twareg to herd while they themselves herd cattle belonging to Twareg Iborogan.

(per animal) or balanced use of resources. Because small herds mean less people can be supported, and a shortage of people results in poor management, the outcome may be environmental degradation in particular areaa even if the overall density of animals is low (Dahl 1981: 209). In the project zone, individual herder households' animal holdings are small, but the total number of animals is increased by investment in livestock by non-herders. Because these animals are managed by households in which labor shortages prevent optimal management practices, the problem is intensified.

There is an important difference between the impact of migrant labor on pastoralism and agriculture. In pastoralism there are seasonal variations in the kinds of work to be done but labor needs are maintained throughout the year: the animals need constant attention. Although dry season labor is clearly the most physically arduous, some rainy season activities require even more hours per person. A minimum number of people to carry out the different necessary tasks must be maintained. For example, although it is not necessary to draw water and dig wells in the rainy season, someone must supervise the herd even when it is drinking at surface water pools as animals often become caught in the mud and have to be pulled out by several people. There are more qualitative decisions of judgement to be made based on knowledge of plants species and the animals' needs. Cattle should have the correct mix of different species and must be prevented from grazing too much of certain plants, and careful attention has to be paid to some species at particular stages in their vegetative cycles, both to avoid problems such as bloat, and also to make sure the cattle get a nutritionally balanced diet. This sort of supervision is essential if the animals are to recover their weight during the short rainy season, and build up their ability to withstand the dry season. Women do not need to spend as much time fetching water and pounding millet during the rainy season, but frequent camp moves to new pastures at this time of year involve considerable work (packing up belongings, loading the animals, unloading, setting up camp).

For these reasons in pastoral economies such as that of the WoDaaBe there is not a slack period of the year when labor is un- or underemployed, such as occurs in Sahelian agricultural economies, and during which people can leave without adverse effects on the production system.

Group cohesion

Migrant labor provides individual people with alternative sources of revenue to those originating from their household and duDal. When WoDaaBe groups have enough cattle, a man gradually accumulates the nucleus of his herd through animals allocated to him by his father and other close paternal relatives when he is young, the offspring of animals loaned to him by relatives and friends, and animals he inherits. The source of his subsistence depends entirely on a larger group of paternal kin, the duDal and taarde, within which social ties are created and reinforced by reciprocal gifts and loans of animals. The source of cash and products he uses for all sales and exchanges is the herd of animals provided orginally by his patrilineage.

Animal distribution mechanisms among the WoDaaBe tend to equalize holdings, and redistribution at times of loss make it possible for individual households to maintain their economic viability. But the functioning of all of these mechanisms depends upon the patrilineage having enough animal capital to draw on.

A young man whose father and other relatives are unable to provide him with enough animals to consitute a minimum viable herd, and who consequently engages in migrant labor to support himself, has fewer ties of obligation and feelings of responsibility to the partrilineage. Migrant labor gives access to resources that do not engender social ties or reciprocity. A BoDaaDo who migrates regularly is less apt to receive haBBanae loans because owners are uneasy about the care of the loaned animal while the borrower is absent. An individual who does not feel obliged to his duDal or taarde and does not make animal loans is himself more vulnerable at a time of future loss. He also makes the group more vulnerable if he does not contribute to the circulation of animals that is an important defense mechanism against the destitution of individual households.

There is an inevitable cumulative effect when increasing numbers of WoDaaBe spend time outside a patrilineage that has previously maintained tight cohesion and mutual aid structures through strong social control and group identity. The migrants are of course affected by living outside the confines

of group sanctions and by being subject to new and different influences. There is also an effect on those WoDaaBe children whose parents spend substantial periods of time away from their camps. Given the content of WoDaaBe kinship relations, a child's upbringing will be altered if he is raised by his grandparents, for example, with whom he has an informal joking relation, whereas his relation with his parents is one of respect and restraint.

In most African societies migrant labor is both a result and a cause of increasing cash needs as well as of changes in consumption patterns, sources of prestige, and social structures of interdependence. Shifts in terms of trade and taxes contribute to increased cash needs. These factors are at work in WoDaaBe society. However more fundamental to an understanding of migrant labor among the WoDaaBe is an analysis of changing access to basic resources.

Accurate long-term statistics that would allow calculations of terms of trade for livestock and cereals (the WoDaaBe's major cash expenditure) are scanty. Terms of trade are subject to sharp fluctuations but there is little evidence for long-term trends disadvantageous to pastoral products. Animal taxes (stopped in 1974) and head taxes (stopped in 1977) have not been reinstated for herders. They pay only a small arrondissement-level tax (400 CFA per person).

A comparison of Dupire's description of WoDaaBe society in the 1950s and the current situation shows a striking similarity in consumption habits and sources of prestige, and an equally striking difference in the capacity of the herd to support the household economy. Dupire's observations (1962: 64, 127, 133-4) indicate that family herd sizes were then sufficient to meet consumption needs without substantial animal sales, whereas sales of young females are now not infrequent. At the same time, articles purchased are remarkably similar. The only additional items found in WoDaaBe camps today are radio-cassette players and flashlights, and even these are only used by some groups. Tea and sugar consumption however has increased considerably.

The point to be made is not that consumption patterns have not changed (they have, as the proportion of millet to milk in herders' diets has increased substantially), but that inadequate herds are a more basic cause of migrant labor than increased cash needs (just as small herds are the cause of increasing dependence on millet). Prestige and status structures have not yet changed significantly and herding remains central to them. Dupire's observation (1962: 134) that livestock is the only culturally acceptable form of wealth among the WoDaaBe is still accurate. Migrant labor is considered a hardship accepted out of necessity and often with a certain amount of humiliation. As one BoDaaDo expressed it, it is like going to the dispensary.

The situation in 1981-1982 demonstrates the importance of food availability to decisions about migrant labor. The combination of poor pasture during the dry season and late rains caused more animal deaths than usual at this time of year and seriously reduced milk production. There were losses of lactating females and the milk of those whose calves died dried up. Milk available during the 1982 rainy season was thus more limited than in other years and the period of the rains (normally the time of milk surplus) was shorter. The period of migrant labor was correspondingly extended in many cases. Some WoDaaBe who had gone south during the 1981-1982 dry season heard about conditions in the pastoral zone and did not return for the rainy season as they do each year. Others, whose 1982-1983 dry season departure normally would be at the earliest after the worso (the annual rainy season gathering of the lineage segment which is important to the WoDaaBe), left before the worso, which is extremely unusual.

There is evidence that if WoDaaBe had herds sufficient for their subsistence they would not migrate. A BoDaaDo woman (from the Bii Hamma'en Doosewol east of Abalak) interviewed has made seven trips since the drought (people in her group did not engage in migrant labor before 1974). However in 1982 her husband obtained twelve head of cattle to herd for a Twareg from Abalak, and this year she stayed in the camp and exchanged milk for millet rather than migrating. The women in this group say clearly that if they had enough milk cows they would not leave, and explain that they did not migrate before the drought because their herds were sufficient to meet their needs.

Furthermore, as mentioned earlier, groups whose losses were not as extensive during the last drought and who were left with a sufficient nucleus of animals used traditional redistribution systems to reconstitute the herds of individual households. They have not engaged in migrant labor. In other groupa where seasonal labor takes place because there was not a sufficient number of animals remaining to distribute, those households with adequate herda do not send members away to work.

It ia possible that the phenomenon of migrant labor has become so wideapread in some WoDaaBe groups (for example the Bii Hamma'en in the Dakoro area) that attitudes have changed more fundamentally. But aasertions that large numbers of WoDaaBe migrate simply out of habit or a sense of adventure must be examined carefully in terms of the relation of the seasonal variation of the production of the herd to the consumption needs of the people dependent on it.

A show of bravura on the part of WoDaaBe who migrate may be covering a feeling of disgrace. The critical factors are the production of individual household herds (number, ages and aexes of animals and seasonal variation in milk production), terms of trade of animals for cereals at the times when cereal purchases are a necessity, and the number of people that must be supported by each herd.

It is clear that migrant labor is becoming not only increasingly wideapread among the WoDaaBe of the project zone, but also a permanent phenomenon rather than a temporary recuperative mechanism.

(3) Animal ownership

WoDaaBe society is relatively unstratified. There are mechanisms that maintain an egalitarian atructure, and embryonic forma of stratification are attenuated. However an internally unstratified structure within WoDaaBe society should not obscure the insertion of the WoDaaBe in a wider political and economic system over which they have little control and which largely determines the conditions of their existence. The nature of their interaction with sedentary peoples and other pastoralists is not random and must be carefully analysed.

There are rediatributive mechanisms that reduce large differences of wealth between individual WoDaaBe households. Traditional risk-avoidance and insurance strategies reduce the effect of natural hazards, climatic fluctuations or animal disease for example. For these mechanisms to operate however, there must be a minimum basic animal capital to circulate between members. In the past, through a variety of means, WoDaaBe society has provided dispossessed households with animals, their means of subsistence. The WoDaaBe have never been isolated from other herding groups or sedentary populations, but because they were able to overcome temporary losses within their group and maintain viable individual units, they were more able to determine the terms on which these interrelations took place.

What seems to be happening now is a continued reduction in total animals belonging to WoDaaBe. There are not a sufficient number of individual production units with a surplus of animals adequate to supply all needy households without threatening their own viability. This lack of internal economic strength means that the WoDaaBe are not able to put into practice the defense mechanisms they know to be necessary for their long-term survival as herders. They are increasingly subject to conditions outside their society which in the past they had a sufficient margin of material means to manipulate. Now they increasingly have to accept these conditions on unfavourable terms. This further reduces their economic viability and further increases their vulnerability and dependence on conditions they do not control.

There have always been exchanges of goods and services between WoDaaBe and other groups. The WoDaaBe do not live exclusively from their herds. They exchange or sell animals and animal products for agricultural products to supplement their diet. They do not have artisans, leather, wood or metal workers, and must obtain these goods from the market or neighboring groups. Throughout West Africa sedentary groups confide their animals to FulBe to herd and FulBe herds provide manure for cultivated fields while their animals pasture the stubble left after harvest.

There is a double process now operating in the project zone. On the one hand there are increasingly destitute herders unable to reconstitute their pre-drought herds because they are constantly obliged to use their animal capital faster than it can reproduce. At the same time there appears to be increasing investment by non-herders in animals herded in the project zone. Both processes are determined by a variety of factors, but are interrelated.

A BoDaaDo who does not have enough animals for his subsistence either because of loss or because of the poverty of his father will first turn to his agnatic group for loans and gifts of animals. If there are not enough other WoDaaBe households that can provide him with animals without themselves becoming unviable, he must look elsewhere. Choices between and combinations of the two main alternatives currently available to WoDaaBe herders - migrant labour and entrusted animals, or jokkere - have been discussed above. As in the case with migrant labor, taking on jokkere has permitted WoDaaBe to continue herding in the pastoral zone but does not allow them to reconstitute their own herds to the level of economic self-sufficiency. Since the 1968-1974 droughts there have been enough needy WoDaaBe looking for animals to herd that the conditions on which these animals are tended by WoDaaBe have changed.

In the past, although WoDaaBe rarely worked as hired herders, there was a system of compensation for their labor, either with money or animals, that allowed the herder gradually to build up his own herd and become independent. Since the last drought WoDaaBe have been herding animals for outsiders with only the milk of those females in the herd that are lactating as payment. This is in fact a meagre compensation for the labor furnished. Although proportions vary widely from herd to herd as will be explained below, only a fraction of the jokkere are females and only some of these are lactating at any given time. Furthermore during the dry season when food shortage is a problem for herders, milk production is almost negligible and the owners often call back lactating animals for their own consumption. The willingness of herders to tend jokkere on such disadvantageous terms is an indication of their poverty. If the herder demands more compensation for his work than the milk of the animals he is caring for, the owner can easily find another herder willing to provide labor for what amounts to an extremely limited salary.

The aggregate effect of this phenomenon is favourable investment possibilities for people with capital. Young animals can be bought and kept in the bush at no direct cost to the owner for forage or herding labor. Over time these animals reproduce and the herd increases. Individual animals, particularly males, can be sold several years later at many times their original price.

Pre-drought situation

The WoDaaBe of the project zone have been moving gradually north since the beginning of this century. Just over the past generation most WoDaaBe have moved even their habitual dry season areas beyond the limit of rainfed agriculture. The pressure of extending cultivation and the growth of villages (and village herds) around formerly isolated administrative posts, as well as the drilling of boreholes, and a period of good rainfall that briefly pushed ishoheyets north, all contributed to this process.

Therefore until quite recently (up to 30 or 40 years ago) the WoDaaBe, although gradually moving north, remained within regions that they shared with cultivators. This implied considerable interaction, both in terms of exchanges and of course conflict. Most of the older WoDaaBe (in their sixties) presently using the project zone were born and nomadized during their youth south of the project zone. There is nothing new about the northern movement of the WoDaaBe. But there is now a significant difference in that they have moved into a region that is considerably more arid. The area south of Tahoua and Tanout where the WoDaaBe were in the 1940s and 1950s has a mean annual rainfall of approximately 400-500 mm, but most WoDaaBe are now in areas (both during the dry and rainy seasons) where mean annual rainfall is between 100 and 300 mm. The limit of rainfed agriculture in the Sahel is generally considered 350 mm.[1]

---

1. There is nonetheless scattered cultivation throughout the project zone, particularly in low-lying areas. Although these fields have low yields and in many years crops fail entirely, they are still a source of conflict between herders and cultivators.

There are two important implications of this change. Because the WoDaaBe are in more arid areas, livestock-raising is more hazardous for them. At the same time, because of their physical separation in more diatinct zones, the WoDaaBe in the project zone and agricultural peoples now have a different relationship.

In the past it was easier for the WoDaaBe themselves to shift temporarily out of pastoralism into agriculture at times of animal loss, because fields were available and the WoDaaBe were in more fertile areas. Now even agricultural people are cultivating more marginal areas because there is no longer fertile, uncultivated land available. Richer fall-back zones, important at times of low rainfall, are farther away for the WoDaaBe and less accessible because of more extensive cultivatation and habitation. In 1974 the animals of most WoDaaBe groups did not have the strength to walk the long distance without grass cover that separated them from southern zones where there was adequate pasture.

There has been a modification in the sorts of neighborly and familiar interaction that existed in the past between complementary users of the same region. This interaction typically takes place through exchanges of livestock production for agricultural products, with herders taking the animals of sedentary people north away from fields during the rainy season, and grazing stubble after the harvest while manuring the fields. However if there is not adequate rainfall, manure will burn crops. In the more arid areas the WoDaaBe are currently using, the possibility of burning is increased and the farmers prefer to forgo the benefits of fertilizer because of the higher risk of damage.

At the same time that the material base of WoDaaBe economy has been weakened because of reduced access to richer land, increased animal losses, and more difficulty rebuilding their herds, the WoDaaBe are geographically further removed from agricultural groups and do not have the same relations of coresidence and neighborly intercourse. The WoDaaBe constantly repeat that in the past they took the animals of their sedentary neighbors with their own herds during the rainy season transhumance because of friendship. Now they

are obliged to herd the animals of sedentary people because they do not have enough animals of their own for subsistence. They are unable to negotiate the terms on which this provision of herding labor takes place. Although many of the older WoDaaBe have long-standing ties with people in villages of the areas in which they grew up, their sons, who are now herding the animals belonging to these villagers in areas further north, have a relationship that is closer to that of a hired laborer.

This does not mean that there is no longer interpenetration of pastoralism and agriculture south of the project zone. This has been maintained and probably intensified. It is likely that the agro-pastoral FulBe groups that are based in villages, particularly in the Galmi-Madaoua-Bangi area, have maintained the more classic exchange relations with their agricultural neighbors. Because most of their animals were further south at the time of the last drought and because many also had fields to fall back on, their losses were not as severe as those of the WoDaaBe further north.

Dupire, who studied the WoDaaBe in the 1950s and 1960s, says that cases of WoDaaBe working as herders for others were only the result of extreme poverty and were rare (1962: 127). She gives details of the payments that rich WoDaaBe made when they themselves hired a FulBe or Buzu herder: clothing, milk, animals at regular and fixed times (1962: 139). She lists herding animals for sedentary people as a source of revenue for a small number of individual WoDaaBe and stresses that it was a temporary recourse at times of hardship (1962: 126 and 132).

Current conditions

The critical factor is that the change in the conditions under which jokkere are now herded by WoDaaBe means that taking jokkere is not a temporary strategy for destitute herders. It has become a continuing necessity for a large proportion of WoDaaBe if they are to continue herding in the project zone.

The general practice is for the WoDaaBe to have the use of milk produced by the animals they are herding. As explained above the actual quantity of milk available can be very small. But if, added to the milk produced by his own animals, and perhaps reduced consumption needs because of migrant labor, this milk permits a BoDaaDo to sustain his family in the bush, he prefers the extra work involved in tending the jokkere, including the non-lactating animals, to abandoning herding altogether. WoDaaBe identify themselves as herders and do not have other skills by which they can make a living. Employment opportunities in Niger are limited. Leaving herding signifies removing themselves from their group which is something most WoDaaBe will avoid if at all possible. There are isolated cases of WoDaaBe receiving occasional other payments from the owners of the jokkerreji they tend: sheaves of millet from Twareg who cultivate fields nearby, several sugar loaves because there were no lactating females among the jokkere, a calf after four years of herding, money (2,000-3,000 CFA) when one of the jokkere is sold. There is more likelihood of receiving a young calf if the owner is particularly rich. The norm however is that the milk is the only payment. At a time of food shortage for sedentary people the owners often take back the milk cows. For example before the 1981 harvest millet prices were particularly high and owners of jokkere were keeping their lactating females in their villages to provide milk for their own families.

If one of the jokkere diea the BoDasDo must show its skin to its owner quickly or he will have to pay for the animal. If the loss occurs while the herder is at a long distance from the owner's village this means leaving his herd for several dsys or weeks. If one of the jokkere animals is lost, always a poasibility even for the WoDaaBe's own animals, the herder is usually suspected of having sold it and must pay the owner for it. In 1981 the Bii Korony'en Koron Dassasu cited the case of a herder who had five jokkere die. He had to pay for four of them and because he was unable to do so, his friends and relatives grouped together to contribute to the payment. When the owner decides to sell one of his animals, the herder is obliged to leave his camp to take the animal to market. This is a hardship when WoDaaBe groups are far from markets during the rainy sesson, and during the dry season when labor demands are high.

Extent of jokkere phenomenon

The herding of jokkere by WoDaaBe occurs throughout the pastoral zone from Tchin Tabaraden to Tanout. The numbers and distribution of jokkere tended vary widely from group to group and within groups. There are WoDaaBe groups that do not herd jokkere at all. Some of these, like the BiBBe Dennke in the area south of Tanout have tried to find jokkere to herd but have not been able to obtain any. Others, like the Bii Korony'en Yisaw (north-east of Abalak) have other strategies: a large proportion of Yisaw engage in migrant labor. Still others, like the Bii Korony'en WeDDinde, do not herd jokkere because they have sufficient herds of their own.

Even among the groups that do herd jokkere, variations are large and can not be predicted without detailed investigations. For example within the Kasawasawa lineage, the segments in the Damergou have large percentages of jokkere whereas the Gazabanko'en segment of the Kasawasawa in the Abouhaya area does not herd jokkere. Within the Jiijiiru lineage, on the other hand, both the segments in the eastern part of the project zone (for example the Jiijiiru Wayeewa) and those in the western part (the Jiijiiru Hamburu) have large numbers of jokkere.

Within segments some families may have 90 percent of the herd composed of jokkere while other families do not herd any jokkere. The distribution is not determined by prestige. For example in the Gojanko'en Gawwanko'en and in the Bii Korony'en Koron there are two reapected chiefs, one particularly widely esteemed, who have jokkere. In some groups a large number of people have small numbers of jokkere in their herds whereas in other groups there are smaller numbers of families tending jokkere with larger proportions of jokkere in their herds.

It is thus misleading to make global statements about the percentages of animals owned by WoDaaBe and those they herd for others. We can however identify groups that are the most dependent upon jokkere: these include the Bii Hamma'en Ciwtel, the Bii Hamman'en Doosewol, the Bii Korony'en Koron, the Njapto'en Aadiranko'en, the Gojanko'en Gawwanko'en, the Gojanko'en Goje, and the Jiijiiru Wayeewa (see chapter 4.1 for the geogrsphic distribution of these groups).

Two examples taken from these groups will help illustrate the extent of the phenomenon we are describing. The Bii Korony'en Koron Dassasu (a fraction of the Bii Korony'en Koron) are divided into four sub-groups. One of these groups owns about 200 herds, the average size of which is 25 adult cattle.[1] Three-quarters of these herds have jokkere in them. The average number of jokkere per herd is eight to ten, but some herds are composed almost entirely of jokkere whereas other herds have only two or three jokkere. A smaller sample taken from the Bii Hamma'en Dossewol consists of thirty herds with an average herd size of 20.6 cattle. Seventy percent of these herds have jokkere in them. The average number of jokkere per herd is 11.5 and the average number of animals owned by WoDaaBe per herd is 9.1. The total number of cattle concerned is 620, 55.5 percent of which are jokkere. Considering only the herds in which there are jokkere (21 herds consisting of a total of 345 head), there are a total of 124 head that belong to WoDaaBe with an average of 6 per herd and an average of 16 jokkere per herd.

Owners of jokkere

There are different categories of owners of jokkere. The factors defining these categories are the ethnic group of the owner, his principal economic occupation, and the amount of capital he has available and is allocating to investment in livestock. These factors determine different strategies adopted by the owner and are related to the size and age/sex structure of the herd given to the WoDaaBe to tend, the sort of relationship the herder has with the owner, the reasons for confiding animals to WoDaaBe, and variations in the seasons during which the animals are herded by WoDaaBe.

---

1. More than one conjugal family may depend on one herd for its subsistence. If a family head and adult sons, or other closely related relatives, do not have enough animals to be independent, their cattle will be combined in one herd.

WoDaaBe herd animals belonging to people in three ethnic groups: Hausa, Twareg and Arab. In terms of economic occupation, the owners are either cultivators, merchants, civil servants or other herders. The size of investment, the number of animals owned, can be quite small. For example small-scale cultivators in a year of good harvest, if they have a surplus, often buy a few animals. Twareg herders who own primarily camels and small ruminants often have several head of cattle as well. At the other extreme there are large investments in livestock, for example by merchants with enough capital to buy large numbers of young males when prices are lowest and to keep them until they have gained their maximum weight and prices in the market are at their highest.

People with small amounts of capital to invest buy mainly females. Because they are relying on biological reproduction to increase their holdings rather than additional purchases and want some milk to drink, the structures of their herds are likely to resemble those belonging to herders with a high proportion of females. Similarly their marketing strategies will be closer to those of herders. They sell animals if they need cash, if a female is reaching the end of her reproductive period or is sterile, or if males have reached their maximum market value. Herds are relatively stable because they are not primary sources of revenue for consumption. Other revenue for the owner is being generated by agriculture, service sector salaries or commerce.

Those who have more capital available to invest in livestock are more likely to buy young males whose market value rise sharply as they grow. These herds are larger and have a large proportion of males. There is a more rapid turnover as animals are being raised primarily for sale. Young males are bought, kept until they gain weight, are sold, and more young animals are bought. Large investors give their animals to the WoDaaBe to be herded throughout the year. They are less apt to call back the lactating females than are owners with small herds, but because they sell more animals the herder tending their animals is obliged to go back and forth to the market more often.

Hawsa cultivators who have small animal holdings give their animals to WoDaaBe to herd particularly during the rainy season because they need to keep their animals away from their fields and because their own labor is fully occupied by agricultural work at this time. Their animals benefit from the rich and abundant rainy season pastures away from villages to which they are taken by the WoDaaBe during the rainy season transhumance.

Twareg herders who entrust their cattle to WoDaaBe do so for several reasons. They recognize the specialized cattle herding knowledge of the WoDaaBe, as the WoDaaBe appreciate the superior knowledge of the Twareg with respect to camels. Furthermore the Twareg have more diversified herds. Herding four different species demands more labor than many Twareg management units can now summon particularly since the departure of many Twareg ex-slaves. Since Twareg herd largely camels, sheep and goats, which have watering and pasturing requirements different from cattle, they often confide their few cattle to WoDaaBe to herd. It is particularly dry season watering that is a constraint and the Twareg frequently take back their cattle during the rainy season.

The owners of jokkere herded by WoDaaBe are generally Hawsa cultivators, merchants or civil servants with whom the WoDaaBe have had contacts since the period about a generation ago when they were further south, or Twareg with whom the WoDaaBe share the region they are currently using, or newly arrived Arab merchants building up a commerce in developing villages such as Abalak.

The villages in which the Hawsa owners of jokkere live largely correspond to the migration routes different WoDaaBe groups followed over the past fifty years. The Bii Hamma'en Ciwtel herd animals belonging to people from Kangui and Mayata. The owners of jokkere herded by the Bii Hamma'en Doosewol are from Tabotaki. Other owners of Doosewol jokkere are Twareg Iberogan. The Gojanko'en Gawwanko'en herd animals belonging to Hawsa cultivators, in particular from the villages of Ibohane and Wodey, south of Chadawanka. They also have jokkere belonging to Twareg Iberogan agro- pastoralists who live north of Chadawanka. Most of these individual owners have small numbers of cattle they entrust, but several Gawwanko'en tend large herds belonging to Arabs who live in Abalak. The Gawwanko'en are now in the area around Abalak whereas 40 years ago they were in the Chadawanka region.

The Jiijiiru Wayeewa herd animals belonging to Arabs, Twareg, and four large livestock owners from the Tanout area. The jokkere herded by Njapto'en Aadiranko'en are owned by Hawsa from Keita, Busaraaje, Barsanga, Insafari, Wassamana, Barmou and Tanaski. Owners of animals herded by the Bii Korony'en Koron are from the area between Dakoro, Intawila and Chadawanka, and are both owners with large herds and small-scale Hawsa cultivators who have just a few animals. The Bii Korony'en Koron Dassasu have animals belonging to Iberogan from around NgaBullon and Aziza, other Twareg from Marikini (all in the region the Dassasu now use) and to Hawsa from Tabotaki, Dikitan and Wurno (the area the Dassasu used to be in). The Yaamanko'en, who came to the Tamayo area from the east and thus do not have contacta with sedentary people south of where they now are, herd animals belonging to 2nd Group Twareg who are in the region around Abalak.

There are owners with large animal holdings that are herded by many different people. For example there is a well-known owner in Tabotaki who has animals in many herds of the Bii Korony'en, Bii Hamma'en and FulBe Ndowii'en.

Consequences

The modifications of herd management strategies and resource use that occur when WoDaaBe herd large proportions of jokkere belonging to other people rather than their own animals have implications for the immediate productivity of the herd and the long-term viability of the WoDaaBe economy.

Two principal factors account for modifications of strategies. WoDaaBe herding jokkere own and dispose of only the milk of lactating females, not the animals themselves or their off-spring. Herd management decisions are therefore directed primarily toward obtaining maximum short-term milk off-take, and the calf suffers. In contrast, when a WoDaaBe family owns enough animals for its subsistence, these decisions are based on the long-term productivity of the herd as a whole, and the calf gets more milk. Second, as explained above, the number of people that can be supported by a herd composed of jokkere is less than the number of people that can be supported by a herd of the same size composed of animals owned by the herder. A herd management

unit tending jokkere can therefore be faced with a labor shortage necessitating makeshift measures detrimental to the long-term well-being of the herd. An overall increase in the proportion of jokkere in the pastoral zone will reduce the human carrying capacity of the zone, even if the overall number of animals stays the same.

When a family owns enough animals for its subsistence, an important objective of domestic production is the provision of milk for consumption and exchange. However the long-term continuation of this enterprise depends on a careful balancing of immediate needs and the future reproductive capacity of the herd. Animals are not only a direct source of milk but also the herder's only source of revenue to meet all other needs as well as his reproductive capital. Milking therefore involves a complex balancing of different needs. Milk is needed for immediate human consumption and for exchange for cereals. Milk must also be left for the calves' consumption to ensure future milk supplies in the case of female calves and animals for sale in the case of males. If cows are over-milked for immediate consumption, the health of their calves suffers. The herder must have healthy female calves to replace adult cows when they become old, and if he does not have males to market he will be obliged to sell females when he needs cash.

Normally when a calf is unhealthy or if its mother is not producing enough milk, the herder will not milk the mother but leaves all the milk for the calf. If however the herder does not own the animals he is tending, considerations of future production are less important and it is in the interest of the herder to milk more than he normally would.

WoDaaBo herding jokkere are likely to use less labor intensive practices than if they are tending their own animals, both because they are less concerned with the future well-being of a herd of jokkere and because they are more likely to have labor shortages. Herders of jokkere have a tendancy to use boreholes, around which pasture is not good, rather than digging or investing in their own wells from which water has to be drawn by hand. They also tend to be less mobile and are more likely to remain near villages partly because they do not worry about the poor pastures around villages. The owners of the animals often attempt to restrict the herders' movements so they can be

contacted more easily when the owner wants to sell an animal and so he can maintain some supervision of his animals.

The WoDaaBe make different arrangements for their own animals. If a BoDaaDo has only a few animals of his own and an entire herd of jokkere to tend he can put his own animals in the herd of a relative who takes them away to good pasture while he himself remains with the jokkere in the region of the owner's village. Another example is a man in the Cahidooji lineage with five sons who does not have enough animals for the six families dependant on them. He takes on jokkere which are herded by two sons who during the dry season camp in the area around the owner's village and water the animals at the village borehole. The three remaining sons will take the family's own animals further north where there is better pasture and they water at hand dug wells.

The Bii Hamma'en Doosewol, a group that depends heavily on jokkere, spent the entire 1981 rainy season in an extremely small area around Abalak. This limited mobility not only reduces access of the animals to pasture of better quality, but limits the social interaction of the group with other WoDaaBe. Reduced mobility and concentrations of animals around boreholes and villages result in an inefficient exploitation of the resources of the pastoral zone as a whole.

In many different respects, taking jokkere cuts the herder off from his group. The judgement other WoDaaBe make about those who herd jokkere is revealing of the poor management this practice often entails. If the group does not have sufficient animal capital for redistributive mechanisms to operate, the individual must find his own solution outside the group. Taking on jokkere further removes the individual from his group; the WoDaaBe say, "he must follow the kinnal[1] of the Hawsa." He is often near villages rather than with the other members of his group. Other WoDaaBe do not like to camp

---

1. The group of adult herd owners that consults about rainy season camp movements and resource use.

in areas where there are concentrations of jokkere herds because they say the herds are larger and those tending them do not care about the health of the animals.

The mechanisms of group solidarity that are adapted to the constraints of the environment and the high risk of livestock-raising are further undermined because people with a large number of jokkere are excluded from the network of animal loans (either haßBanae or short-term loans of milk cows). WoDaaBe do not like to have their loaned animals in a herd that is tended under less than ideal conditions and worry about their animals being wounded in fights that break out in jokkere herds that have large proportions of males. The project herd demographics study reported in chapter 3.2 showed a clear inverse correlation between herds with haßBanae and herds with jokkere animals.

WoDaaBe political organization and kinship relations are fluid and are based on co-residence and a coordinated use of common resources (Dupire 1975:323). The need to herd jokkere means that WoDaaBe are obliged to obey other constraints, with wide-ranging consequences for the organization of their society.

As with migrant labor, herding jokkere under the conditions now prevailing is a stop-gap measure which WoDaaBe resort to because of an unviable economy. By herding jokkere, WoDaaBe families have been able to remain in the pastoral zone. Over time however it has done nothing to alleviate the fundamental problem of an inadequate capital base. Milk and the cereals that can be obtained from the exchange of milk products are an important contribution to the domestic economy but all other needs must be met from the sale of the herder's own animals.

WoDaaBe take on jokkere only when they do not have enough animals to meet their needs. Therefore their herd, both in terms of absolute numbers and the age/sex structure is usually already below the threshold necessary for it to grow at an adequate rate. Since the herder can not sell jokkere he is still obliged to market his own animals to meet cash needs, further diminishing his reproductive capital.

The case of a herder from the Gawwanko en fraction of the Gojanko en is not a typical. In 1974 after th drought he had four cattle left. He managed to obtain a herd of thirty jokkere to tend But because the milk of these animals was not sufficient to meet all of the needs of his household he gradually had to sell his four animals to buy cereals and other necessities Since the drought he has received five haBBanae loans but has had to sell all of their off-spring to meet his cash needs.

There are other needs for animals for which jokkere cannot be substitued because they are not the property of the herder. When a man's wife comes to live in his camp he should have three animals of his own to show her that she will milk and that along with their off-spring will be inherited by her children. In some WoDaaBe groups a man should give an animal to his father-in-law. There should be three bulls to slaughter for a marriage, and an animal to be slaughtered at the name-giving ceremony of each child born. A man must be able to allocate animals for the nucleus of his sons' future herds; the obligation to provide these animals is not merely a social nicety, but is an imperative for the material reproduction of WoDaaBe society

It is important to distinguish between animals being held as an investment, as jokkere herds are, and herds upon which the owners depend for their subsistence. The WoDaaBe have no other source of revenue so they are continually obliged to deplete their herds which must be of a minimum size and age/sex structure if biological reproduction is to compensate for sales and deaths. This threshold varies because it is determined by the number of people dependent on the herd, but once the herd drops below the threshold (as most WoDaaBe herds did after the last drought), a downward spiral begins which it is difficult for the herder to remedy. Herding jokkere does little to build herds back up beyond the threshold.

Jokkere herds increase at a faster rate than those of herders because they are not being drawn on for subsistence (apart from milk off-take). Their owners normally have revenues from other sources: agriculture, salaries, commerce. Even if the productivity of jokkere herds is reduced because of over-milking or less than optimum management, livestock is nonetheless a good investment. The owner has no labor or forage costs so reproduction and the weight gain of animals as they grow are pure profit. Investors with other sources of income can afford to hold animals until the optimal time for marketing.

Herders are well aware that they get the highest prices from males when they have reached their maximum weight at the age of five or six years. When WoDaaBe have an adequate herd it is males of this age that they sell. But since the drought few herders have a reserve of adult males and are obliged to sell other categories of animals. A male calf's weight increases rapidly over the first five years. Although its market value is low in its first year or two it rises rapidly thereafter. A herder faced with pressing cash needs however is obliged to sell a young male if he has no other animals besides reproductive females, the sale of which would be even more detrimental to household production.

Calf mortality is highest in the first year and then drops sharply. Calving, caring for young calves and weaning are operations that require considerable supervision on the part of the herder. After the first year, holding an additional animal in his herd while it gains weight does not demand much additional labor or involve forage costs. It the herder sells a male in its first one or two years he carries the high risk of mortality in the first year and the relatively high labor input of the cow-calf operation, without profiting from the animal's subsequent weight gain. This is however what large numbers of herders in the pastoral zone are forced to do currently because of poverty. For herders, these sales are the result of poverty. But the sales provide excellent investment opportunities for people with capital who can buy the young males at a low price and keep them in the bush at no cost through the jokkere system until their value has increased considerably.

Periods of acute difficulty for herders offer the best conditions on the market for investors, and continuing poverty of herders assures a supply of young males for investors. In 1973 cereal prices were extremely high and markets were flooded with animals. Merchants and others bought animals at such low prices that although many died, if they were able to save some by feeding them supplements or taking them south to keep them alive until the 1974 rains, they were able to make huge profits because of the sharp rise in animal prices after the drought.

(4) Structural changes in the WoDaaBe economy

Theoretical poverty threshold

The processes described above appear to be undermining the long-term viability of the WoDaaBe economy and society, transferring income and wealth from poor herders to rich urban and village people, and reducing the overall economic and ecological productivity of the pastoral zone. The precise impact cannot yet be quantified, and it is certainly not evenly distributed throughout the WoDaaBe economy. However some quantitative estimates of the key processes are appropriate. The following calculations are based on mean parameters from the production systems research on the WoDaaBe economy described in earlier sections; to what extent they are representative of other pastoral production systems in the project zone is not known.

The model follows the mean WoDaaBe production unit described in the budget section above: it contains 8.9 people and disposes of a herd of 38 cattle; these may be owned or loaned (haBBanae) If more than a few of the cattle are entrusted (jokkere), the basic parameters change since their calves cannot be sold by the herder. The minimum daily calorie requirements of this production unit are assumed to average 2,000 kcal/person/day throughout the year except in the hot season when they rise to 2,250 kcal.

Using the empirical herd structure and dynamics parameters for the WoDaaBe economy as reported in chapter 3.2 (40.5 percent reproductive cows, 65 percent calving rate, 60 percent of calvings in the transition and early rains and the rest in the late rains and cold season), and milk production according

to lactation stage and season (using the figures in table 4.2.11 as a guide) estimated milk production from a herd of 38 cattle is shown in table 4.2.44. It is assumed that no milk is sold or exchanged, and that all cereals are bought at market; WoDaaBe seasonal cereal inflows to the sample households, shown in table 4.2.14, are used to construct the model. Using these figures, table 4.2.44 shows the seasonal nutritional profiles of the model production unit.

Table 4.2.44 Seasonal calorie coverage from different sources in model WoDaaBe production unit

	Daily requirements and coverage (kcal and quantities) in season:				Year
	rains	cold	hot	transition	
Estimated requirements	2,000	2,000	2,250	2,000	750,750
Food intake:					
Milk:					
- liters	(2.1)	(1.4)	(0.4)	(0.5)	(400)
- kcal/person[1]	1,680	1,120	320	400	320,320
Cereals:					
- kg	(0.18)	(0.44)	(0.31)	(0.37)	(119.4)
- kcal/person[2]	630	1,540	1,085	1,295	417,900
Sugar:					
- kg	(0.05)	(0.05)	(0.03)	(0.03)	(14.19)
- kcal/person[3]	180	185	115	126	54,915
Total kcal intake	2,490	2,845	1,520	1,821	793,135
Estimated coverage (% of requirements)	125	142	76	91	106

Notes:
1. Energy value of milk: 800 kcal/liter.
2. Energy value of cereals: 3,500 kcal/kg.
3 Energy value of sugar: 3,870 kcal/kg.

Table 4.2.44 shows that the model production unit covers its estimated calorie requirements in the rains and cold season, but fails to cover them in the hot and transition seasons; over the year as a whole the model production unit just covers its requirements. However, the deficits would suggest that the WoDaaBe would lose weight in the hot and transition seasons, and in fact the nutrition survey reported earlier in this chapter found weight losses at this time.

Table 4.2.45 summarizes the percentage contribution of food from different sources to total calorie intake in the model production unit. Over the year as a whole, milk accounts for an important proportion of total calories, and in the rains, rises to 67 percent of the total. Cereals account for a quarter of calories intake in the rains, rising to 71 percent in the hot and transition seasons. Sugar, drunk in tea, contributes 7 percent during the year as a whole.

Table 4.2.45 Sources of food intake in WoDaaBe model production unit

	Percent of calorie intake by origin				
	rains	cold	hot	transition	Year
milk	67	39	21	22	40
cereals	25	54	71	71	53
sugar	7	7	8	7	7
Total	100	100	100	100	100

The model production unit's total annual millet requirements are 1,100 kg or 120 kg/person. At an average year-round millet price of 135 CFA/kg, the production unit's annual expenditure on millet is 150,000 CFA. The model production unit's herd of 38 cattle has estimated yearly sales of 3 young males aged 1 - 2 years, each worth 25,000 CFA, and an old female worth 70,000 CFA. Total annual income from sales of animals from the herd is thus 145,000 CFA, which covers millet purchase.

This model WoDaaBe production unit is thus able to cover its nutritional requirements, but has no surplus income for other necessary purchases such as clothing, inputs to herding or other consumer goods. It can increase its income to cover these extras by exchanging some of its cold season milk for millet (thus reducing cash spent on cereals), by herding additional small stock, or by migrant labor to reduce the production unit's total calorie consumption. However the relation of resources to people in the model production unit described is clearly close to the minimum required for autonomous pastoral production under present conditions in the project zone, and may be described as the pastoral poverty threshold. In the conditions described, it corresponds to a level of 4.3 cattle/person, or 3 TLU/person.

The age at which the production unit sells its male cattle is an important determinant of the production unit's income. If instead of selling them at 1-2 years it sells them at about 4 years, at 80,000 CFA each, and allowing for two additional years of mortality risk of 4 percent a year, its total sales income rises from 150,000 to 291,000 CFA. This allows the production unit not only to cover its millet needs but also its other requirements.

However empirical observations in the project zone, described in the household budget section earlier in this chapter, show that WoDaaBe herders are not able to take advantage of this sale of their male animals at an optimal age, but are being obliged to sell their males very early. Of 65 male cattle sold by WoDaaBe socio-economic sample production units during the 1981-82 survey period, only 25 (38 percent) were aged over 3 years, while over half were aged 1 - 2 years. During the same period, more than half of the 59 females sold were calves, heifers or reproductive cows, indicating economic pressures on herders that jeopardise the future reproduction of the herd. These reproductive females are sold because of lack of suitable males: in the WoDaaBe sample, more than half the households had no more than two males over one year old in their herds.

Taking the ratio of 3 TLU/person as a poverty threshold, table 4.2.46 shows the proportion of people in the WoDaaBe household production sample, as well as two Twareg samples, who are below this threshold, as well as the proportion below a threshold of extreme poverty set at 1 TLU/person.

Table 4.2.46 Poverty in WoDaaBe and Twareg samples

		Percent of people in production units with TLU/person ratios of:		
	Number of people	< 1	1 - 3	Total < 3
Twareg:				
-sample A	(145)	23	34	57
-sample B	(182)	23	53	76
WoDaaBe	(131)	16	73	89

Note: For the detailed herd distribution tables for these samples see the annex to this chapter.

These calculations suggest that about 90 percent of the WoDaaBe in the project zone are below the poverty threshold, and that 10 percent of WoDaaBe are in extreme poverty.

(5) Conclusion: the WoDaaBe economy in a downward spiral?

The argument concerning the transformation of the WoDaaBe economy presented above can be summarized briefly.

Following significant losses in the drought of the early 1970s the national livestock herd is partly reconstituted to pre-drought levels in the case of camels, sheep and goats, although cattle totals are still estimated at less than their pre-drought numbers. However the distribution of these animals has changed, both in terms of geographical zone and of owners: a much

larger proportion of the total animal population is in the southern farming zone than before the drought, and there has been a significant increase of ownership of animals, especially cattle, in the pastoral zone by non-herders (farmers, civil servants and traders). As a result of these changes in the distribution of herds, a substantial number of herding households, especially WoDaaBe, have not been able to rebuild their herds to viable pre-drought levels, and are operating with herds below the minimum capital level required for self-sufficient pastoral production.

Herding households live from a mixed diet of milk (usually no more than 25-40 percent of total annual calorie consumption) and cereals (the source of almost all the remaining calories) which they get by exchanging milk and selling animals, especially old females and young males. It is in herders' best interests to sell these males at 3 to 6 years, when their value, discounted by the risk of mortality, labor and other costs, and the opportunity cost of holding them rather than selling them, is at its highest.

The generally low level of household herd sizes obliges herders to sell increasingly younger males and even females of reproductive age, depriving the household of the benefits of the rapid increase in value of these animals over their first few years of life. Herders now have to sell their males at 1 or 2 years, having carried the high risk of mortality in the first year; and the low value of these animals obliges them to sell more of them to meet their fixed cereal needs, thus accentuating the downward spiral of herd decapitalisation.

Pastoral households with insdequate and declining herds have to respond by getting more milk or more cereals. In WoDaaBe (and also Twareg) society, traditional mechanisms exist to provide lactating cows to poor households to supply them with milk and in some cases, such as the WoDaaBe <u>haBBanae</u> transactions, with calves as the nucleus of an increase in herd capital towards a more sustainable level. However, although such transactions still function, too many pastoral households are now too poor for such traditional mechanisms to be able to solve the problem alone.

Where herding households are unable to increase the amount of resources (animals or cereals) at their disposal, they can reduce the demands made on those resources by selective seasonal labor emigration. Herders go on labor migration not so much to earn large sums of money - few of them manage to do this - but to reduce cold and early hot season cereal consumption, thus reducing the need to sell animals from an already insufficient and declining herd.

With increasing numbers of animals belonging to non-herders, there are increasing possibilities for herders to take on entrusted animals from the new owners who want them kept in the pastoral zone. The traditional rules for this, which rewarded the herder with milk and a young animal from time to time, have been undermined by the presence of large numbers of poor herders competing to take on entrusted animals because there is no other option open to them. This is particularly true of the WoDaaBe. Among the Twareg, the traditional social hierarchy and the numerous links to relatively wealthy Twareg outside the herding economy have maintained somewhat better entrustment conditions. But in neither case does animal entrustment provide the basis for rebuilding herds, since in the commonest form of contract the only reward is milk; herders with entrusted animals may be able to exchange some of this milk for cereals, but have still to sell their own animals to buy most of the cereals on which they subsist for most of the year.

Traditional loans and gifts of animals are an effective way of reconstituting household herds that are below the minimum necessary for subsistence from within the resources available to small groups of herders themselves. Because the transactions take place betwen kin and friends they are accurately targetted to those in real need and are fully repaid; they thus represent a continuous and optimal reallocation of livestock capital within small groups to ensure that no household is forced out of the economy by lack of capital as long as there is some surplus to subsistence requirements somewhere in the group.

The disadvantage of these traditional mechanisms is, first, that they cannot solve problems of animal capital shortage when the group as a whole has too few animals (although among the WoDaaBe at least they continue to operate even in situations of extreme proverty), and, second, that since such animals are managed according to production herd principles (sale of young males and old females) with a maximum overall growth rate of 2 or 3 percent per annum, they cannot compete with the growth in numbers of animals belonging to non-herders, which are managed according to investment herd principles (sale of males at profit maximising age for reinvestment in females, buying in males and females which have survived the high mortality of the first year), with an annual growth rate of 15 percent or more.

The fact that many WoDaaBe (and also Twareg) households in the pastoral zone now have herds at or below the minimum needed for autonomous pastoral production also has a negative effect on traditional animal transfer mechanisms designed to provide new households with the minimum animal capital needed to start life as independent units. The nucleus of this herd in both WoDaaBe and Twareg economies is a heifer given to children shortly after birth; this and its descendents are managed according to investment herd principles - animals are only removed from the herd to be replaced by reproductive females - for maximum growth. Pressure for sales to meet cereal and other requirements on household herds below the subsistence minimum lead to parent households eating into this essential future capital stock of successor households. The result is a progressive undermining of the fundamental process by which the pastoral economy reproduces itself over time.

Labor migration as a way of avoiding distress sales of animals has as its main direct economic disadvantage the fact that it often leads to absences in the hot season, a time of high labor demand for watering. Although many migrants try to return in time to contribute to hot season watering, the absence of some adults leads to the adoption of different watering strategies, for example the grouping of herds and their watering at boreholes with an accompanying reduction in forage availability and increased disease risk as compared to a more labor intensive strategy of herd division and watering at deep traditional or shallow sand wells. It is likely that this results in lower production in such herds.

There are also important social consequences of regular labor migration of adult men and women. Families are broken up for long periods, small children may not get proper care, and new diseases are brought into the community.

The system of animal entrustment lowers the productivity of the pastoral zone in the following ways:

(a) In the form practiced among the WoDaaBe and some Twareg, the herder'a only reward is milk. There is thus an incentive to the herder to overmilk cows, at a cost to calf nutrition and survival, since the herder gets no benefit from the calf. Calf mortality among entrusted animals can be expected to be higher than among owned animals.

(b) Since non-herders manage their herds according to investment principles and as a store of wealth, do not pay real labor costs, and, unlike herders, are not obliged to sell males to buy cereals, they hold onto males until they are older in order to profit to the maximum from the value added in the animals' growing years. Destocking of young males at an ecologically, and from the herder's point of view economically, optimal age is not achieved. More generally, since investors' herds grow at 15 or more percent per annum, as compared to herders' 2 or 3 percent, pastoral zone feed resources are more rapidly exhausted, and the flow of animals for traction and fattening in the south is slowed down.

(c) Since little milk is produced in the dry season, there is little incentive for herders to work harder at watering and pasturing in this season. Herders with larger numbers of entrusted animals are more likely to water them at boreholes and pasture them nearby in the dry season, as compared to herders with their own animals who prefer to water at traditional deep wells or shallow sand wells, to avoid the confusion and disease risk of boreholes and their overgrazed pastures. As a result, entrusted animals risk greater dry season weight loss, lower cow fertility and higher mortality than owned animals. Vegetation and soil degradation around boreholes is increased.

(d) The owners of some animals entrusted to herders like to be able to visit the animals and insist therefore that they be kept at a reasonable distance from their village or town, thus reducing the herders' migratory movements and flexible ecological strategies, increasing risk to them, and increasing also the likelihood of environmental damage around villages.

(e) Because herds containing entrusted animals are managed less well than owned animals, other herders are reluctant to make traditional animal loans to herders who have entrusted animals in their herd. Herders who accept entrusted animals are excluded from the pastoral society's own herd reconstitution mechanisms.

(f) With increasing numbers of entrusted animals, which herders cannot sell since they do not own them, rapid destocking in the event of a drought becomes more difficult.

The cumulative effect of these processes on the WoDaaBe economy is a progressive replacement of animals owned by herders by those owned by non-herders, an increase in the average age of sale of males, a reduction in the overall productivity of the livestock present in the pastoral zone, a downward spiral of economic viability of pastoral households, destructive social processes triggered by large scale seasonal absences, a further undermining of the pastoral society's own self-help and insurance mechanisms, a progressive reduction in the ability of the economy to guarantee the minimum herd capital for new household formation, increased pasture mismanagement and environmental damage in the pastoral zone, and an increased vulnerability to drought on the part of households operating with diminished and below subsistence herds of their own and entrusted animals which they cannot sell.

Annex to Chapter 4.2

Herd distribution in project socio-economic samples

Table 4.2.47 Herd distribution in Twareg sample A (a strong hierarchically-organised group, dominated by "noble" and ex-slave classes).

No. of TLU/person	Households		People		Total TLU	
	No.	(%)	No.	(%)	No.	(%)
< 1	12	(34)	33	(23)	14.8	(2)
1 - 3	11	(31)	50	(34)	98.8	(15)
3 - 5	-		-		-	
5 - 10	9	(26)	46	(32)	330.5	(50)
10 +	3	(9)	16	(11)	214.3	(33)
Total	35	(100)	145	(100)	658.4	(100)

Note: TLU calculated as: camel (1), cattle (0.7), sheep and goats (0.1), donkeys not added in.

Table 4.2.48 Herd distribution in Twareg Sample B (less hierarchical marabut class).

No. of TLU/person	Households		People		Total TLU	
	No.	(%)	No.	(%)	No.	(%)
< 1	6	(16)	42	(23)	27.3	(6)
1 - 3	20	(53)	96	(53)	181.3	(40)
3 - 5	7	(18)	28	(15)	110.5	(24)
5 - 10	4	(11)	13	(7)	92	(20)
10 +	1	(3)	3	(2)	41.8	(9)
Total	38	(100)	182	(100)	452.9	(100)

Table 4.2.49 Herd distribution in WoDaaBe socio-economic sample (no traditional social hierarchy).

No. of TLU/person	Households		People		Total TLU	
	No.	(%)	No.	(%)	No.	(%)
< 1	2	(13)	21	(16)	11.7	(4)
1 - 3	11	(73)	95	(73)	200.4	(75)
3 - 5	2	(13)	15	(11)	53.8	(20)
5 - 10	-		-		-	
> 10	-		-		-	
Total	15	(100)	131	(100)	265.9	(100)

4.3 THE TWAREG

HISTORY AND SOCIETY

Migrations

The Twareg, as we know them today, are comparative newcomers to the Sahel. Their language, Tamajaq, is a dialect of Berber, indicating their historical association with northern Africa; and it is generally supposed that prior to the Hilalian Arab invasions of the 11th century onwards most of the Twareg were found along the northern edges or in the centre of the Sahara. It was these Arab invasions which effectively pushed the Twareg south.[1]

For the Nigerien Twareg there were two major areas into which their ancestors migrated and from which they subsequently moved still further south - the Adghagh-n-Ifoghas (of northeast Mali) and the Ayr Massif - and it is largely in terms of these two mountainous transition zones that one can describe the migratory history of most of the contemporary Nigerien Twareg population. The Adghagh was once the home of the Iwllemeden and Tengeregedesh, while Ayr was the fulcrum around which the Kel Gress, Kel Ferwan, Kel Fadey, Ikazkazan, and Kel Owey migrations took place.

Before 1000 AD there appear to have been only two major Twareg groups in the Ayr Massif, the Iberkoreyen (whose modern descendants include the Ayt Awari and the Kel Aghlal) and the Igdalen. Quite early on, however, the Iberkoreyen began moving out of Ayr and into the Tchin Tabaraden area; the Iberkoreyen claim to be the original Twareg inhabitants of what is now referred to as the Kel Dinnik zone is clearly consistent with their migration history. The Igdalen, too, did not remain in the Ayr Massif itself but migrated southwestwards, towards Agadez and even further south and west. Both groups appear to have moved into areas which were largely uninhabited and certainly underutilised.

---

1. The literature review in this chapter relies heavily on the work of Bernus (1974, 1981), Bonte (1970, 1975, 1976), Baier (1980) and Oxby (1978).

Previous Page Blank

These early Iberkoreyen and Igdalen migrations out of Ayr appear to have been provoked by the movement of Itesen and Liaawan, in turn, into Ayr during the 11th century. On the basis of this, it is likely that the Itesen and Lisawan were the first Twareg to begin a series of southward moves from the Sahara. In the next two centuries they were joined in Ayr by the Kel Gress and Kel Owey, both groups again coming in from the north. The next set of Twareg migrations into Ayr occurred during the 14th and 15th centuries when the Kel Ferwan and Kel Fadey moved into areas west and north of the Massif. These "medieval" movements were followed by the last major migration, that of the Ikazkazan and other related groups, in the 16th century.

By the end of the 16th century, then, the Ayr region was occupied by a relatively diverse Twareg population. The various confederations - Kel Owey, Kel Gress, etc. - recognised in principle the authority of the Sultan of Agadez (an office created at the beginning of the 15th century): in practice the real power of the Sultan was severely restricted. Whatever the political configuration might have been at the time, there can be little doubt that there was considerable tension between the various Ayr groupings; and that the conflicts which inevitably broke out led to a new set of migrations, this time out of Ayr. Between the 17th and 18th centuries, several Twareg groups moved south again. The Lisawan migrated into the Ader during the 17th century; and, at about the same time the Immuzareg and Lisawan exodus was followed, in the 18th century, by the Kel Gress and Itesen move into Ader and well into the agricultural zone.

Even among the groups remaining in the Ayr region, the period was one of grographical flux. While the Kel Ferwan moved into the areas to the immediate south of Ayr, the Kel Fadey gradually moved southwest, establishing themselves on the northeastern boundaries of Kel Dinnik territory. In fact, most Twareg left Ayr, leaving only the Kel Owey in the Massif itself.

We have seen that for most of the eastern Twareg, Ayr was the central focus of their migrations and emigrations. The western Twareg, on the other hand, began their migrations from the Adghagh-n-Ifoghas, a mountainous region in northeast Mali. Prior to the Moroccan invasion of 1591, most of the

western Twareg were to be found in the Adghagh, effectively held there by Songhay military power. With the defeat of the Songhay in 1591 and the Moroccan capture of Timbuktu and Gao, however, the Twareg were no longer so restricted. The first major move out of the Adghagh occurred around 1654 when the Tadmakket moved west towards Timbuktu, following a feud with the other main group in the Adghagh, the Iwllemeden. The latter, in turn, left the Adghagh around 1690, moving south into the Gao and Niger Bend areas, attracted, no doubt, by the prospect of easy pickings among the demoralised Songhay and the better pastures of the south.

From this main Iwllemeden block derive most of the western Twareg of Niger. At the end of the 17th century a succession dispute within the Iwllemeden confederation resulted in the eastward migration of several groups, headed by the Kel Nan, into the Azawagh and beyond. These Iwllemeden became known at the Kel Dinnik (People of the East) in order to distinguish them from their western kin, the Kel Ataram (People of the West). The Kol Dinnik migration took them into a zone already occupied by the Iberkoreyen and Igdalen, over whom the Iwllemeden imposed their political domination, although not without considerable resistance.

Further west still, around Tera and Ayorou, other Iwllemeden sub-groups drifted away from the confederation's heartland. On the right bank of the Niger (known as the Gurma) the Tengeregedesh, Loghomoten and Dufarafarak had established more or less independent status by about 1830. On the left bank, around Ayorou, the Kel Tahabanat established themselves.

Since the mid-19th century the geographical distribution of the Nigerien Twareg has remained, in broad terms, unchanged. The last 180 years have been in marked contrast to earlier centuries when migratory mobility was perhaps one of the distinctive features of Twareg society. This is not to say that there have been no changes in the spatial configuration of the Twareg - there have certainly been minor adjustments - but to merely indicate that, for whatever reason, mobility on a massive scale has ceased to be an integral part of the Twareg social system.

Society and geo-politics

The preceeding section has provided a brief description of the migration history of the Nigerien Twareg, largely in terms of major confederations such as the Kel Dinnik or Kel Gress. In this section we turn to a description of Twareg society, attempting to make clear what is being discussed when groups like the Kel Dinnik are mentioned.

For the moment the description concentrates on traditional social structure; the next section deals with some of the changes that have taken place since the turn of the century. It is stressed, however, and despite the changes of the last 80 years, that a broad understanding of traditional Twareg society is essential for any analysis of contemporary economy and society among the Nigerien Twareg.

In describing traditional Twareg society it is convenient to draw an analytical distinction between three "systems": the status system, the tawshit system and the ettebel system. The three systems are not, however, operativel, distinct, but are largely interdependent of each other.

First, the status system. Nigerien Twareg society is constructed out of a series of different social groups. Each individual in Twareg society belongs to one of these social groups, and only one: they are unambiguously exclusive. Just as Twareg society can be divided into male and female, young and old, so too can it be divided into a variety of social taxa. These social groups, moreover, are arranged in s hierarchical fashion, so that some are of higher ststus than others.

At the apex of this social pyramid are the imajeghen. The centrality of the imajeghen to Twareg society is shown by the fact that the name of the Twareg language, Tamajaq, is a derivative of the word amajagh, singular of imajeghen. Tamajaq is the lsnguage of the imajeghen. The imajeghen are the warrior aristocracy of Twareg society and to them accrues the most social prestige.

Beneath the imajeghen come the ineslemen and imghad. The ineslemen are of a religioua standing, as their name suggests: an-islem (sing.) means, literally, "of Islam". In French the ineslemen are often described as marabouts. There is, in fact, considerable variation among the ineslemen populations; some are undeniably of a learned and literate Islamic tradition, others much less so, and still others barely discernible as Muslims. Whatever their differences, they all remain nonetheless, ineslemen. In Niger, and particularly among the Kel Dinnik, the ineslemen may also be referred to an imazwaghen.

The imghad are of lower status than the imajeghen. The literature on the Twareg haa a tendency to deacribe the imghad aa "tributary vassals" to an imajeghen aristocracy, thus making an explicit comparison with feudal society. The status of the imghad, however, appears to vary from place to place. In the Gurma, for instance, Loghomoten imghad enjoy a high status while among the Kel Ayr groupings they are of relatively low status. Whatever the regional variations in the standing of the imghad, they are inevitably lower in statua than the imajeghen but higher than most other groups.

Below the imajeghen, inealemen, and imghad are a variety of lower status illelan, or free, status groupa. Of these, the most easily described are the inadan or artisans. The inadan form, for all intenta and purposes, an occupational caste: the men are blacksmiths, woodworkers, jewellera, the women leather workers. Other groups are of a similarly low but free status. The Iboghileyten, for example, are of mixed illelan and slave origin. The Iheyewan are another such group, neither ineslemen nor imghad but certainly not servile. These many low status illelan groups have never really been adequately described in the literature and, in many cases, have been classified as imghad, despite the fact that this categorization is manifeatly inaccurate. It is clear that groups such as the Iboghileyten and Iheyewan are of lower status than the imghad

The final seriea of status groups we describe here gradually shade into the slave category. First, the ighawellan ("dont l'affranchissement se perd dans la nuit des temps" Bernus 1981:75). The ighawellan, who are particularly numerous among the Kel Gress, are ex-slaves, long freed by their masters. Of much the same status as the ighawellen, but still often referred to as eklan, are the iderfan; their only difference to the ighawellan appears to be that they have been more recently emancipated by their masters.

The final status group are the eklan. The distinction between illelan and eklan, between the free and the unfree, is fundamental to Twareg society. Eklan are the descendants of slaves captured in the pre-colonial past, a time when the more mobile Twareg could raid neighbouring sedentary populations and seize captives. Eklan, unlike illelan, but like cattle, could previously be owned; a concomitant to their being property was that eklan were also inheritable. Their position as slaves made the eklan the lowest status group in Twareg society. For Niger there are two main categories of eklan, eklan-n-egef (slaves of the dune) and, on the other, ordinary camp eklan. The eklan-n-egef appear to have enjoyed a de facto position akin to that of the iderfan and ighawellan, despite the fact that they remained full eklan. The ordinary camp eklan, however, are of unambiguously low status and unprivileged position.

The following table provides a very brief summary of the Twareg status hierarchy in central Niger. The particular terms used most commonly in the major confederations are noted.

Table 4.3.1 Twareg status terms by confederation

	Kel Dinnik	Kel Gress	Kel Ayr (Kel Fadey, Kel Ferwan)
aristocracy	imajeghen (1%)	imajeghen (5-8%)	imajeghen
religious groups	imazwaghen, ineslemen (25%)	ineslemen (few)	ineslemen
vassals	imghad (2.5-3%)	none	imghad
low status illelan	inadan (3%) iboghileyten iheyewan Debbakar	inadan (3-4%) none	inadan iboghileyten itagan izelitan
emancipated slaves	iderfan (32%)	ighawellan (75-80%)	
slaves	eklan (36%)	eklan (10%)	eklan

Note: Figures in brackets indicate, wherever known, approximate percentages of total population for each status category.

As can be seen from the Kel Dinnik and Kel Gress data, the imajeghen, ineslemen, amd imghad are usually minority populations; in contrast, the ighawellan/iderfan amd eklan account for well over 60 percent of the total population in both confederations. For the Kel Ferwan and Kel Fadey the data do not exist to provide a status breakdown for the population; from what evidence there is, however, the Kel Ayr groups appear to be much the same in having a very small imajeghen population, but with few ineslemen and many more imghad, and, in all likelihood, a majority eklan population.

The tawshit system is articulated within the status hierarchy. There are two levels at which the concept of tawshit operates. At its highest level tawshit refers to a status group in its entirety, for example the imghad as a whole. Thus if one asks a Twareg what his tawshit is, his initial response will usually be to state his status. The next, and lower, level at which tawshit operates is in distinguishing between the constituent groups within each status category. Thus further questioning of, say, an amghid will reveal that he is of, for example, the Illabakan. A tawshit (tiwsatin pl.) is fundamentally modelled in the idiom of kinship, both at its minimal, and to a lesser extent, maximal levels. At the level of a named group within a status category the tawshit is seen as being a descent group, made up of people who claim common descent from a given ancestor; this claim to common ancestry is, of course, largely putative and few tiwsatin can provide complete descent genealogies. The Illabakan tawshit (one of the imghad groups among the Kel Dinnik) for instance, consists of several hundred individuals, the vast majority of whom claim descent from the eight children of Goza and the four sons of Ntadu, who were, in turn, close kinsmen. The logical consequence of a tawshit being portrayed as a descent group is that all members of a tawshit can claim to be kinsmen and kinswomen.

At its higher operative level tawshit is less directly of a kinship nature. It is, however, legitimate for members of, say, one imghad tawshit to claim members of other imghad tiwsatin as their kin. This usage of tawshit appears to be especially frequent among the imajeghen and imghad but even among them it is often explicitly recognised as being an idiom of similarity and solidarity. To a certain extent, then, this upper level use of tawshit represents a fusion of status and kinship.

For present purposes the important feature of the tawshit system is that it defines the constituent groups within a status category. The following list provides some examples of Kel Dinnik tiwsatin according to status:

imajeghen: Kel Nan, Tiggirmat, IXerXeren
ineslemen: Ayt Awari Seslem, Kel Eghlal, Ikaradaman
imghad: Illabakan, Inamagrawan, Ibadaydayen
iderfan: Taghed Bahu, Iderfan.

Two status groups, the inadan and eklan, only rarely have constituent tiwsatin. Eklan, by dint of de jure ownership, belong to the tawahit of their masters; thus an akli belonging to an amajagh of the Kel Nan will claim his tawshit as being Kel Nan although it is clear that his identity has not been determined by descent from the Kel Nan's imajeghen ancestors. Inadan, equally, can claim membership in the tawshit with which they are economically associated; otherwise they will refer to themselves simply as inadan.

Taken together the status and tawshit systems provide a structure within which individuals can be located: a Twareg is always of status x and tawahit y. The location of people within this structure is almost entirely determined by considerations of kinship. For most people their status and membership in a particular tawshit are conferred through patrifiliation: the son of an Illabakan man is also of the Illabakan and therefore of imghad status. The major exceptions to this principle of patrifiliation are the eklan for whom status is usually matrifillially inherited: the son of a slave woman (and, in theory, regardless of his paternity) was also a slave; moreover, he belonged under traditional rules to the owner of his mother.

An important feature of the social structure so far described is that the various social strata tend to be endogamous. The imajeghen, usually only marry other imajeghen, imghad other imghad and so on. Status endogamy has the crucial consequence of limiting kinship relations within status groups, thereby reinforcing the notion of, say, all imghad, regardless of their individual tawshit membership, being kinsmen. Status, thus not only confers a social position within the overall structure but also defines an

in-marrying group. The Twareg themselves explain status endogamy on the grounds that a person should only marry someone "like" himself or herself, which is to explicitly stress the differences between status groups. As later sections explain, endogamy also serves important ends, inevitably related to the maintenance of a particular kind of political economy.

Before moving on to a discussion of ettebel, it should be pointed out that the preceding descriptions of status and tawshit are highly generalised and subject to considerable local variations. Thus, among the Kel Gress, a tawshit usually consists of a set of imajeghen families, their eklan and, in addition, their subordinate ighawellan; the Kel Gress tawshit does not correspond to the descent stereotype as described above. But despite these regional variations the main point remains true for all Twareg: Twareg society is structured out of two inter-related modes of organisation, on the hand status, and on the other kinship. It is the inter-articulation of these two modes of social organisation which makes Twareg society the distinctive system that it is.

Ettebel signifies several things at one and the same time. Literally translated ettebel is a drum. The drum, in turn, is the major symbol of political authority as held by an amenokal or chief: for each Twareg ettebel there is a corresponding amenokal. In Niger, ettebel is limited exclusively to the imajeghen; strictly speaking, only a man of imajeghen status can be an amenokal. The drum, moreover, is restricted to only certain imajeghen tiwsatin. In central Niger the imajeghen tiwsatin to which drums are attached are as follows: for the Kel Dinnik, the Kel Nan; for the Kel Gress, the Tatamagarett; for the Kel Ferwan, the Irawattan; and for the Kel Fadey, the Ighalwen.

Ettebel also signifies a relationship. To be ettebel to a tawshit demonstrates, depending on circumstances, a relation of political subordination. Attached to the Kel Nan ettebel are several other imajeghen tiwsatin and a host of other lower status groups, all of whom recognise the chief of the Kel Nan as supreme political leader of the Kel Dinnik confederation. In practice, and even in his heyday, the Kel Nan chief was probably little more than a war leader, a focus of military solidarity for a geo-political unit known as the Kel Dinnik. Within a drum-group, as some of these Twareg confederations are known, the imajeghen tiwsatin occupied a pre-eminent political position, the tawahit invested with the drum itself being more of a primus inter pares than anything else. Subordinate to these imajeghen, and informally parcelled out among them, were all the other groups of the confederation. This subordination to the imajeghen took two main forms. At its most formal this relation of dominance was expressed by the annual payment of tiwse, or tribute, to the imaheghen. Tiwse was paid in several forms: as livestock, in slaves, in leather tents etc. In addition, the imajeghen could rely upon their "right" to practise tarkept, an informal appropriation of wealth and subsistence from their political subordinates; from what is known of these arrangements it would seem that specific imajeghen lineages would live off a set off tiwsatin recognised as being "theirs". In return for the material support obtained through tiwse and tarkept the imajeghen of a confederation were expected to provide protection and military leadership for their clients, a function that has been responsible for the feudal motif which so often occurs in the literature on the Twareg. The individual imajeghen tiwsatin were also responsible for protecting their individual clients from the predatory attentions of other imajeghen within the confederation.

For the most part ettebel relations characterise the political organisation of the illelan tiwsatin. Alongside this structure there were also a series of relationships between iderfan/ighawellan and their respective patrons. Thus ineslemen could expect a regular tributary payment from the groups of slaves to whom they had granted freedom. One should also add here that most of the higher status illelan owned slaves and that the eklan therefore also made contributions to their masters, in the form of both labour and products.

What emerges from this brief description of the ettebel system is that the Twareg confederation or drum-group was essentially a political organisation at the head of which were the imajeghen. In return for the military services they provided, the imajeghen were able to extract surplus from their political clients (together with what they obtained from their own eklan) who, in turn, extracted a surplus from their economic clients. Seen in such a way ettebel provides us with the series of relationships between status groups and tiwsatin as they were described earlier.

To complete this section, a brief description of the Kel Dinnik confederation, the most important Twareg group in the project area, will be provided. The Kel Dinnik are one of the most populous confederations in the Sahel, currently numbering some 70,000; they occupy a huge territory, from Telemses in the west to Ingal in the east, from Tahoua in the south to the southern fringes of the Sahara in the north.

The area appears to have been first occupied by Iberkoreyen and Igdalen, who moved into it from the 11th century onwards. Despite raids from the west these original Azawagh Twareg, who were of ineslemen status, maintained political independence until the arrival, from the early 18th century onwards, of the Iwllemeden. The Iwllemeden, properly speaking, are imajeghen, divided up in central Niger, into five main tiwsatin: the Kel Nan, Tiggirmat, IXerXeren, Irreulen, and Tellemidez. Following the death of their chief Karidenna around 1700, a succession dispute broke out among the Iwllemeden, then based around Menaka; the dispute resulted in a fission, with the Kel Nan leading the other imajeghen and most of their clients towards the east, and leaving the west under the control of the Kel Kummer and their allies.

The Iwllemeden Kel Dinnik, as the Kel Nan grouping became known, migrated into the Azawagh. At the time the Kel Nan held the drum (which must have been created in the aftermath of the main succession dispute) and thus received tribute from their imghad clients, as well as the ineslemen groups (Ijawanjawaten, Izawiten) who had followed them east. From what is known, the first decades of Iwllemeden presence in the Azawagh were characterised by persistent attempts on the part of the imajeghen to impose their authority over the Iberkoreyen and Igdalen. Their failure to do so was made obvious by

El Gelani's ineslemen revolt in the early 19th century. El Gelani, who obtained considerable help from his Fulani mentors in Sokoto, declared a holy war on the imajeghen and successfully defeated them. Islamic and reformist fervor aside, much of El Gelani's success must be attributable to the chagrin felt by many ineslemen, who quite probably found imajeghen predations and authority oppressive. The ineslemen interlude, however, only lasted until 1816, when the imajeghen, with the aid of several allies, regained control in the Azawagh.

In the years following the defeat of El Gelani the Iwllemeden gradually strengthened their position. Incessant warfare throughout this period, usually with other Twareg confederations, appears to have increased imajeghen authority; given their sole raison d'être as military protectors, warfare can only have provided the imajeghen with all the legitimation they needed to extract tribute and surplus from their political clients. At the end of the 19th century the Kel Nan "allowed" a number of Arab tribes, disenchanted with Kel Kummer authority, to move into the northern areas of their territory, thereby obtaining some valuable and grateful clients.

The Kel Dinnik confederation was symbolically centered on the drum of the Kel Nan, from whom were drawn the amenokals of the confederation. In matters concerning the confederation as a whole (for example, relations with the Kel Gress) it would have been the Kel Nan chief who had the final word. Within the confederation each imajeghen tawshit had its own dependent tiwsatin. The Kel Nan for example could rely upon regular material support from their imghad (Illabakan, Inamagrawan) and from the ineslemen groups associated with the Kel Nan (the Tamjirt, for example). Their rights over these clients were contingent upon their providing protection, both from non-Kel Dinnik and from other imajeghen within the confederation. Tiggirmat oral history, for example, recounts the case of an IXerXeren amajagh seizing several camels from an Ijawanjawaten ineslemen herd; since the Ijawanjawaten were traditionally under the immediate protection of the Tiggirmat an appeal was made to the latter who then repossessed the camels and humiliated the IXerXeren amajagh concerned.

France and Niger

The French conquest of what is now Niger was a relatively short-lived affair. Between 1899 and 1905 the French imposed colonial rule over most of the area, ushering in a new era for the Sahelian Twareg. Of the major Twareg confederations in the area, only the Kel Gress of Ader and the Immuzzarag of Damergu put up any serious resistance (and thus suffered military defeat); the Kel Dinnik and Kel Ayr, on the other hand, surrendered without much fighting. The imposition of taxation, the levying of livestock requisitions, and French interference in the internal affairs of the Twareg all contributed towards pushing the Twareg into revolt in 1916-17. The French put down the revolts and in some areas, particularly in the Ayr, carried out some very repressive reprisals. With the revolts over, and the Twareg badly defeated, the French began to exercise a much greater influence on local affairs.

First and foremost, there is the question of political change. As the preceding section has shown, Twareg society was strongly organised around the imajeghen's ability to provide military protection for their clients. Colonial conquest, the much greater military potential of France, and the considerable human losses suffered by the imajeghen during the revolt, all meant that a warrior aristocracy could no longer fulfill its traditional role. Despite this the imajeghen, by virtue of their traditionally pre-eminent position in Twareg society, continued to exercise influence: the French made chiefs of them. However, and perhaps because of the revolts, the colonial authorities did attempt to spread political responsibilities among other status groups; and also to reduce the degree of centralization among the imajeghen themselves. The locus classicus for this policy of balkanisation was the Kel Dinnik confederation. For the Kel Dinnik the French created a new administrative structure, dividing the confederation into six "groupements", four of which were headed by imajeghen tiwsatin, one by the Kel Eghlal (an ineslemen group that had assiduously kept out of the 1916-17 revolt) and one by the Deremshaka Araba. In 1921, following an attempt by the IXerXeren to exercise their traditional privilege of tarkept, the Igdalen were given their own groupement and an autonomus chief, thus separating them off from the IXerXeren under whom they had been previously administered. Finally, in 1945,

the Ayt Awari were taken out of the Kel Eghlal groupement and given their own chief. In all, the Kel Dinnik were to be eventually divided into seven Twareg and one Arab administrative divisions. The overall effect of this new administrative structure was to diminish the influence of the Kel Nan, traditional holders of the Kel Dinnik ettebel, and to give the ineslemen greater independence of the imajeghen. Beyond this, of course, many other things had changed. Imajeghen could no longer exercise their right to tarkept (as evidenced in the Igdalen IXerXeren affair), nor could they expect to receive tiwse any more. Their colonial position as chiefs only granted them the doubtful privilege of acting as tax-collectors for the French. What is remarksble, however, is that the imajeghen managed to retain as much prestige as they did, and which they continue to enjoy today.

While colonial rule meant a definite reduction in the power of the imajeghen it certainly brought distinct benefits to the majority of the population. With tiwse and tarkept rendered illegal, the other status groupa were given a freedom that they had probably never enjoyed before, a freedom to accumulate without inviting imajeghen predation. While it is obviously difficult to assess the degree to which the pre-colonial imajeghen did inhibit accumulation among their clients, it is almost certain that the colonial era was one of politically uninterrupted accumulation (with the caveat that taxation may have partially replaced traditional tribute). In addition, the granting of administrative independence to non-imajeghen groups must have contributed towarda greater political power among the ineslemen and, to a much lesser extent, imghad.

Colonial administration also resulted in the breakdown of some traditional linkages between the pastoral Twareg and their sedentary neighbours. That these linkages were unequal, with the Twareg exercising dominance through coercion, is indubitable. Their disruption, however, did imply that the Twareg were less directly able to secure non-pastoral goods, especially grain.

Perhaps the most significant development of the colonial era for the Twareg was the gradual decline of slavery. In the pre-colonial period the Twareg frequently raided sedentary villages and seized slaves, incorporating such captives as eklan within their own society. Although we can only rely upon census data from the early colonial period, when the eklan accounted for some 60 percent of the total population, it would be safe to assume that even in the pre-colonial era, eklan made up at least half of the population, an indication of their economic importance in Twareg society. It is within the context of this that we can judge the implications of the decline in Twareg slavery.

French policy, in itself, was not a decisive factor. True, and despite their reputation as lukewarm abolitionists, the French did put an end to any slave trade and to slave raiding; the effect of this was to end the external supply of slaves into Twareg society. With regard to domestic slavery, however, French policy was, to say the least, ambiguous. On the one hand, a metropolitan abhorrence for an unforgiveable institution; on the other, a recognition of the importance of slavery to the Twareg and thus a desire not to upset the balance of things. The result of two such contradictory sentiments, unsurprisingly, was an early policy on Twareg slavery that did little to alter the existing situation.

Nonetheless, and despite these ambivalences in French policy, the colonial administration did contribute towards the decline of slavery. Escaped slaves, for instance, could no longer be retrieved by their masters. Eklan were now able to call on administrative support in the event of quarrels between them and their masters. French policy in this respect, although it left the onus on the slave for positive action, must have reduced coercion of slaves.

Although slavery became illegal, most eklan remained dependent on their masters until the late 1930s. Crucial to this persistence of slavery was the fact that the eklan did not often have much choice in the matter; eklan did not leave their masters as often as they might have done for the simple reason that they had nowhere or nothing to go to. In the cases where eklan did perceive plausible economic opportunities outside the traditional system they did not hesitate to take them, as witnessed by the many instances of eklan "secessions" among the Tengeregedesh during the 1950s, when eklan obtained French authority to retain a good share of the livestock previously entrusted to them by their imajeghen masters.

The key factor in the decline of slavery during the colonial period was not so much French policy in itself as a change in economic conditions. By the 1940s and 1950s, many eklan had either accumulated some livestock or found new opportunities, and this change was largely responsible for the slave exoduses of the late colonial period. These developments could only have occurred in the new cash economy brought by colonialism and in a political environment where slavery, if never actually legislated against, could not be officially tolerated.

In 1960 Niger obtained its independence. Little has been written about the Twareg in the context of an independent Niger. At the time, several ex-colonial administrators expressed considerable anxiety over the political future of the Twareg in Mali and Niger, fears which seemed to have been confirmed by the troubled events of the early 1960s in the Malian Adghagh-n-Ifoghas. In Niger, and despite the fact that the Twareg are a minority of the total population (11 percent in 1972), there appear to have been fewer problems. Several factors might be relevant. The livestock sector of the economy in Niger, in contrast to Mali, is quite heavily concentrated in a predominantly Twareg pastoral zone. Consequently, Nigerien interest in livestock exports must imply an interest in the Twareg. Secondly, the Nigerien Twareg, for whatever reason, have participated in the nation-state to a much greater degree than have the Malian Twareg: in Niger there are many Twareg civil servants whose power and influence cannot be ignored. Finally, there is the thorny issue of foreign relations between Niger and neighboring countries, particularly Libya; the effect of these foreign relations has been to give the Nigerien Twareg some political leverage in a young state.

The emergence of Niger as a state has meant that the Twareg, as members of that state, can now participate in government, something nobody could have done under French rule. For the Twareg, political power now exists both within and without the traditional polity. If the colonial era, as we see in the next section, can be characterised as a period when the economy was "opened", the two decades since Nigerian independence can be portrayed as years when the political system, in turn, has been opened up.

Economic evolution

In this section we briefly examine the evolution of the Twareg economy since the 19th century. It should be remembered, however, that there is not a single Twareg economy, but that there are substantial variations from confederation to confederation, as well as within each confederation.

In the pre-colonial period the Twareg were indubitably involved in pastoral production. A substantial proportion of their subsistence needs were met from livestock, particularly in the form of dairy products: however, the Twareg could not have relied on dairy production alone and must have obtained grain to supplement milk. In addition, many other products (such as clothing) could not have been procured from the pastoral sector. As a result the Twareg, even in the pre-colonial period, were dependent upon some kind of relationship with non-pastoral sectors. As far as is known, this nomad-sedentary relation took two basic forms, political and economic. Through their military superiority many Twareg groups could rely upon extracting a regular tribute from sedentary cultivator clients; such an arrangement was, for example, typical of the Kel Gress and, to a lesser extent, of the Kel Dinnik. Assessing the importance of this pre-colonial mode of grain acquisition is, of course, very difficult; circumstantial evidence does suggest that it was a crucial source of grain for the pastoral Twareg. Colonial conquest, however, seriously reduced the ability of nomadic Twareg to dominate, and thus exploit, their sedentary clients; and, as a consequence, increased importance was attached to grain acquisition by exchanges.

The acquisition of grain through exchange took two main forms, either through livestock marketing or through caravan trade. The lack of reliable quantitative data for the pre-colonial era does not allow us to assess the size of livestock trade prior to the 20th century. What is known, however, is that while livestock trade was already well-established at the turn of the century, it grew very rapidly between 1900 and 1930 (and has continued to grow ever since). Several factors were responsible. On the "push" side, the loss of tributary sources of grain forced the Twareg into increasing dependence upon livestock sales as a way of buying grain. Another "push" factor was colonial imposition of taxes, on both people and livestock, which had to be paid in cash and not in kind; this obliged the Twareg to sell more animals than might otherwise have been the case. Throughout the 20th century there has been an increasing demand for meat in neighboring Nigeria, a demand which appears to have been responded to by livestock producers, including the Twareg. In sum, the massive growth of livestock marketing among the Twareg has been the result of an increased dependence on livestock sales as a means of meeting subsistence needs and paying taxes, in the context of an expansion in the demand for livestock in the south.

What have been the consequences of this growth in the livestock trade? One of the most direct changes has been a tendency among the Twareg to switch from camel pastoralism to an increasingly cattle-orientated pastoralism, manifestly a response to Nigerian demand for beef rather than camel meat. The same may also have been the case for sheep, as opposed to goats, given that mutton is in greater demand than goat meat. While this increased emphasis on cattle production has had several consequences for the pastoral zone one, in particular, deserves mention here: that more cattle have resulted in a decline in forage production from wild grains such as Panicum laetum, which are grazed on and easily trampled by cattle. This decline in the wild grain harvest has, in turn, probably resulted in still greater dependence on purchased grain among the Twareg, and thus even more livestock sales. Another development following the commercialisation of livestock production has been the transformation of livestock into commodities with an explicity monetary value. This change may have been responsible for a steady decline in the number of baggage oxen kept by the Twareg.

One interesting consequence of increase demand for livestock has been the effect on the terms of trade between pastoral and non-pastoral products. Betweeen 1900 and 1960 the trend was for the price of livestock to increase much more than the price of grain. Seen purely in terms of grain, then, Twareg pastoralists have experienced an increase in their purchasing power: the aame number of animals sold provides more cash and thus more grain than before. This may have had the effect of reducing the number of animals needed to meet food needs. However, other non-pastoral products appear to have increased in price, sometimes at rates greater than livestock prices, which may have countered the improvement in terms of trade between livestock and grain.

The growth of livestock marketing must also be seen as having contributed to the general process of monetization in the Twareg economy. Monetization, in turn, has also been one of the key mechanisms behind the economic emancipation of many eklan. The fact that from 1900 onwards money became a significant and ultimately pervasive medium of exchange, and that markets developed for most products, has enabled eklan to start transforming their labor into money and then into livestock. Increased opportunities in towns (themselves the result of a growth in commerce) allowed eklan to obtain wages and then animals. Various products, to which the eklan always enjoyed access, also became marketable: the sale of butter and wild grains, for example, yielded cash and thus livestock for the eklan. For the eklan the main difference between the colonial and pre-colonial periods was that during the latter they were unable to acquire the beginnings of an independent livelihood, a condition which changed in the decades following the French conquest. While the process whereby eklan gradually became independent of their masters was complex, it is nonetheless apparent that the many economic developments which occured between 1900 and 1960 played a large part in this.

Apart from livestock sales the Nigerien Twareg have also traditionally relied upon caravan activities to provide them with non-pastoral goods. Of the Twareg confederations in central Niger only Kel Gress and Itesen have been heavily involved in caravanning. Most of these caravan activities concerned the Bilma salt trade, of which more will be said below. Here it is sufficient to note that the Bilma caravan trade has declined since the 1950s; as a result, the Kel Gress no longer rely upon their camel caravans to provide them with the revenue they did in the past.

This decline in the value of caravan activities can be interpreted as having increased, in relative terms, the economic importance of livestock production among the Twareg. At this point, a preliminary conclusion can be made: since the 19th century, the Twareg economy has undergone an important transformation, from being a mixed activity economy to one that haa become increasingly reliant upon livestock. This specialization of production has also meant that the Twareg are now very much peripheral to s lsrger economy.

Given this greater dependence on pure pastoralism among the Nigerien Twsreg, the implications of other developments can be assessed. The pastoral zone has seen several changes since 1900. To begin with, there has been a widespread migration of WoDaaBe into the zone from the south. This movement has not been without problems, particularly when one remembers that this WoDaaBe "colonization" occurred at a time when the Twareg were becoming more dependent on livestock production; in several senses, WoDaaBe and Twareg are competing for the aame resources, a competion which did not exist prior to 1900, when the same resources were not as crucial to the Twareg as they are today.

A simultaneous development has been the spread of cultivation into formerly unfarmed areas. As will be seen in later sections of this chapter, a good deal of the recent expansion in cultivation can be attributed to poorer Twareg themselves taking up farming. The spread of cultivation has had the effect of making pastoral resourcea still scarcer, again at a time of increasing dependence on liveatock. Looked at from the point of view of the pastoral Twareg, the migration of WoDaaBe and the expansion of cultivation northwards, taken together, amount to serious competition.

The last hundred years have seen major changes in economic conditions in central Niger. It is easy to visit a Twareg camp in the pastoral zone and imagine that life goes on as it has always done; a cursory look at the region's economic hiatory, however, clearly shows that what we see now is not what we might have seen a century or so ago. The fact is that many Twareg are now more dependent on livestock than they have ever been, and in environmental cnnditions very different to those of the turn of the century. Coupled with an increased competition for pastoral resources, the population has continued to grow, with many implications for the future.

PASTORAL PRODUCTION

Seasons

The pastoral Twareg of Niger divide the year into four major seasons: akasa, gharat, tagrest, and awellan. These seasons correspond both to particular climatic regimes and to periodizations in economic activity. This section provides a description of each season, largely from the point of view of the Kel Dinnik.

Rains-akasa (June - September)

When the first rains begin to fall most Twareg are at the southernmost point in their annual nomadic cycle, with people and animals concentrated around the dry season's watering points, boreholes, deep or shallow wells. By then pasture is poor and the livestock weak from the long treks of the dry season. Amokoso, the first or transition part of the wet season, is a time when the Twareg are anxious to take their herds and flocks away from exhausted dry season watering. Transition season grazing, in fact, is rarely any better than the dry season grazing which preceded it; the first rains are usually insufficient to allow any more than germination in annual grasses, and all that they do is moisten the standing hay. In contrast to dry hay, wet hay is recognized by the Twareg as very poor fodder. The transition season is a period when the Twareg merely attempt to move to new pastures and to find rainfed pools of water. Abandoning wells and returning to ponds is a crucial consideration: the animals can once more water every day, and for people the long hours of watering are over. The early rains, however, are very uneven in their distribution over space and meagre in quantity; the result is that the transition season is a time when Twareg camps move wherever they can, when choice is limited. The first few weeks following the first rains are characterised by unpredictable movements among the Twareg. In May 1968, for example, most of the Illabakan camps at In Waggar borehole moved southeast towards Shin Gharegan, where early rains had filled several small ponds, an exceptional move given the Illabakan's general tendency to move north during the rainy season. By June, however, the Shin Gharegan water-holes had dried up, forcing the Illabakan to return north and back to In Waggar.

As the rains begin to fall more regularly, as grass grows taller and the ponds gradually fill up, Twareg camps start heading north towards the salt licks. In central Niger the most highly valued salt licks are known as taferkast, which are only found near Tegguida in the Ighazer. There are other kinds of salt licks, known as ahara, but they are not of the same quality as the taferkast of Tegguida. The main problem with the Tegguida salt licks is that they are, for most of the Kel Dinnik and Kel Gress, far to the north. to get to them, there must be sufficient pasture and enough water on the routes northward; and for this the twareg must usually wait until enough rain has fallen.

In the past, the Tegguida salt licks were visited by most of the livestock and camps of the Kel Dinnik, Kel Gress, Kel Fadey, and Kel Ferwan; the rainy season was therefore a period of enormous concentrations of people and animals. Today, however, many Twareg only send their animals to the Ighazer while the camps, and thus most of the people, remain south around Ingal. The animals are taken to the salt licks by young men and client herders.

Because they must wait for rain to fill the ponds and allow the grasses to grow, most Twareg do not set off from Tegguida until mid-August. In 1967, for example, a large Illabakan camp began its move north from In Waggar on 19 August, arriving on the plains around Ingal on 7 September, travelling some 100 kms in 19 days. At Ingal the main camp pitched its tents, sending only its herds, accompanied by young men and eklan, the extra 60 kms to the Tegguida salt licks. The long moves north usually follow regular routes, with each tawshit having its own set of migratory paths; the regular, even predictable, movements of mid-rainy season, then, are in striking contrast to the more random pattern of transition season nomadism.

The rains is the only time in the year when pasture and water are relatively abundant. As a result, the Twareg recognise that how their animals fare during the rains is an all-important consideration in determining how well they will do in the long months to come. Part of this well-being is in the provision of salt; the minerals taken in at salt licks are recognised as vital to the animals' health. Taferkast, in addition, acts as a purgative, cleansing the animals' stomachs.

Once the herds have spent several days at the Tegguida salt licks they return to the southern plains, rejoining the main camps. By now the rains will probably have ended and the Twareg must begin thinking about a return to their southern dry season sites, before the ponds between Ingal and the south have dried out. The Illabakan camp which had arrived at Ingal on 7 September began its southward descent only two weeks later, and by 30 September it had regained a position immediately north of In Waggar, on dry season pastures. In other years the move south may take longer, depending on the availability of surface water; as long as ponds remain in water the Twareg will delay their return to dry season pastures.

In social terms, the rains is a season of intense activity, and plenty of pasture and water allow camps to come together for weeks at a time. It is moreover seen as a season of plenty, symbolised by a purely milk diet among many pastoralists. Leisure is also a quality of the rainy season, when ponds free people from the need to spend long hours watering animals or fetching water from distant wells. There is, nevertheless, work to do: moving camp in itself takes up much time, while abundant water and pasture lead more animals to stray and thus more time is spent searching for them.

Post-rainy season-gharat (October - mid-November)

Once the rains have stopped the grasses begin to dry out: gharat has begun. Day-time temperatures are high and a hot dry wind blows. For the sheep and cattle there is a change in grazing: the main rainy season grasses are now abandoned and the animals search for other fodder which remains green, wild melons in particular. Despite this there is usually a steady decline in milk production from livestock, and most Twareg can no longer rely upon milk to meet most of their subsistence needs. From the post-rainy season onwards, the Twareg must look for alternative sources of subsistence.

One such alternative to milk is wild grain, known as ishiban. The several varieties of annual grasses collectively known as ishiban usually grow on low-lying, moister areas. As the camps move south, many of them harvest the wild grains found along their transhumance routes. This grain provides an invaluable food supply, supplementing and sometimes replacing a dwindling milk diet.

By the post-rainy season, most of the smaller seasonal ponds have dried up, forcing the Twareg to move to the bigger pools. In consequence there is a greater concentration of camps. Generally most Twareg try to use these remaining pools for as long as possible, delaying the moment when they have to move to dry season pastures around wells and boreholes. A division of the herda and flocks often takes place during the post-rainy season. Sheep are often separated from the main camp and entrusted to a single herder (an ex-slave, kinsman, or salaried employee). Camels are also included in this herd division. Many of the larger and wealthier of the Illabakan camps, for example, regularly divide their herds, the main camps making the full descent into the In Waggar valley, while flocks of sheeps and herds of camels, under separate supervision, are kept north, watering at the larger pools. In many cases the separated flocks and herds rejoin the main camps at In Wagger during December and January; in other cases they may remain separated throughout the year, relying on smaller wells, and only rejoining the mains camps with the first rains of the new year.

Cold season-tagrest (mid-November - mid-March)

The post-rainy season gives way to the cold season when the nights, and then the days, get colder. The harmattan (amesgress), a strong wind from the east and northeast, starts to blow. Despite these associations with the cold and the harmattan, the significance of tagrest is that it is the beginning of the long dry season.

By the beginning of the cold season only the very largest pools remain. For most Twareg water is obtained from more permanent sources - wells and boreholes - and with this changeover to well-watering begins a new pattern of grazing and watering. Camps position themselves at some distances from their watering points, so as to be relatively close to outlying pastures. During the cold season cattle are watered every other day (and occasionally every three days). Unlike the WoDaaBe, the Twareg very rarely herd their cattle, neither for grazing nor for watering. For watering, all that need be done is to "show" the cattle where the wells are; from then on, they will themselves make the trek down to the wells every other day. Grazing is also left to the cattle. Only cows in calf are supervised at all. Calves are usually kept in

the area of the camp, separately watered, and attached to the calf-rope every night. Their mothers return to the camp on their own every night and are driven out to pasture the following morning.

Camels are only watered once a week during the cold season; for six days in a week most camels are allowed to graze at will on outlying pastures. On watering days, however, the camels must be rounded up and then driven down to the wells for watering, a task which may take considerable time, since camels may wander several miles away from their owners' camps. Again, camel calves and their mothers are more closely supervised: the calves are tied to stakes every night before their mothers return to the camp. Goats, which are watered once every three or four days during the cold season, require more day to day supervision than either camels or cattle; most of the work, however, can be done by young boys, even girls. The flock is driven out to pasture in the morning and then, towards late afternoon, brought back into the camp; on watering days they are herded to the wells and then back again.

Of the four main livestock species raised by the Twareg, sheep are by far the most demanding in terms of work. Sheep flocks require almost constant supervision at pasture, day and night. During the cold season sheep are watered every third or even fourth day, when they are taken to the wells and then, still accompanied by a herder, back to outlying pastures.

Once at the wells, all livestock must be supervised so that they do not get mixed up with other flocks and herds and so that each animal gets its share of water. Someone must draw water from the wells, pouring it into long wooden troughs for the animals to drink from. The general procedure is to water the animals once, immediately they have arrived, and then allow them to rest, in shade if possible, for several hours before watering them for a second time (known as meshu); the first watering, it is said, makes up for the water lost in previous days while the second provides animals with water for the coming days at pasture.

The cold season is a time when milk production in goats attains a peak; it is the main season for kidding and also a period of the year when many trees bear fruit, providing goats with excellent fodder. Milk production in cattle,

and especially in sheep declines rapidly from the peaks of the rains; the quality of cold season milk, however, is said to be high. For camels, milk production tends to remain fairly steady. Despite milk from goats the cold season is characterized by a predominantly grain diet and throughout this time most Twareg rely on livestock sales to obtain millet or sorghum.

Hot season-awellan (mid-March - May)

From February onwards the days begin to get hotter and by mid-March even the nights have become hot; once this has happened awellan has started.

By then there are heavy concentrations of people and animals around the major watering points. Many shallow wells dry up, forcing camps to move towards the most permanent water sources: deep wells, boreholes, and the more reliable shallow wells. This geographical concentration of livestock increases pressure on available pasture. The areas between camps and wells are devoid of standing hay, covered only in animal tracks. Outlying pasture is now even more distant from the wells and camps; although camp movements are minimal by comparison to rainy season nomadism, there is a tendency for camps to move still further away from their watering points, in search of closer pasture. This movement away from water inevitably means that the treks down to the wells are longer and more exhausting for both people and animals. Added to the greater distance between camp and well is the need to water livestock more frequently. The fierce heat of the hot season means that most livestock can no longer be left unwatered for more than one day: cattle, sheep, and goats must now be watered every other day and even camels require more frequent watering (once every four or five days). Not only has the distance covered increased but the number of times the trek must be made has also increased. At the same time pasture is becoming scarcer. For the animals, the hot season is a severely debilitating period.

The hot season also makes heavy demands on people. Camps must be provisioned with water and every morning women set off for the wells with donkeys and empty goatskins. Depending on how far from the wells the camp is, this work of fetching water may take up most of the day, the women not returning until late afternoon. Men are also needed at the wells, to supervise and water their livestock.

Domestic work reaches a peak during the hot season. Now that milk production from livestock has fallen to a minimum, and most of the milk must be left for the younger and weaker animals, the Twareg live off a purely cereal diet. For the women more grain means more pounding and preparation, and more time spent in searching for firewood. For the men the need to obtain grain and therefore to sell livestock becomes a major concern. They must make frequent visits to markets, buy grain, and transport it back to the camps, at a time when livestock prices are going down and grain prices going up.

In sum, the hot season is characterised by a progressive decline in pastoral resources, with a corresponding increase in the time and energy spent in ensuring subsistence. By its end the Twareg and their liveatock are exhausted. Everybody anxiously awaits the re-appearance of the Pleiades in the night sky and the beginnings of efray, a moist wind from the south. With the new stars and winds, awellan is nearly over and the year has begun its cycle once more.

Table 4.3.2 summarises the main features of tho different seasons for the Twareg of the project zone.

Table 4.3.2 The seasons according to the Twareg

Months	Season	Weather and environment	Social life	Activities
June-September	(1) amokoso	First rains. Ponds fill. Moist hay.	Dispersal of camps.	Unpredictable movements.
	(2) akasa	Frequent rains. Green grass. Many ponds.	Clustering of camps.	Salt cures. Northward moves. Milk diet.
October-mid November	gharat	End of rains. Grasses dry out. Ponds begin to dry up.	Dispersal of camps.	Division of herds. Wild grain harvest. Southward moves. Milk declines.
Mid-November-mid-March	tagrest	Cool days and nights. Ponds dried up.	Gradual concentration of camps.	Rejoining of bush herds. Grain buying begins. Kidding. Dry season watering begins.
Mid-March-May	awellan	Intense heat. Distant pastures.	Maximum concentration of camps.	Intensification of watering routine. Major livestock sales.

Animal husbandry

One major difference between Twareg and WoDaaBe pastoralism in central Niger is that while the latter are principally dependent upon cattle, the former practise a mixed species husbandry. In general, all the Twareg groups in the region demonstrate some commitment to sheep and goat pastoralism with regional variations in the emphasis on either cattle or camels. On the basis of pre-drought livestock estimates for each of the four main confederations, percentages of total TLU holdings by species can be calculated, as in table 4.3.3.

Table 4.3.3 Pre-drought holdings of livestock by Twareg confederation (percent of total TLU)

Confederation	Camels	Cattle	Sheep/goats
Kel Ferwan	53.7	18.5	27.8
Kel Fadey	28.3	34.2	37.5
Kel Gress	26.7	43.8	29.5
Kel Dinnik	16.9	67.9	15.2
Central Niger Twareg (total)	17.9	65.6	16.5

Source: Calculated from Bernus (1981).

Several points are worth making. Considered as a whole, the central Niger Twareg are clearly very dependent on cattle. Although the aggregation of all livestock data allows the size of Kel Dinnik holdings and its large cattle component to strongly influence the overall picture, and although problems with the data suggest that cattle have, in fact, been overestimated in relation to both camels and small stock, the inevitable conclusion must be that any notion of the contemporary Twareg (as a whole) being "camel pastoralists" is wrong. There are, however, variations within the Twareg population. The Kel Ferwan appear to rely on camels much more than any other confederation, while the Kel Gress, due largely to their long-standing involvement in caravan transport from Bilma, also keep larger numbers of camels than might otherwise be expected given their very southerly territory. Moreover, and even with a main emphasis on cattle, the central Niger Twareg do practise a mixed species pastoralism. What is emphasised here, however, is that cattle are, for most Twareg, the main species of livestock raised; as was noted above, this dependence on cattle has probably been a relatively recent development, the result of market demand for beef.

The result of mixed species pastoralism among the Twareg is that they have had to develop husbandry techniques and knowledge for each of the four main species. Of these, camels are perhaps the focus of most interest and knowledge, somewhat surprising given that cattle are, in fact, more numerous and more important. It is sometimes claimed that this disproportionate knowledge of camels relates to their peculiar importance in traditional Twareg society, as the animals par excellence of an imajeghen aristocracy. Perhaps a better explanation is simply that cattle have only recently taken on great importance among the Nigerien Twareg, and that husbandry knowledge relating to them is, as yet, underdeveloped; camel husbandry, on the other hand, is a much older established practice and knowledge of it correspondingly greater.

Having provided a brief contextual framework within which to view Twareg animal husbandry, the following sections briefly describe the salient features of Twareg technical knowledge as they relate to the various livestock species.

Cattle husbandry

Cattle are generically known as shitan (tast s.). The Twareg cow is usually described as being an Azawak: relatively short at the shoulder, with short horns, and of very variable colouring. As such, it is very different in appearance to the Bororo breed herded by the WoDaaBe. Opinions as to the quality of each breed vary. The Twareg themselves claim that they prefer Azawak cattle for two main reasons. Most importantly, Azawak cattle are reputed to be much less demanding in their fodder requirements: what a Bororo can graze on can equally be grazed by an Azawak, but the reverse does not hold. In consequence, the Twareg say, Azawak cattle are hardier and better able to survive periodic droughts and sustained periods on poorer pastures. A second reason often given by the Twareg for their preference for Azawak cattle is that they require remarkably little supervision. Bororo cattle, on the other hand, need constant supervision; as one Kel Azar amajagh put it, the WoDaaBe appear to have little time to do anything other than herd their cattle. Interestingly, Twareg opinion on Azawak compared to Bororo milk production is not unanimous: some say that the Azawak produces more milk, others (albeit a minority) that the Bororo yields more milk.

The Tamajaq terms for cattle, by sex and age, are shown in table 4.3.4.

Table 4.3.4 Twareg cattle classification by age and sex

Age	Male	Female
0-6 months	edel	tedelt) all calves are known
6-12 months	aloki	talokit) as iberkawan
12-24 months	ahiri	tihirit
24-36 months	aru	
> 4 years	esheg) bull	tast
	amaka)	
	esu) castrate	
	azger) baggage ox	
very old	ebarao	tebarowt

Young calves are kept near the camp and tied to a calf-rope every night, before their mothers return to the camp. Once the cows have returned, milking can begin: a calf is untied and allowed to suckle its mother. It is then pulled back and tied to its mother's forelegs so that milking can begin; once the milker has finished the calf will be allowed to suckle again, remaining with its mother until she leaves the camp for grazing. After a year most calves are weaned by a method known as ebayenbay; a sharpened twig is attached to the calf's muzzle so that each time it approaches its mother the twig pricks her udder and the cow thus moves away. As soon as they have been weaned calves are put into the main herd and thus left largely untended.

Castration of males usually takes place when they are two years old. Two techniques of castration are used by the Twareg; crushing and cutting. The second method is less frequently practised because it carries a risk of

consequent infection, especially during the wet season when most castrating takes place: during the rains the animals are at their strongest and the Twareg reckon that castration should occur then, rather than at other times of the year. Among the castrates some are chosen as baggage oxen, and trained as such.

Since the Twareg practise no form of breeding control in their cattle, calvings can, and do, occur throughout the year. Nonetheless, most calvings take place at the beginning of the wet season. Most cows calve away from the camp, in the bush, and only infrequently do the Twareg feel it necessary to attend cattle calvings. Should a cow lose its calf soon after calving, its Twareg owner may try to force the cow to adopt a new calf (both to assure continued lactation and, in certain cases, to provide an "orphaned" calf with a new mother and a steady supply of milk); to do this he will simply rub the placenta of the dead calf all over the new calf and then present the animal to its new mother, who may or may not adopt it. On other occasions, and especially when the original calf has died several days after parturition, the Twareg present the cow with a new substitute calf and then surround it with dogs or even threaten it with a man mimicking a hyena, in the hope that the cow will, through maternal instinct, adopt its new calf. When a cow has refused all attempts at adoption, the only way to obtain milk from her is to practise asakaf, blowing up the cow's vulva at every milking.

Perhaps the most remarkable feature of Twareg cattle husbandry in central Niger is the degree to which Azawak cattle take care of themselves. The Twareg appear to spend a fraction of the time that WoDaaBe do on herding and supervising cattle. Despite this, Twareg cattle herds regularly reproduce themselves, providing their owners with a good proportion of their total milk, needs and a steady income from cattle sales.

Camel husbandry

In central Niger the Twareg, along with the Arabs, are recognised as specialized and knowledgeable camel raisers: as has been noted in chapter 4.2, WoDaaBe often rely on the Twareg for the care and maintenance of their camels.

Two kinds of camel are kept by the Twareg. The Kel Dinnik herd the Azawagh variety or white camel. The Azawagh is said to be raised and selected for its milking qualities. The other variety of camel is usually associated with Twareg groups who originally came from the Ayr, the Kel Ferwan, Kel Fadey, and Kel Gress. This pied variety is known as the azerghaf, and is reputed to be specially bred for its qualities as a pack animal, hence its association with the Ayr Twareg, many of whom are active in the Bilma caravan trade. These characterisations of the Azawagh and azerghaf camels as being respectively specialized milk and pack animals are, of course, very generalized.

The Tamajaq terms for camels, by age and sex, are shown in table 4.3.5. The generic term for camel is alam (imenas pl.).

Table 4.3.5 Twareg camel classification by age and sex

Age	Male	Female
0-6 months	awara	tawarat
6-12 months	alagod	talagod
1-2 years	aburegh	tabureght
2-3 years	akarkor	takarkort
3-4 years	amugey	
	asaka	tesageyt
>4 years	alam wan imuleyen (castrate)	talamt
	amali (bull)	
>8 years	srrigan	

Camel calves are tied to stakes every night. Milking she-camels, although it can be done by a single skilled man, is usually done by two or three people. Camel calves of more than one year will usually have begun to browse, but in order to reduce their suckling a coarse rope net is placed over their mothers' udders. At the age of two years camel calves are forcibly weaned, by attaching twigs over the calves' muzzles, rendering any attempts at suckling very painful for them.

For male calves, training for riding begins when they are between three and four years old, at an age corresponding to the onset of sexual maturity in she-camels. When they are four years old, most males will be castrated by the cutting method. It is claimed that few males are left uncastrated. This high rate of castration is said to be an attempt to reduce the level of rutting conflict among adult males. Data from the camel production study in chapter 3.2 above, however, do not show particularly high levels of castration among camels.

While camels can be ridden from four years old if properly trained, pack animals usually take seven or eight years before they are sufficiently strong for long journeys. Once they have attained physical maturity, male camels can work until they are about fifteen years old, after which their strength declines rapidly.

Mating among camels can be difficult and the Twareg often aid mating camels, most commonly by tying the she-camels down; this is most frequently done during the wet season when the males are rutting and in peak condition. When repeated and successful mating takes place but where pregnancy does not ensue, the Twareg will sometimes place salt in the she-camel's vagina, a treatment that is considered to increase fecundity.

Because camel calvings can be problematic, pregnant she-camels are carefully watched, particularly in the latter stages of their pregnancy. If possible a man will try to be present at the calving; as soon as the calf is born he will blow air into its nostrils, to encourage normal respiration. He will then take the calf to its mother and milk out the colostrum for the calf to drink.

When a she-camel loses its original calf, several methods can be used to encourage the adoption of a new calf; again, adoption serves to maintain milk production and can provide orphaned calves with new mothers. As with cattle, one method is to rub the placenta of the dead calf on the substitute calf and hope that the she-camel will then adopt it. The most successful and best known technique for forcing adoption, however, is <u>arazay</u>. <u>Arazay</u> begins in

the early evening when a lactating she-camel without a calf has its anus sewn up with twigs; its tail is then tied up onto its back, in order to reduce any irritation and pain. Next, the camel's nostrils are cut, the blood stopping it from being able to smell the new calf; alternatively, and especially in the case of she-camels which have calved more than once before, their own dung pellets are mixed with hair from the substitute calf, then placed in her nostrils and then held there by the upper lip, which is folded and tied over her nose. The she-camel is then left for the night. The next day it will be blindfolded and then the new calf tied to a nearby stake; the anus will then be untied and the camel will defecate. At this point the blindfold is removed and the camel presented with its new calf, which it may adopt as its own (the defecation is intended to make the she-camel feel that it has given birth). If the she-camel does not adopt the new calf, arazay will be continued for the next few days until it is successful.

Like cattle, camels do not appear to need very close herding supervision and for most of the time they browse unaccompanied by a herder. The Twareg, however, must ensure that their working camels receive enough fodder; baggage camels, for example, can trek 30-40 kms a day but every fourth day must be allowed to browse. Camels which have returned from the long Bilma caravans must be rested and allowed to browse for a correspondingly long period.

Goat husbandry

The goats herded by the Niger Twareg are relatively large, with long necks, small heads, and short hair. Goats are kept for milk production and as a source of home-consumed meat; some are sold, but their economic importance appears to be their role in household self-subsistence.

Twareg terms for goats are shown in table 4.3.6. The generic term for goat is taghat (ulli pl.).

Table 4.3.6 Twareg goat classification by age and sex

Age	Male	Female
0-6 months	egheyd	tegheyd
6-12 months	abariom	tabariomt
onset of sexual maturity	esagey	tesageyt
adult	azolar	tadawalt) one kidding taghat) two or more kiddings
very old	eghader	teghadek

Some Niger Twareg practise breeding control among their goats, by ligaturing the penis of males. The males are released at the beginning of the wet season and kidding reaches a peak after the rains and during the cold season. There are two ressons for this seasonal breeding control: first, herders do not want to have to care for very young kids during the wet season when camp movements are very frequent (young kids must be carried, along with the camp baggage, on donkeys and camels); a second reason is that the cold season pasture is excellent for goats, so that milk production will be at a high level during the first few months of lactation. The animal production survey conducted by the project and reported in chapter 3.2 above, found that although the Kel Fadey Twareg surveyed did not control the breeding of their goats, there was nevertheless a peak in kidding in the cold season, due no doubt to natural seasonal influences on the goats' reproductive cycle, and in particular a peak in conceptions in the transition period between the dry season and the rains.

Male goats can be castrated either very young, at one or two months, or when they are older, at one year. The mode of castration varies: for young kids by cutting; for older animals by crushing.

Kids are usually weaned after seven months or so. Weaning simply consists of tying a thin cord through the kid's mouth, thereby inhibiting suckling. Once weaned, the kids are left to follow their mothers at pasture.

Goat management is undemanding. Flocks are allowed to browse in the immediate vicinity of the camp and are retrieved before nighfall. Occasionally, a shepherd will take his flock to pasture, and, with the aid of a long staff, pull fruits and branches down for the goats.

Sheep husbandry

Twareg sheep are large animals, of generally white coloring but with darker head coloring. Sheep are kept for a number of reasons, the most important of which is their commercial value. In addition sheep provide milk, particularly during the wet season.

Tamajaq terms for sheep are tabulated in table 4.3.7. The generic term for sheep is tille (eyfed pl.).

Table 4.3.7 Twareg sheep classification by age and sex

Age	Male	Female
0-6 months	akerwat	takerwat
6-12 months	ashkam	tashkamt
12-18 months	ebakar	tebakart
18-24 months	ajaghol	tejagholt
2-3 years	abagog	tabagog) one lambing
3-4 years +	ekrar	tille) two or more lambings
very old		tiboran'

Breeding in sheep is quite closely controlled by the Twareg. Control is achieved by ligaturing the ram's penis throughout the period from the end of the rainy season until February/March. As a result, most lambing occurs between July and August, at a time when pasture is abundant and when the ewes can produce plenty of milk. Young lambs, unlike young kids, are quite sturdy and thus pose few problems during rainy season movements when they will simply follow their mothers in the main flock. Weaning of lambs, from the age of six months, is by the same method used for kids. Castration is also similar to that in goats. For both sheep and goats, adoption of a new lamb or kid by an animal that has lost is own progeny is fairly simple. A shepherd merely rubs a finger in the animal's vulva and then rubs the smell onto its nose; when presented with a substitute kid or lamb the animal will only smell itself and thus adopt the new kid/lamb.

Twareg sheep husbandry is distinguishable from that of all other livestock by its intensity: sheep need constant attention. Most Twareg would agree that the most difficult animals to keep are sheep, simply because they must always be accompanied by a herder.

In addition to the basic techniques and knowledge used by the Twareg in the project zone to raise livestock described in preceding paragraphs, the Twareg also dispose of a substantial knowledge of animal diseases and of cures and treatments. Notable among these traditional treatments is the shiqiyaz, a simple form of vaccination used for bovine rinderpest and bovine pleuropneumonia. With regard to pastures and fodder plants, the Twareg are equally knowledgeable. Several species of toxic plant are recognised and the best fodder plants are also well known. However, such detailed knowledge is left largely unused for the simple reason that most cattle, camels, and goats are left to graze themselves.

Finally, the Twareg are always concerned that their animals receive sufficient salt. For many pastoral Twareg the annual visit to Tegguida is vital. The Tegguida salt licks, however, can only be visited during the wet season and for the rest of the year other sources of salt must be found. Several kinds of salt can be bought - taferkast, transported from Tegguida; Tawdenni salt (known as alkamra or tafarat); or Bilma salt (takest). Pure salt is often mixed up with the earth of a termite nest and with dried, pounded leaves of Boscia senegalensis.

Livestock and property

Before going on to describe the way in which pastoral production is organised by the Twareg, this section deals with the critical issue of livestock and property devolution. As will be discussed below, livestock are the principal means of production to which access is regulated by property (or control) relations; as a consequence, the way livestock are distributed throughout society and how the ownership pattern is reproduced in time are considerations vital to an understanding of the Twareg economy.

The first concern is with the system of property devolution. How do the Twareg transfer livestock to a successor generation, thereby ensuring the material reproduction of Twareg society? It is convenient to discuss property devolution in a cyclical way, beginning with an individual's youth and documenting the various possible transfers of livestock which may accrue to him or her. The discussion draws on material relating to the Kel Dinnik in particular but is applicable to most Twareg in the pastoral zone.

Seven days after a child is born it is baptised, its father sacrificing a sheep or goat to commemorate the occasion. To mark the occasion further the baby child may be given an animal by one of its senior kin; such a gift, among the Kel Dinnik, is known as ajif, a term that refers only to baptism gifts. The kind of animal given as ajif seems to be variable. Some Twareg feel that the most appropriate animal to give as ajif is a young animal (of whatever species) that was born at roughly the same time as the child. The question of who gives ajif is also variable; the first thing to note about ajif is that it is not an immutable obligation, although some Twareg say that

it is almost obligatory for a father to give his first son ajif. It also seems to be case that male children are far more likely to receive ajif than female children; there is a definite and general association of ajif with male offspring. Hence there will be, and are, Twareg who never received ajif; and those who did receive ajif may have done so from a number of kin: father, father's brother, father's sister, mother's brother.

Subsequent gifts of livestock (indeed, of anything) are referred to as tehakay. Again, such pre-inheritances are not obligatory but can, in cases, amount to substantial gifts of livestock. One of the remarkable features of Kel Dinnik tehakay is the notion that an individual has an affinity with some livestock species and not with others; to discover where a person's fortune is, which animal "goes best" with him or her, a child may be given first a cow which, should it die, is replaced by a camel, and so on. As with ajif, male children receive priority over female children in tehakay, while the range of potential donors is apparently much the same. Tehakay can be received on several occasions, one of which may be at marriage. Thus an anislim of the Izawiten is recorded as having given his eldest son one cow as ajif, at the time of this birth, and then, when his son married for the first time, a further gift of two cows as tehakay.

Children can receive animals throughout their youth, although their rights in those animals are not defined in a completely unambiguous way. There is an important distinction between alxalal and alxaram. Eharey wan alxalal refers to a person's proper, personal wealth, with which he or she can do as he or she wants; eharey wan alxaram, on the other hand, refers to wealth that is, for a given individual, untouchable, wealth that is explicitly not theirs. Thus for person x, who is father's brother to person y, the livestock wealth of the latter is alxaram; it is alxalal to y. While alxaram and alxalal might be easily delimited in the case of relatively distant kinship, the boundaries of personally inalienable property in the case of very close kin (for example, parents and children) are much less clear. To a large extent it depends on who is asked; some Twareg claim that the person who has given a junior kinsman (such as a son) ajif or tehakay animals retains some rights in the particular animals which were originally given, but that once the original animals have died or been exchanged, the donor has no rights in subsequent

progeny. Other Twareg claim that a father does retain rights in the livestock of his children and that he can, should he wish, sell them for whatever reason. There is a general consensus, however, that a father's rights in his sons' animals, although existent, are limited: the Twareg who sells all his children's animals will not be well thought of by society at large. Lastly, some Twareg (usually adolescent sons) maintain that a child's ajif and tehakay animals, and their progeny, are alxaram to everybody except the children concerned.

At any rate, and despite the fact that ajif and tehakay are explicitly optional, most Twareg can expect to receive at least two or three pre-inherited animals during their lifetimes. Subsequent to pre-inheritance, Twareg will, at the death of their parents or close patrilateral kin, inherit livestock. The rules for Kel Dinnik inheritance (tekasit) are articulated by Koranic law such that, at the death of a man, his wife receives a small share (one eighth), his children the rest, divided up so that sons receive twice as much as daughters. The same kind of rules apply to women's livestock except that if her husband is alive when she dies he receives one quarter of the inheritance and the children the remaining three quarters. Only if a man or woman have no children will more distant patrilateral kin inherit (matrilateral kin never inherit), the first being siblings, then parallel cousins and so on. One final feature of Kel Dinnik inheritance to note is that the inheritance is always equally (given sexual distinctions) divided up among the individual inheritors; there is not qquestion of an impartible inheritance.

Ajif, tehakay, and tekasit are all institutions of property devolution which appear to favour men, rather than women. There is, however, one institution which, expecially among the Kel Gress, favours the devolution of property to women. El khabus, as it is known, is recognised by Koranic law as a form of pre-inheritance, as a transfer of property between the living which will not be subject to normal rulings on inheritance. Among the Kel Gress, el khabus is said to be a common mode of property transfer between mothers and their daughters.

The transfers of livestock associated with Twareg marriage must also be documented. Twareg marriage requires the payment, on the part of a man, of bridewealth (taggalt). The bridewealth is almost always paid in animals, but the number of livestock paid varies from place to place, and with status. Among imajeghen, bridewealth is usually paid in camels: the Iwllemeden pay between three and four camels as bridewealth, the Kel Gress anything up to twenty camels with an average of five. In addition to these bridewealth camels (which should be females), an imajeghen husband will also be expected to contribute two bulls for slaughtering during marriage festivities. Among the imghad and ineslemen, the bridewealth consists of she-camels or cattle: a typical Illabakan bridewealth consists of two she-camels and one cow, while Izawiten ineslemen pay one she-camel or two or three cattle as bridewealth. Iderfan, ighawellan, and eklan usually pay their bridewealth in the form of sheep or goats. Bridewealth payments increase the higher one's status and there is an association between camels, and then cattle, as bridewealth for higher status groups.

In order to pay his bridewealth a Twareg can solicit contributions from kinsmen and friends, a process known as shirgit, described below. The bride's kin may make contributions to their future affine's bridewealth by simply reducing the number of animals they will accept as bridewealth; this is especially the case where marriages are between close kin such that the husband is already a close kinsman of his wife's parents. Once the shirgit has been completed, a man will make up any remaining balance with animals drawn from his own personal holdings.

The bridewealth assembled, the animals are handed over to the woman's father. The principal recipient, however, does not usually obtain alxalal rights in his daughter's bridewealth animals, which are regarded as belonging to the woman herself, even if they remain in her father's camp. Among the Kel Gress, however, most of a woman's bridewealth is sold off to pay for her domestic equipment.

From the husband's point of view, therefore, the payment of bridewealth represents a transfer of animals from his ownership (often mediated by shirgit contributions) to that of his wife and, indirectly, her kin. In return for

this transfer, however, a woman and her kin must provide something. For all status groups except the imajeghan, a married woman must bring a tent and its equipment with her. Additional to the tent, a wife should also provide the pack animals necessary to carry her baggage; and in the past a wife usually brought one or more slave women with her, as the domestic labour force for her new household. The tent and domestic equipment can often cost a woman's family a considerable sum of money: one Illabakan's woman's domestic equipment cost her family 30,400 CFA in total. Throughout her marriage a woman will be expected to maintain her domestic equipment and periodically to replace her tent with a new one.

The provision of a tent is the minimal obligation of a wife and her kin. Most Twareg husbands can also expect their wives to take up residence with them accompanied by some "dowry" animals. Among the Kel Dinnik these animals are known as shimuzagin (literally, milk animals); among the Kel Gress and Kel Ferwan they are known as asinger. Shimuzagin animals belong neither to the husband nor to his wife but remain, despite their transfer to another camp, the property of a wife's father; the married couple only exercise milking rights over their shimuzagin. Such animals are explicitly intended to be a contribution towards the upkeep of a married daughter and her children; they cannot, however, be sold to meet that household's cash expenses. The number of animals thus brought by a wife can vary enormously: one Izawiten woman is recorded as having only two cows as shimuzagin; an Iberogan wife as having a single cow as shimuzagin; while a wealthy Kel Gress chief is recorded as having allocated fifty camels as asinger to his eldest daughter and thirty asinger camels to her younger sister.

In addition to any shimuzagin animals a woman may bring with her, she may also, depending on circumstances, bring her own animals to her husband's camp, animals received as ajif, tehakay, or tekasit, or even the livestock paid for her bridewealth. Over these animals she does exercise proper ownership rights; and her husband, by asking her, can use these animals to help meet the cash needs of his household.

This series of livestock transfers can be summarised in diagrammatic form as shown in figure 4.3.1.

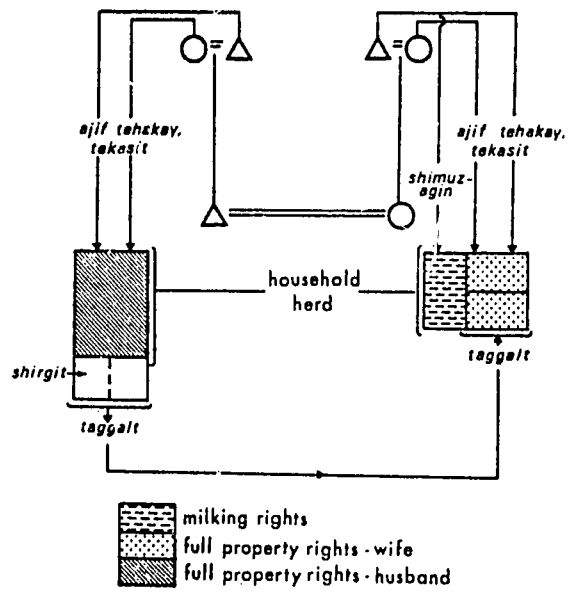


Figure 4.3.1 Livestock transfers and the constitution of household herds among the Kel Dinnik Twareg

In the event of divorce a woman returns to her kin, along with her tent (and any servants) and with all her own livestock and any ahimuzagin. The livestock paid as bridewealth is only returned to her husband if it is generally acknowledged that the wife was primarily responsible for the divorce; otherwise, they remain hers.

One of the more perplexing issues about property in Twareg society is the question of women and property. A common myth about the Twareg is that their women enjoy a priveleged position and that their relatively high status is partly explicable because the Twareg are, in some sense, "matrilineal". In fact property devolution among the Twareg is quite clearly influenced by Islam

so that the inheritance of property has a bias in favour of men. Despite this, it is often the case that women own substantial numbers of livestock. In one Kel Ferwan camp, for example, 20 percent of total livestock holdings were owned by women; and, in addition men and women, taken together, had either inherited or been given 25 percent of their livestock by their mothers. From the same data it is also apparent that women receive the major proportion of their livestock from their mothers; 65 percent of total women's holdings originated from maternal gifts and inheritance (Oxby 1978).

Perhaps one of the reasons for the importance of women's holdings is the use made of women's livestock. As we have seen, Twareg women usually receive far fewer animals from their fathers than do their brothers. What distinguishes their herds from those of their brothers, however, is that while animals must regularly be sold from the latter in order to meet cash requirements, the former are much less heavily exploited. A woman is not expected to bear the brunt of household subsistence and, as a consequence, her herds will be less frequently eaten into; those of her husband, on the other hand, are the major resource out of which household costs are met. Men, in addition, are the main actors in social life: it is men who are approached during a shirgit and will therefore contribute to their kin's bridewealth expenses. While there is no direct evidence to support this interpretation, it seems nonetheless likely that off-take from male-owned herds is higher than that from women's herds, which would explain in part the sometimes large holdings of Twareg women. The implication of this is that women's wealth can provide a valuable source of livestock to future generations. This is not the result of an especially elevated position among Twareg women but merely the consequence of men, not women, being responsible for providing subsistence.

From this brief review of property devolution among the Twareg it can be seen that kinship occupies a pre-eminent position in the channelling of wealth from an outgoing to an incoming generation. For one large Kel Ferwan camp, of the 791 TLU held by camp members, 92 percent had its origins in gifts and inheritances from kin (mainly fathers and mothers); theft, salaries in kind, and purchases accounted for only 8 percent of total TLU (Oxby 1978). The grid of blood kinship relations, then, is the single most important framework for property devolution among the Twareg.

That this should be so is, of course, hardly surprising. However, within the context of another feature of Twareg society this transmission of wealth along lines of kinship takes on a greater significance: given that kinship is so crucial to property relations, the fact of endogamy among the constituent strata of Twareg society serves to "enclave" property. It is to this question of endogamy that we now turn.

Edogamy operates at the level of status. Imajeghen almost invariably marry other imajeghen, ineslemen marry other ineslemen, and so on. Status endogamy is not, strictly speaking, a prescription; however, marriages between people of different status are regarded as anti-social and are never encouraged. Among the Kel Gress only 7.1 percent of one set of marriages among imajeghen were recorded as being with either slaves or non-Kel Gress (Bonte 1976); among the Iwllemeden Kel Dinnik the imajeghen appear to be almost totally endogamous. High rates of endogamy are characteristic of the higher status groups; the lower status groups, on the other hand, appear to be less rigorously endogamous.

Twareg endogamy is also strong at the level of the individual tawshit. Thus, members of the Illabakan demonstrate a strong tendency to marry other members of the Illabakan. This tawshit endogamy is expressed in terms of a preference for close kin marriage. All forms of cousin marriage are permissible in Twareg society, with a stated preference for cross-cousin marriage. Data from a set of Kel Gress imajeghen marriages show that of all marriages between kin, parallel cousin marriages account for 22.4 percent of the total, and cross cousin marriages 32.8 percent (Bonte 1976).

The tendency for Twareg marriage, then, is for most marriages to take place within the limits of a status group and among such status endogamous unions there is also a tendency for high levels of tawshit endogamy and thus a high frequency of close kin marriages. While it is difficult to explain why endogamy is so characteristic of Twareg society it is easier to discern the consequencea and implications of such a marriage pattern. First, close kin marriages maintain property within a recognizable kin grouping. Secondly, and most importantly, status and tawshit endogamy engender a closed system of kinship relations, producing a fusion of kinship and status. Endogamy, as

already noted, serves to render status groups into quasi-kinship groups, reinforcing, say, the legitimacy of an amghid claiming all other imghad to be kinsmen.

The enclavement of kinship within status has the consequence that the devolution of property, being based on a grid of blood kinship, is confined to the status group. By so doing, status groups are including themselves with regard to livestock, and, at the same time, excluding others from access to their property.

Not only are status groups in Twareg society socially unequal but they are also economically unequal. Simply stated, there is a tendency for imajeghen, ineslemen, and imghad to own a disporportionate amount of livestock, and for iderfan, ighawellan, and eklan to own much less. When this unequal pattern in access to the means of production is combined with an endogamous marriage system, the result is that the pattern is consistently reproduced. A pre-given inequality in property holdings, coupled with a parallel enclavement of kinship (which is maintained by endogamy) is the distinctive feature of Twareg society.

Data in support of this overall characterisation of Twareg society is scant and much of it impressionistic. Most ethnographers of the Twareg would agree that the imajeghen, ineslemen, and imghad are usually much wealthier than the lower status populations. Data for a large Kel Ferwan camp, for instance, show that twelve out of twenty three "noble" adults own more than 5 TLU each, and that only four nobles are actually propertyless; for the eklan and ex-eklan, on the other hand, 55 out of 58 adults own less than 4 TLU each with 22 of them being propertyless. The problem here is that the eklan and ex-eklan to be found in such noble camps often tend to be the poorest, almost by definition. More convincing, however, is data on the "occupation" of the 400 household heads making up a Kel Ferwan "tribe", which shows that 83 percent (15/18) of all noble household heads are pastoralists, 43 percent (9/21) of all tributary household heads are pastoralists, but only 15 percent (34/231) of all eklan and ex-eklan household heads as pastoralists, the majority being classified as cultivators or agropastoralists (Oxby 1978).

All of this indicates that when we talk of the pastoral Twareg an important caveat is called for: the most pastoral, because they tend to be the wealthiest, are the higher statua groups. As the Kel Ferwan data show, there is a clear association between high status Twareg and pure pastoralism.

For the moment it is concluded that a kinship determined mode of property transmisaion and a system of endogamy have the effect of reproducing inequalities in access to livestock among the Twareg. Property devolution does transfer wealth to a successor generation but does so within the context of a system where some people are permanently excluded, and others always included.

Herd reconstitution

Many of the same processes operate when Twareg seek to reconstitute their herds after important losses. Sahelian pastoralists face the constant problem of recurrent drought and periodic outbreaks of livestock diseases, calamities that can decimate, even destroy, a man's herds within the space of weeks. Such disasters, moreover, are largely random in their incidence and frequently only a part of the pastoral population is left destitute, other sections of the population not having been so unfortunate. Hence, at any one point in time, some sections of the total population are faced with the problem of insufficient livestock from which to obtain a living while others do not face this predicament. Given this tendency for there to be, at times, non-viable sections and, at the same time, viable sections, one might expect there to be mechanisms whereby the former are supported, or even given the means to regenerate their herda, by those in a more fortunate position. For the WoDaaBe, the haBBanae system is just such a mechanism, representing a mode of transfer of livestock from those with sufficient animals to those who do not have herds of a size large enough to allow self-subsistence. While the haBBanae system does come under severe stress in the period following a major drought, it does, nonetheless, represent a coherent mechanism by which destitute pastoralists can begin to rebuild their herds without having to leave the pastoral economy entirely.

In the case of the Kel Dinnik no equivalent institution exists, although there are a number of methods by which a Twareg can obtain replacement animals (methods which are of a radically different nature to the haBBanae loan) and material support.

The closest that the Kel Dinnik get to a haBBanae system is in tamesadeq, a transfer of livestock from rich to poor that is explicitly motivated on grounds of piety and Islam. In theory there is a specified rate of "tithe" (e.g. a man with thirty cattle is expected to give, as tamesadeq, one young bull; a man with forty is expected to give one heifer, and so on) which only starts at a given level of wealth. In practice, tamesadeq payments are largely left to individual calculation. The donor, by giving an animal to the recipient, loses all rights in that animal; tamesadeq, then, is an outright gift and not in any sense a loan.

So far tamesadeq has been described from the point of view of the donor who is likely to be relatively well-off. What makes tamesadeq specifically Twareg in nature, however, is the category of recipient. In the secular confederations, tamesadeq is given to one of two categories of people: either a marabout (a prominent member of an ineslemen tawshit) or a taloqqi, a poor man.

The marabout will usually sell such livestock in order to obtain grain during the dry season. For the secular tiwsatin most tamesadeq is probably paid to marabouts and the poor only infrequently receive tamesadeq animals. For the religious ineslemen confederations, however, the tamesadeq payment is made to the poor; it is said that the absolutely poor receive priority over relatively poor kin but that if no unrelated paupers are identified the gift should be made to one's poorer patrilateral kin.

The major caveat to any notion of tamesadeq representing a transfer of wealth from rich to poor, however, is that, in practice, a number of social categories (which vary according to the donor) are excluded from the tamesadeq circuit. The most striking of these is that of the eklan: only if an akli is seriously in debt can he receive tamesadeq from an illelan person; otherwise the eklan are outside of the illelan tamesadeq circuit. Equally, status

groups tend to keep tamesadeq within the bounds of their status. An amghid, for instance, is very unlikely to give tamesadeq animals to a member of a lower status illelan tawshit, reserving any such payments for his marabout or for poorer imghad. The extent, then, to which tamesadeq operates as a redistributive mechanism is limited by the class and status structure within which it is encapsulated. The overall pattern is one of retention within a given category and exclusion of others.

One should also note that tamesadeq is a system entirely activated by the donor. It is for the donor to assess the size of his payment and it is for the donor to decide who will receive his tamesadeq animals; the potential recipient is not expected to solicit payment.

The second mode of livestock transfer among the Kel Dinnik is much less formally constituted than tamesadeq. Shirgit refers to the process whereby a pastoralist, for whatever reason, seeks contributions of livestock. Classically the shirgit is undertaken by a man wishing to marry and then searching for contributions to his bridewealth payment (taggalt); but shirgit can also be the process by which a poor man sets out to reconstitute his herd by asking for contributions from a variety of people. A pastoralist undertaking a shirgit wanders from camp to camp, discussing his problems, soliciting contributions of livestock from camp members until he has finally achieved his goal or run out of potential contributors.

Again, and on the face of it, shirgit does appear to be a way for poorer pastoralists to obtain livestock from wealthier members of the population. The superficial impression has, however, to be abandoned when the full character of shirgit emerges. To begin with, the number of potential contributors to a Twareg's shirgit increases the higher his status: an amajar's shirgit can encompass many more people than an akli's. This is partly a consequence of the fact that there is a political reciprocity involved in the shirgit, such that the recipient may ultimately be asked by the donor to render some kind of political or patronal service; and, because the hierarchy is what it is, those Twareg of a higher status are likely to be in a much better position to extend political aid than Twareg of lower status. With shirgit, then, an amajar can ask for contributions from eklan but they,

in turn, are not in a position to ask the imajaren for contributions (although an akli can ask his de jure owner for help). It is often the case that the most successful shirgits are those undertaken by traditional chiefs: they, more than any other are in a position to repay an "economic" debt with a political service. In sum, the shirgit mechanism represents a transfer up the status hierarchy, from those at the bottom to those at the top (who on an individual basis may have lost herds through, for example, drought).

When the status hierarchy is also the class hierarchy, what shirgit does is provide the temporarily or randomly poorer members of the upper classes with a means of access to the livestock of lower status groups. It is not, then, a mechanism in the absolute sense for the redistribution of wealth.

The last and perhaps most frequently practised Twareg livestock transfer mechanism to be discussed here is known as shiyat. The donor lends the recipient a cow in milk, allowing him to drink the milk, but the cow and calf are returned to the donor at the end of lactation. The precise form of the contract is highly variable. The recipient may retain the cow for several years and, in extreme cases, may even do so for as long as he lives, but the one invariant feature is that ownership rights in the cows themselves and their progeny are not transferred, but remain the inalienable property of the donor.

From the donor's point of view shiyat loans can be several things at the same time. For one, the animals thus loaned are supervised and herded by other labor (which is "repaid" with milk); for another, shiyat animals often represent the dispersal of a man's holdings, a way of reducing risk. Finally, the shiyat animal can be an integral part of a complex patron-client system, the recipient in debt to the donor, and, in time, the donor may request a service from the recipient.

In contrast to tamesadeq the recipient of shiyat actively solicits them; he must approach another Twareg and ask for the loan of milk animals. Recipients will usually be poor, in need of milk; the donors are usually wealthy with surplus milk animals. Among the Kel Dinnik it seems that the most common recipients of shiyat are of iderfan or eklan status and that in

return for such loans the eklan will give grain to the donors. One should also add that in the case of eklan shiyat the loan can also be seen, in part, as a way in which former owners maintain a dominant position with regard to ex-subordinates.

Of all the traditional Twareg loan systems, then, shiyat is the one that seems to represent a genuine transfer of material support from those in a surplus to those in a deficit position. But, and most importantly, the shiyat transfer denies the recipient category the means to generate or regenerate livestock wealth; the lower classes are maintained but not allowed access to the means of production. True, milk can either be sold or turned into marketable butter or cheese but herders in need of shiyat loans are unlikely to be in the position to do anything other than sell or exchange dairy products in order to obtain grain, let alone transfer such acquired cash into purchased livestock. Hence shiyat, while permitting a transfer of resources down the class hierarchy, does nothing to impair the reproduction of that same hiersrchy.

Finally one should note that the Kel Dinnik traditionally practise a shiyat type system as payment to their own contract herders. Under this system, a rich Twareg entrusts his herd to a poor contract herder who, in reward, receives milk from a pre-determined and allocated number of milk cattle. As in the jokkere system among the WoDaaBe, the herder receives no animals as payment.

Herd reconstitution as described for the Kel Dinnik is a paradoxical institution. To the extent that it takes place it is only really effective for those already in a socially privileged position: it is almost by virtue of status that a Twareg can regenerate his herds. That is to say that the periodic incidence of misfortune among members of the politically important, higher status groups is nowhere near as catastrophic as it is for the Twareg of lower status. To begin with, higher status Twareg can appeal to their often well-off kin, by definition of the same status, and their position also enables them to appeal to many other lower status Twareg for material aid which is likely to be extended to them because of their status. In contrast, the eklan are almost totally excluded from the livestock transfer circuits, and hence confined to positions of unrelenting poverty.

The lack of a genuinely redistributive method of herd reconstitution among the Kel Dinnik is entirely consistent with the nature of Twareg society. It is the hierarchical nature of Twareg society that, in its roproduction, determines the distribution of access to the means of production. The tiwsatin system and endogamy allow for the maintenance of kin-articulated classes while any non-kin regeneration or transfer mechanisms are structured such that they do not damage the hierarchy.

The organization of production

In describing the organization of pastoral production among the Twareg it is necessary to distinguish between residential, herding and consumption units, all of which may be different in composition.

The largest and most unstable residential unit in Twareg society is the camp (sghiwan). In central Niger, Twareg camps vary greatly in size: at one extreme ia the huge Tamesgidda camp with over a hundred tents; at the other are the tiny one tent camps. Camps are simply clusters of tents spread over several hundred metres. In general most camps consist of tents from the same tawshit, reflecting a greater degree of familiarity between kinsmen. In economic terms, however, a camp is not particularly significant: a camp may remain together for several months, all constituent tents moving as a group, but in time parts of the camp will move away. The camp is a fluid residential assocation.

It is within the camp that we find operative economic units. The basis of such units is the tent. Among the Twareg of central Niger tents take two forms: on the one hand, the leather tent (ehaket), principally associated with the Kel Dinnik; on the other, the mat tent (ehan n isalan), principally associated with the various Ayr groupings. Both kinds of tent are mobile and both can be referred to as ehan, as "home". In all groups apart from the imajeghen, tents are the property of women, part of the dowry that they bring with them at marriage. Tents, then, are preceded by the formation of a conjugal unit: the first occupants of a tent are a woman and her husband, who will subsequently be joined by their children. Conterminous with the creation

of a new tent is the formation of a new consumption unit, which the husband is responsible for. It is the husband who must provide food and clothing for his wife and children.

Corresponding to this new consumption unit is a livestock holding, which is made up of a man's own animals, his wife's own animals, and any shimuzagin animals loaned by the wife's father. From this holding a man is expected to provide all necessary subsistence: milk during the wet season, grain during the dry. In addition to his immediate nuclear family, however, a man may also be expected to provide for several other dependents. First, he may have kin - a widowed mother, an unmarried brother, children from an earlier marriage - who may live in the same tent or in another, always co-resident tent. Very rarely is a married man responsible for the subsistence of any currently married kin; married kinsmen are normally expected to provide for themselves, while married kinswomen will be provided for by their husbands. Beyond kin, a man may also be responsible for eklan dependents, who will be of two kinds, his own or those of his wife. In the past, and to a lesser extent today, illelan women brought slave girls with them at marriage; such "dowry" slaves would receive their food and clothing from their mistress's husband. they might live in the same tent, or if adult, live in their own separate tents. An illelan husband may have his own eklan to whom he is also responsible for subsistence: in most cases they will be male and may thus have their own families, again dependent on their illelan master.

A consumption unit, then, is rarely smaller than a tent and its occupants, and quite frequently consists of several tents. With regard to kin dependents, widowed or divorced women are often dependent on their married male kin for support. This is especially so among the Twareg where divorce and widowhood rates are relatively high: among the Illabakan, for example, some 20.9 percent of all women aged 20 or above were divorced/widowed in 1976 (Bernus 1974); while the INSEE/SEDES (1966) survey, in 1963-64, of Twareg in Tchin Tabaraden arrondissement, recorded 15 percent of all women aged 20 and above as either widowed or divorced. If the children of such widowed or divorced women are taken into account, this factor must contribute towards relatively high dependency ratios among some Twareg. Compared to the WoDaaBe, however,

the effect may be compensated for by the fact that the Tuareg are rarely polygynous, while WoDaaBe frequently have polygynous households.

In the past the number of dependent eklan found in illelan camps was much greater than it is today; nevertheless, there are still many eklan who continue to depend on their masters for subsistence. A consideration here, in the context of dependency ratios, is that most of the eklan who remain in illelan camps are women, who do not enjoy the same mobility as eklan men.

Although married men are those most responsible for providing their dependents with subsistence, this is not always the case. Widowed or divorced men continue to support any kin, while adult men who have never married may find themselves responsible for feeding widowed mothers and younger siblings.

Consumption units are usually domestic units at the same time. The group of people who depend, for subsistence, on a given herd almost invariably carry out the necessary domestic work: food preparation, water collection, milking, tent construction. In another terminology, Tuareg consumption units could be described as "hearths". Activities such as food preparation are under the charge of a senior woman; should illelan still have eklan it will be the ex-slave women who do most of this domestic work.

The organisation of pastoral activities, such as herding and watering, often entails the agglomeration of domestic and consumption units. Typically two or more tents combine their herds and flocks and share the workload by alternating herders. Such cooperative herding units can consist of more than forty people among, for example the Illabakan. Data for the Illabakan in 1967 show that 1,022 people were organised into 103 "families", or herding units, giving an average of 9.9 persons per herding unit (Bernus 1974). Other data for a single Kel Ferwan camp indicate that 236 people were grouped into 20 "households" or herding units, giving an average of 11.8 persons per unit (Oxby 1978). Averages, however, disguise the fact that many herding units consist of very few individuals, sometimes as few as two.

Variations in the size of herding unit can be accounted for by two main factors: different stages in domestic development and the presence or absence of eklan. Of the eklan who have remained in their masters' camps, most appear

to have stayed with the wealthier among the illelan. Household and livestock data for the Illabakan in 1967 show that there is a positive correlation between the number of eklan in an imghad herding unit and the number of livestock owned by members of that unit (Bernus 1974). The same pattern holds for the Kel Ferwan of the early 1970's. This correlation is not surprising; wealthy households can afford to maintain eklan, while the latter, through their labor, ensure the maintenance of that wealth. The pattern has continued and today imajeghen and ineslemen of the Kel Dinnik, traditionally the wealthiest groups, have retained the most eklan in their new camps. The other side of the coin is that many of these still dependent eklan are the poorest members of Twareg society, who, in exchange for subsistence, provide their illelan patrons with the greater part of their labour. As already observed, women account for a disproportionate number of such dependents, reflecting a tendency for women to be poor and for eklan men, by virtue of greater mobility, to leave their illelan masters.

The second factor which explains variation in the size of production unit is the developmental cycle. When a man first marries and forms a new household or consumption unit he can also create his own separate herding unit; this may have been especially true in the past when he could have drawn on an eklan labour force. Today, however, in most cases he will, at this early stage in his life, continue to live with his father and any siblings that he has. The general pattern is for sons to remain with their fathers, combining herds and sharing work, for as long as the latter are alive. When the father dies several things may happen. Sons of the same mother tend to remain together, along with their widowed mother; sons of different mothers, but the same father, are likely to separate, forming new production units. If their mother is dead, siblings may go their own way; for an only son, of course, this is inevitable following the death of his father and mother. In an Illabakan camp of 28 tents for example, there were nine herding units (and 21 consumption units): two of which were made up of fathers and married sons (and eklan), three consisted of married sons or divorced daughters and widowed mothers, and four were independent conjugal units (Bernus 1974). Although there is a tendency for married brothers to stay together as a single herding unit this is by no means certain. Three Ibadaydayen brothers, for instance,

operated three separate herding units during the dry season of 1982-83. Important to this flexibility is the fact that property holdings are entirely distinct: both pre-inheritance and inheritance practices clearly divide holdings up among a set of siblings so that there is no property in common among brothers when their fathers and mothers have died. That brothers maintain herding units separated from each other does not imply, however, that they may not combine herds with other kin or friends, but such arrangements may often be only short-lived. In time each married brother establishes his own extended family unit, with co-resident married sons.

The largest herding units, then, are likely to be made up of older men and their married sons who still support a group of eklan. The smallest units will be made up of conjugal families who no longer control a client eklan labor force.

This pattern is also variable according to season. During the wet season, when camps are commonly much larger, there is a tendency for previously separate herding units to combine labor with other herding units; in the dry season, when ecological conditions do not permit such localized concentrations, herding units tend to be smaller. In general Twareg herding arrangements are quite flexible.

Variations in size of herding unit, by implication, reflect variations in the size of a common labor force. A large extenoed family with several attached eklan families can call upon a bigger pool of labor than a small conjugal family with no eklan. In the first case, an agglomeration of several property holdings results in capturing considerable economics of scale; a smaller herding unit, almost regardless of the size of its livestock holdings will, per capita, work much harder than a larger unit. Larger herding units, therefore, are likely to be more labor productive.

Larger herding units, moreover, are likely to be more productive in a more direct sense. The Twareg, as described above, practise a mixed species pastoralism: a single herding unit will often manage herds of cattle and camels, and flocks of sheep and goats. Each species has its own specific requirements which must be catered for. What is good pasture for cattle is

not necessarily good pasture for camels. It may thus prove advantageous to separate a set of animal holdings, sending camels to a different area to that of cattle. The ability of any herding unit to do this, however, is contingent upon the size of the labor force at its disposal: smaller units do not enjoy the same management flexibility as larger units. In this context, the Azawagh region boreholes provide watering facilities which demand very little in terms of labor, in contrast to deep or shallow wells. The drawback to borehold watering is that pasture deteriorates rapidly due to a high concentration of animals and heavy grazing; well watering, on the other hand, provides better pasture. During the 1982-83 dry season several Kel Eghlal camps appeared to be making good use of these differences. By keeping smaller milk herds for watering at deep wells, with a reduction in labour, they benefitted from better milk production; and by sending their larger dry herds, under the supervision of eklan and iderfan, to the bore-hole at Acalak, they reduced overall labor requirements with little cost in terms of milk production.

Among the Illabakan a larger labor pool allows herd managers to separate considerable numbers of livestock from the main camp and thus make use of different pastures. In 1967, the Illabakan operated 29 such separate bush herds. The number of animals involved were as follows: 1,640 sheep, 620 goats, 415 camels and 100 cattle, approximately 22 percent of their total livestock holdings at the time. These 29 herders, known as Kel Tisigant, worked for 27 Illabakan herding units; in most cases these herding units were the largest among the Illabakan. Of the 29 Kel Tisigant herders, sixteen were eklan, the rest being family or contract herders; those imghad who retained eklan obviously reaped considerable benefits from their larger labor force (Bernus 1974).

In summary, Twareg pastoral production is organised along lines of kinship and dependence: kinship because it is consanguinity which dictates how wealth is transmitted, and dependency because wealthier Twareg can support, in exchange for labor, the poorer members of Twareg society.

Marketing and consumption

This section provides a summary of subsistence patterna among the Twareg and how these requirements are met. The first part consists of a description of consumption items; the second, a description of the exchange system used to obtain many of these consumption items.

Food is the central subsistence item. For the Twareg we can conveniently divide food items into pastoral products and non-pastoral products.

Like most pastoralists the Twareg express a cultural preference for milk as a food staple. All fresh milk is referred to as aX. If milk is drunk fresh it is usually in the morning or early evening; if possible, Twareg prefer that milk is drunk when it is still warm from the udder. Otherwise milk can be drunk curdled, when it is known as aX isilayen (or simply asiloy). Curdled milk is made from the milk of an evening milking which is left to curdle in a culture overnight and then drunk the following morning. Curdled milk is also used for processing butter: the morning's curdled milk is beaten in a goat skin until a creamy butter separates out. The butter is stored and the remaining milk drunk. Alternatively, fresh milk can be processed into cheese, which is pressed and dried in the sun. In general, butter and cheese are the only dairy products marketed by the Twareg; in contrast to the WoDaaBe and FulBe, the Twareg rarely sell or exchange curdled or fresh milk.

Meat is the other major pastoral product. As with most pastoralists, the Twareg only infrequently slaughter animals for home consumption. For the most part, slaughter occurs on special occasions (the Islamic new year, naming and wedding ceremonies, religious sacrifice, for visiting guests), or when illness or disease have all but killed the animal anyway. Meat, especially that of camels or cattle, is often stored by drying.

While meat makes an insignificant contribution to the Twareg diet, dairy products can be of great value. However, the ability of a given consumption unit to depend entirely upon dairy products is limited by the number of lactating animals available and hy grazing conditions. As a result, only

rarely can the Twareg expect to live off a purely milk diet for much more than the three or four months of the rains and the season immediately following, when the pasture is abundant and milk production high. In fact, it would appear that relatively few Twareg (only the very wealthy) ever live off a pure milk diet for any length of time. In consequence, the Twareg are, for most if not all of the year, necessarily dependent on non-pastoral foods for their subsistence. Outside the wet season, this dependence is even more pronounced; by the end of the dry season when milk production may have stopped (perhaps because all that is produced must be left to the unweaned calves), most Twareg are living off a diet very like that of the agricultural Hausa.

The non-pastoral food staples on which the Twareg rely fall into two broad categories. First, and of lesser importance in overall nutritional terms, are wild grains. Collectively known as ishiban these wild grains can provide a valuable source of food from after the rains onwards. Cultivated grains have been of increasing importance in the Twareg diet. Of those available, the central Niger Twareg prefer millet; neither sorghum nor rice are considered staples by the Twareg. For those Twareg who practise little or no cultivation, most millet must be purchased at market.

Both wild and cultivated grains are prepared and eaten in much the same way. Grain is pounded and eaten in one of two forms. The first, known as aghajera or tidda, consists of a fine flour to which curdled milk is usually added; the dish is eaten cold. A variety of other items may also be added to the basic aghajera - dates, sugar, wild fruits - to make it tastier. The other major kind of meal, known as eshink, is a hot porridge of pounded and cooked grain, to which may be added fresh milk or gravy or, more rarely, butter. The general pattern is for aghajera to be eaten in the morning and for the eshink to be eaten at night.

In terms of food, the Twareg are heavily dependent on non-pastoral products for subsistence. Food, however, is not the only consumption item for which the Twareg must look outside their own production system: there are many other items which they do not produce for themselves. Tea and sugar, for

example, are consumed in large amounts by the Twareg. Salt must also be purchased. Clothing is another important consumer item, as are many sundries regularly bought by the Twareg, such as soap, tobacco and batteries.

In short, contemporary Twareg society consumes a great deal which its pastoral economy cannot, and does not, produce. It should be noted that many of today's consumption goods are recent items in Twareg subsistence: in the past, greater use was made of local resources while many items simply did not exist on the markets. There has been a trend towards greater consumerism and a consequent increase in the degree to which the Twareg are dependent on the market for subsistence.

The most traditional way of meeting subsistence requirements and obtaining non-pastoral products is by exchange in kind, without cash entering the transaction. Among the Twareg, most such exchanges are for livestock, and not for livestock products. Transactions in kind usually take place in the pastoral zone itself; in the Azawagh, Aderawa Hawsa and Kel Gress ighawellan transport sacks of grain from the south and exchange them for livestock at the main watering points, such as In Wagger. From a few household budgets collected among the Illabakan in 1967-68 it appears that most of these transactions in kind take place after the rains and during the cold season. These exchanges, compared to cash-based transactions, are less favourable to the pastoral Twareg; and the Aderawa and ighawellan reap a substantial profit from their initiative. Since 1968 several new markets have opened up in the northern pastoral zone, thus reducing the time and energy spent by Twareg in visiting markets. They now increasingly sell livestock at markets, rather than engage in transactions in kind.

Marketing of livestock is the main way in which contemporary Twareg obtained the means to acquire non-pastoral products. The development of markets in the pastoral zone has been relatively recent (the new markets at Abalak and Tofamanir, for example, only began in 1975), the result of continued demand for beef and improvements in the Nigerien road network.

Several things can be noted about Twareg marketing in the pastoral zone. To begin with, the marketability of the different livestock species appears to be variable. On the basis of 1967-68 data for livestock holdings and for six household budgets among the Illabakan (Bernus 1974), table 4.3.8 can be drawn up.

Table 4.3.8 Livestock holdings and sales, by species, among the Illabakan, mid-1960s

Livestock species	% of total cash sales	% of total TLU (all Illabakan)
cattle	54	27
camels	25	49
sheep	18	10
goats	3	14
Total	100	100

Although there are inadequacies in the sample size for cash sales, it is clear that cattle and sheep, while accounting for only 37 percent of the Illabakan's total livestock holding, account for 72 percent total cash receipts from livestock sales. Conversely, camels and goats account for 63 percent of TLU holdings but only 28 percent of cash receipts. From the same budget data it is also apparent that cattle are the most frequently exchanged animals in transactions in kind. The conclusion is that cattle and sheep, out of proportion to their numerical importance in the herds, are easily sold, while camels and goats are more obviously retained within the pastoral economy. This pattern is not surprising given that market demand for cattle and sheep is greater than for camels and goats.

In the case of the Illabakan, who are among the northernmost of the Kel Dinnik, their emphasis on camel holdings is not representative of the wider population. As was shown earlier, most Kel Dinnik livestock are cattle.

Given that, and the above data, we can conclude that cattle are the most important livestock species kept and marketed by the Twareg. Low rates of camel and goat marketing are consistent with their uses in the economy. Camels are kept as riding and pack animals, as well as for milking, while goats seem to be the major source of meat in the Twareg diet, as data on goat flocks in chapter 3.2 above show. A corollary to these observations is that the major losses reported among sheep and cattle during the 1968-73 droughts may also partly reflect the fact that many more cattle and sheep were sold in order to buy grain.

Most Twareg market their livestock through a middleman (amadellel), who provides his clients with food and lodging during their stay at the market, for which nothing is charged, and in return handles the sale of animals. For each animal sold the middleman receives a fixed commission; buyers maintaining that he simply adds his commission to the price they pay, while the Twareg maintain that he effectively deducts it from the price obtained. Middlemen are also responsible for guaranteeing sales and ensuring that stolen animals are not sold.

Conclusion

Pastoral production among the Twareg of central Niger is based on the raising of several species of domestic livestock, with a commercial emphasis on cattle and sheep, but with an important subsistence contribution from camels and goats. A brief examination of their economic history showed that since the turn of the century the Twareg in the pastoral zone have become increasingly, and more directly, dependent on pastoralism as an economic activity; associated with this development has been a tendency for greater participation in exchange, intrinsic to pure pastoralism, and thus a gradual switch to cattle and sheep as the most valuable livestock. If the pattern of demand for beef and mutton does not change in the near future, the trend in Twareg pastoral production is likely to continue. Both of these inter-related developments - specialization in livestock production and an emphasis on cattle and sheep - have had the overall result of rendering the Twareg more vulnerable to external market forces.

Contemporary Twareg pastoralism is also distinct from its traditional form in one key respect: illelan property owners can no longer rely upon a subordinate and dependent labour force to the degree as they once did. Nowadays, more eklan live independently of their former masters. This departure of servile labour can be attributed to autonomous accumulation among many eklan and, at the same time, a change in the ideology of dependence. Those who do remain with their masters are often the poorest. The Twareg population has also been growing, placing pressure on resources, which may account for a diminished ability on the part of illelan to support dependents.

But the most important conclusion is that modern pastoral production among the Twareg is disproportionately controlled by the traditionally high status groups: it is the imajeghen, ineslemen, and imghad who are the wealthiest. While they certainly own more animals than their numbers warrant, they may also, between them, own most of the Twareg livestock in the pastoral zone. The implication is that the low status and larger proportion of the Twareg population is less well off, in terms of livestock holdings, than the high status section. The available evidence, both direct and circumstantial, points to the conclusion that pastoral production is a predominantly high status concern, and that low status groups such as the eklan and iderfan have much smaller holdings than their traditional patrons. Given that Sahelian pastoralism is an inherently risky enterprise, and that modern developments have made the pastoral sector more sensitive to market risk, this implies that the modern low status population enjoys a smaller margin of error in subsistence production. Many low status Twareg do not even have enough animals to live a purely pastoral way of life.

The conclusion is that there are, in fact, two Twareg populations: on the one hand the relatively well off imajeghen, ineslemen, most of whom can and do rely upon pure pastoralism; on the other hand the lower status, poorer iderfan, eklan and others for whom pastoralism is a precarious way of life. There is, of course, considerable interraction between these two Twareg populations.

The first sections of this chapter have described the dominant activity of the high status population. The next section examines the non-pastoral activities of the Twareg.

NON-PASTORAL SECTORS

Cultivation and forage production

While livestock raising has usually been seen as the main economic activity of the Sahelian Twareg, it is less frequently noted that many Twareg also practise some cultivation. Estimates in chapter 4.1 of this report show that of the 172,000 Twareg in the project zone, 24,000 practise "pastoralism associated with rainfed cultivation" and a further 65,000 are classified as "agropastoralists". In contrast very few WoDaaBe cultivate. As a result, any description of the Twareg economy would be incomplete without some discussion of cultivation.

Two main kinds of involvement in cultivation can be identified among the central Niger Twareg. The first type is an opportunistic cultivation, the second a more committed agropastoralism with a correspondingly greater degree of sedentarization.

Opportunistic cultivation is practised by members of many Twareg groups, most of which are of Kel Dinnik, Kel Ferwan or Kel Fadey origin. Such pastoralists are opportunistic cultivators in the sense that they plant only when they judge that the rains will be adequate and when such planting makes few demands on labor for livestock production, which remains their principal economic activity. The Illabakan, who normally spend their dry season in the area around In Waggar, well north of the ordinary limits for rainfed cultivation, are opportunistic cultivators. In 1967 a total of 22 Illabakan families (out of a total of 103 families) sowed fields of millet at In Waggar and Shin Salatin. Each field was given a single weeeding and was surrounded by a roughly constructed fence of Acacia branches. The fields, planted at the beginning of the wet season, were then left largely unguarded when the camps began their move north towards Ingal. They were harvested during October and November, after the Illabakan had returned from the Tegguida salt licks. The millet thus harvested rarely exceeded thirty guerbas per field. Another example of this opportuniatic cultivation is provided by the Arkana, an independent eklan group of the Kel Ataram, who spend most of the year in

Niger. The Arkana plant millet if they judge that the early rains have been sufficient; fifteen days after planting they weed their fields for the first and only time. Planting and weeding accomplished, the Arkana head north with their livestock, harvesting the fields when they return after the rains. The yields are small, estimated to average 160 kgs per family. A final example of opportunistic cultivation is that of the Kel Azar. The Kel Azar proper, a tiny group of Kel Dinnik imajeghen, regularly employ several ex-slaves to plant and harvest fields of millet near In Ameriknin (a well northeast of Tamaya). According to the Kel Azar the millet thus obtained rarely supplies them with more than a month's grain needs.

The motivation behind cultivation as practised by the Illabakan, Arkana, and Kel Azar is clear: the millet harvests, despite their small size, do reduce the quantity of grain that must be bought during the dry season. Opportunistic cultivation is characterised by a minimal labor input (a single weeding) and a millet monoculture (other crops are rarely grown), both of which are consistent with a sustained commitment to pastoralism.

Agropastoralism is very different to these opportunistic practices. Most agropastoralists are found in the southern areas of the pastoral zone and the majority of them are of low status: ighawellan, iderfan, eklan n egef. Several features distinguish such agropastoralism from the opportunistic cultivation practised by the Illabaken and others. Agropastoral Twareg will, if necessary, plant several times; if the first planting fails, successive plantings are made, until one succeeds. In addition, several crops may be planted: the three main varieties are millet, sorghum and peas.
The greater variety of crops planted indicates a greater concern with assuring a harvest of some sort: if one crop fails, another may still yield a harvest. Finally, agropastoralists do a great deal more work on their fields, particularly with regard to weeding. The first weeding occurs fifteen days after sowing: it is followed, some two weeks later, by a second weeding. In addition to the hard physical work of weeding, Twareg agropastoralists carefully watch over their fields, an activity which restricts their mobility. Their nomadism is therefore more transhumant in nature than that of the pure pastoralists: only the younger men take the herds and flocks northwards to the salt licks.

Among agropastoralists the harvest and weeding are characterised by collective or exchange labor. For weedings, each field owner can call upon locally recruited work parties who undertake collective work, known as imugazen. Such collective work is paid for by the provision of meals and refreshments; they are also reciprocal in nature. The Kel Gress also practise a similar mode of labor recruitment for agricultural work: wealthy imajeghen can call upon client ighawellan to work their fields in return for subsistence, mobilising in the process a network of traditional political ties.

Within an agropastoral household, landholdings are usually of two types. On the one hand is the family field, tawogust (tiwugas pl.), controlled and managed by the household head. All members of a household will work on this field for five days in the week. On the two remaining days, members of a household can work on their own individual plots, known as etakas (iteksan pl.). Dune fields are cultivated for three to five years, after which they are left fallow for at least twelve years. On more clay soils, however, cultivation can continue for up to eight years, following which the fields will be abandoned for a long fallow period.

In good years harvests from their fields can provide agropastoralists with all their annual grain needs; this is especially true of Kel Gress ighawellan, whose dependence on millet production is very considerable. In other years, when grain production is insufficient for consumption needs, Twareg agropastoralists rely on livestock sales to make up shortfalls.

The origins of Twareg agropastoralism appear to be quite diverse. Some groups consist of ex-slaves, descendants of eklan who were settled on agricultural land by their illelan owners. Members of the Tamjirt are an example of this process; they were originally settled around 1860 in the Shaaba valley by the Kel Nan, to whom they paid an annual tribute of between 80 and 100 kg of millet. Other agropastoral groups are also of eklan descent but their colonization of cultivable land followed secessions from their pastoral masters during the colonial period. Finally, many Twareg began to cultivate in the years following droughts; in such cases their participation in agricultural production can be seen as part of the process whereby the

pastoral economy regularly exported non-viable sections of its population during periods of stress in the pastoral zone.

In addition to cultivation, many Twareg harvest wild grains. Harvested wild grain species, collectively classified as ishiban, include Panicum laetum (asghal), Echinochloa colonum (akasof), and Brachiana lata (tegabart). They are harvested from October onwards. Collection of these grains is either on a day to day basis or, less frequently, for a stored harvest. Along with the ishiban harvests, the Twareg also collect wezzeg, the grain of Cenchrus biflorus. In the past these two harvests were of considerable importance to the pastoral Twareg; during the mid-19th century, when the Kel Dinnik and Kel Gress were disputing control over the northern Ader, the former group appear to have relied upon wild grains to meet most of their subsistence needs. As late as 1972 several groups of the Iwllemeden Kel Atarem (Mali) were recorded as obtaining at least half of their annual grain requirements from ishiban and wezzeg.

Other wild foods (especially fruits and leaves) are also collected by the Twareg, but they are less important than ishiban and wezzeg. Several of these other wild crops, however, do provide the pastoral Twareg with drought or emergency food: for example agerof (Tribulus terrestris), enzanen (the fruits of Boscia senegalensis).

Food production from all these plants is a labor intensive process and, as a result, most of the labor force consists of lower status Twareg. Given the increasing autonomy enjoyed by such low status groups, higher status Twareg can no longer rely upon a supply of wild grain. The lower status groups, on the other hand, now obtain the entire wild grain harvest for themselves. While it is difficult to assess the quantitative importance of these harvests, they are probably often major sources of subsistence among the low status population; without ishiban and other wild products, many eklan would probably be unable to continue in the pastoral zone.

In recent years it seems that wild grains have made a reduced contribution to household consumption. This decline can be attributed to the presence of more cattle in the pastoral zone; not only do cattle graze on ishiban grasses,

they also trample the ground making harvesting difficult. In addition, a growth in population has also, in all likelihood, contributed to reduced production per capita.

Twareg involvement in both cultivation and forage production can be seen as an attempt either to reduce their dependence on livestock sales or to compensate for an inadequate livestock base. Opportunistic cultivation and wild grain harvesting, in particular, have the effect of cutting down the need for bought grain, and thus of reducing the number of animals which must be sold or exchanged. The singular involvement of poorer eklan in wild grain production is also indicative of the compensatory effect that these stocks have on the pastoral economy. For agropastoralists the situation is obviously more complex. The origins of Twareg agropastoralism nonetheless testify to the fact that inadequate livestock holdings were instrumental in pushing many Twareg groups into extensive cultivation. Cultivation and pastoralism among the Twareg must be seen as often complementary; pastoralism may merely be one activity in a larger economy.

Migrant labor

Labor migration has been a long-established tradition in what was once the French Sudan. Under colonial rule, taxation was set at such a high level that many Sudanic peasants had little choice but to sell their labor in the more prosperous colonies of the south, Ivory Coast, Ghana, and Nigeria. From the 1930s onwards there was a steady migration of Sudanese labor to the south; for many migrants the movement was seasonal, taking place during the long period of slack in the agricultural economy.

Among the Twareg, this pattern of seasonal or even annual migration appears to have had a rather different history. Pastoral Twareg, unlike sedentary Hausa or Songhay, could more easily pay their taxes, through the sale of livestock. Migrant labor among the Twareg, instead, has its origins in a more recent period.

The first and most striking feature of Twareg labor migration is that the majority of migrants have been, and continue to be, of low status origin, especially ighawellan and eklan. While evidence is only qualitative, even impressionistic, it seems clear that the imajeghen, ineslemen, and imghad are under-represented within the "migrant economy". This is, of course, consistent with two inter-related considerations: that higher status Twareg are less disposed towards what is seen as a degrading activity, and that low status Twareg are usually the poorest members of the Twareg population and, moreover, less constrained by self-perceptions of what is appropriate or inappropriate vis-a-vis work. Another important factor is the steady decline of traditional relations of subordination and dependence since the 1930s and 1940s. Only rarely did emancipated eklan dispose of sufficient livestock and income to guarantee them immunity from periodic disaster; for most eklan, independence from their masters often meant an increased insecurity in terms of economic livelihood.

While many of these newly independent eklan may have helped themselves by taking up cultivation, some of them must still have faced the prospect of sustained poverty. One of the solutions open to them was to migrate south, into the wealthier colonies (and, later, ex-colonies) where they could obtain work and wages.

During the colonial era, one of the countries to which many such eklan were drawn was the Gold Coast. In Accra, in particular, a number of ex-slaves worked as porters, becoming a part of the "Kaya-kaya" community, as it was known locally. This employment as porters, as a manual labor force, has been characteristic of the eklan ever since; one must also view it as almost inevitable, given their lack of education, unfamiliarity with urban life, and the fact that they could only offer labor power in its simplest form. Eklan migrants to Abidjan have also been traditionally associated with the "baranini", or porters, as they are known in the Ivory Coast. More recently many ex-eklan have taken up employment in northern Nigeria, most of them finding jobs as nightwatchmen.

There appear to have been two kinds of migrant, one seasonal, the other more inclined to remain in the cities for one or two years at a time. The seasonal migrants are often men from agropastoral communities, taking advantage of a dry season slack in farming activities. Among these agropastoral communities it would seem that the scale of migration has increased rapidly since the late 1960s, perhaps corresponding to increasing pressure on cultivable land, with a consequent tendency for shortfalls in grain production. Of the migrants who spend more than one year in the south, many come from the pastoral sector; and their intention has often been to accumulate sufficient cash for livestock purchases. Some of these non-seasonal migrants have worked simply to provide their families with cash for subsistence. For every migrant laborer there is probably a unique set of reasons behind his migration; but the overall trend is for poorer Twareg, pastoral or agropastoral, to undertake the long journeys south so as to earn the cash they cannot acquire in any other way, and to use their earnings to support kin and families in Niger.

An important aspect of this labor migration to the Ivory Coast and Nigeria (now that Ghana has ceased to be a pole of attraction) is that the migrants concerned retain links with the pastoral and agropastoral populations; indeed, it is these links that have been largely responsible for their seeking work in the south. This implies a definite inter-relatedness between traditional activities and modern wage labor, the latter being a response to deficiencies in the former. Migrant workers in Abidjan do not usually intend to remain there and the impression is that the migrant sees his work as a stop-gap measure, a way of shoring up gaps in a household economy in rural Niger.

The other kind of migration is of a different nature. Throughout the towns of central Niger small, but increasing, communities of Twareg are found. This population of urban Twareg has undoubtedly always existed: the historical links between pastoral Twareg and commercial communities date back several centuries. Nevertheless, it does seem that more Twareg are taking up a settled life in the towns, and that most of them are of <u>eklan</u> origin. What distinguishes this kind of migration from those to the south is the fact that whole families (rather then just husbands, brothers or sons) are involved. Their employment, moreover, is often different to that of the Abidjan or Kano

migrants. In some cases, whole families are employed as domestic servants, the men as gardeners or nightwatchmen, the women as cooks and cleaners. Their employers are various, Nigerien civil servants, livestock service agents, policemen or European expatriates. It is possible to interpret their migration out of the traditional economy as a response both to poverty and to new opportunitiea. In the past many of these Twareg would probably have taken up farming; today urban employment is an alternative. It is not known whether these town Twareg are of a pastoral or agropastoral origin but whichever, their presence does testify to the inability of a pastoral economy to support the entire Twareg populstion and its demographic increment.

The development of uranium mining around Arlit in norther Niger has also provided new opportunities to Twareg. In fact, of the 1,000 jobs or so directly created by the mining industry only a small number appear to have taken up by Twareg. The mining towns at Arlit and Azelik have, however, provided opportunities in the service sector: many Twareg, especially eklan, live and work in the towns as domestic helpers or shop assistants. Some of these Twareg have settled down as families.

Twareg labor migration has, in large part, been a migration of low statua labor. This is not to say that other Twareg have not undertaken the journeys to the south and worked there; there have certainly been imajeghen and others involved. However, given that the principal motivation for these migrations has been poverty and that the poorest tend to be of lower status, the characterization generally holds true. As we have seen, such a pattern is consistent with the structure of pastoral Twareg society.

Trade and other market activities

In the brief overview of economic evolution it has already been noted that many Twareg have traditionally participated in the salt trade. In this section this commercial activity is further described and analysed; in addition, other such market-orientated activities are discussed.

The central Niger salt trade can be conveniently divided into two components, the Ighazer trade, and the Bilma-Fachi trade. The Ighazer trade is of lesser importance but still deserves some treatment here.

One section of the Ighazer trade is largely in the hands of the Iberogan, low status but free clients of the Igdalen. During the dry season, Iberogan men make the long journey from their camps on the northern edges of the Ader to Tegguida-n-tesemt. They take donkeys, camels, and baggage oxen with them, together with their own supply of food. Once at Tegguida the Iberogan dig up taferkast from the salt deposits and load it into mat sacks; the work, which may last for a week or more, is hard and demanding. Their animals loaded, the Iberogan head south and sell the salt at local markets, where a sack fetches between 600 and 1,000 CFA and is bought by pastoralists for their livestock. The profit belongs to the Iberogan and any other Twareg who lent them pack animals. The long trip to Tegguida and back may be undertaken up to three times a year by the Iberogan.

The other section of the Ighazer trade is controlled by the inhabitants of Tegguida and Ingal who make salt loaves from local deposits (access to which is not open, unlike taferkast deposits). The salt loaves are sold or exchanged at Tegguida or Ingal. The buyers are usually Kel Gress or Hausa caravaners; occasionally some Kel Dinnik participate. The Kel Gress take the salt south, by camel, where it is resold for a substantial profit: in 1970 it was estimated that an average camel load of Tegguida salt could fetch a profit of up to 5,000 CFA. This Tegguida trade goes on throughout the year.

Caravans to Fachi and Bilma, collectively known as the taghlamt, probably account for the largest proportion of central Niger's salt trade. The Bilma taghlamt is comparable to its Malian counterpart, the Taoudeni azalay. While the Twareg have almost certainly transported salt from Fachi and Bilma for several centuries, only since 1777 have they almost totally dominated the trade. In 1777 the Kel Ayr finally wrested control over the Kawar area from the Tubu, after which they imposed their authority over the Kanuri sultan at Bilma. Throughout the 19th century the taghlamt was constantly attacked by Tubu and Arab raiders; these raids were the main reason that the Bilma caravan took on its highly organized nature and enormous size. In 1850 Barth

estimated that the Kel Gress and Itesen camel caravan he saw at Agadez, on its way to Bilma, numbered at least 10,000 animals; given that the taghlamt also included a Kel Owey caravan of equal size, the Bilma caravans of the mid-19th century must have numbered some 20,000 camels a year.

During the early years of colonial rule the taghlamt retained its traditional form, a huge caravan during the autumn, known as the tagharat, and occasionally smaller caravans in the hot and wet seasons. Since the 1940s, however, and because security along the route taken has greatly improved, the taghlamt has been increasingly made up of numerous smaller caravans. The route taken by caravans to Bilma depends on the Twareg group involved: Kel Owey camels trek to Fachi from Ijiwa, in the northern Ayr, while Kel Gress, Itesen, and Damergu caravans reach Fachi by way of Beurkot and the "tree of the Tenere". From Fachi both caravans take the same route to Bilma. On the return journey, the Kel Gress and Itesen head for the Ader, the Kel Owey towards Maradi, and the Damergu Twareg towards Zinder.

Most of the Twareg involved in the Bilma taghlamt are of Ayr origin: Kel Owey, Itesen, Kel Gress, a few Kel Ferwan, and Imuzzarag from Damergu. Only a very few Kel Dinnik regularly participate in the salt trade; of the Kel Dinnik, only the Kel Eghlal appear to be involved on an enduring basis. Thus, for the project zone, this Bilma salt trade is largely in the hands of the Kel Gress, Itesen, and Kel Ferwan. Most of the following concerns the Kel Gress only, who heavily involved: in 1953, of the 28,500 camels used in the Bilma taghlamt, 8,000 belonged to the Kel Gress slone.

The Bilma salt trade consists of a simple double exchange. The Kel Gress and Itesen load millet on their camels at the beginning of the wet season and make the long journey to the Ighazer salt licks, where they remain until perhaps late September. The millet is usually drawn from excess stocks from their own granaries, indicating that Kel Gress cultivation is highly productive. Other items - tea, sugar, clothing - may also be loaded up with the millet; but for the Ader Twareg millet is by far the most important commodity transported north. After the salt cure the camels are taken east towards Agadez and then on to Fachi and Bilma.

Because Bilma salt is recognised as being of higher quality than Fachi salt, most Kel Gress caravans head for Bilma. Once there the first set of exchanges take place: millet is either sold or exchanged for salt and dates. Table 4.3.9 provides, for a selection of years, the quantities of millet, salt, and dates involved in this series of exchanges. These figures apply only to Bilma and include all Twareg transactions (Kel Owey, Imuzzarag, Kel Gress etc) but do not cover imports other than millet, such as clothing or tea.

Table 4.3.9 Imports and exports to and from Bilma

Year	Millet imports (metric tons)	Salt exports (metric tons)	Date exports (metric tons)
1923	90	630	357
1931	250	1037	187
1936	380	1246	550
1953	588	2346	496
1970	309	956	124

At Bilma, salt and dates are loaded on the camels. On average, a laden camel will carry about 120 kg of salt and 30 kg of dates. At Agadez the Kel Gress caravans turn south towards the Ader, where a second set of exchanges takes place. The salt and dates are usually sold to Hausa merchants, who then transport them into northern Nigeria.

Substantial profits can be made in this salt and date trade. Table 4.3.10 shows the estimated profit for an average camel load among the Kel Gress in 1970.

Table 4.3.10 Estimated profit per camel load in 1970

Item	Cost (CFA)	Sale price (CFA)	Profit (CFA)
Millet	1500 (Ader)	3000 (Bilma)	1500
Salt	350 (Bilma)	6000 (Ader)	5650
Dates	100 (Bilma)	500 (Ader)	400
Total	1950	9500	7550

Thus the first set of exchanges (millet for salt/dates) realise a profit of 1,500 CFA; the second set (salt/dates for cash) a profit of 6,050 CFA. At 1970 prices these were considerable profits.

The size of the Bilma salt trade, and the extent to which the Twareg are involved in it can be gauged from estimates of the number of camels which make the journey to and from Bilma. Following the severe disruption of the 1917 revolts, the taghlamt gradually regained its 1913 levels and by 1938 an estimated 22,000 camels were used. The caravans continued to grow during and after the war, with 25,000 camels recorded in 1946 and 28,518 in 1953. Since 1953, however, there have been few reliable figures. The only reasonable estimate available, for 1970, gives 11,070 camels in the taghlamt and does indicate that a massive decline has taken place.

The Kel Gress involvement in this trade is important. Of the 30,000 camels owned in 1970 by the Gress as a whole, over two-thirds belonged to the imajeghen alone, who represented only between 5 and 8 percent of the total population. From this it would seem likely that the imajeghen also own the majority of the camels used in the Bilma salt trade. Kel Gress imajeghen, however, infrequently go to Bilma themselves; instead they employ eklan or ighawellan as caravaners. In return for this labor, caravaners receive per laden camel, approximately 22 percent of total salt by weight. By virtue of their camel holdings, Kel Gress imajeghen reap large profits from the salt trade. Given that a great deal of the millet they trade is grown on their

fields by client ighawellan, the imajehen are making still larger profits as a consequence of this double exploitation.

The 1970 figures are the most recent available estimates of camel numbers in the taghlamt; it is not known what has happened since the end of the drought in 1973. However there has been a decrease in the price of Bilma salt in the south. Between 1960 and 1965 the price of a salt kantu, a block weighing between 15 and 20 kg, varied from 500 to 1,000 CFA. In 1968 the price of a Bilma kantu had dropped to an average of 500 CFA. Even before the 1960s, price series data indicate that, with the exception of the war years, the price of Bilma salt has gradually declined.

As a result of this drop in salt prices, the profits made during the Bilma trade have been reduced. Whether this trend has continued in the 1970s is not known. One explanation for this drop in the price of Bilma salt is that there has been fierce competition on the market, from Amadror (Algeria), Taoudeni (Mali), and sea salt. Until the late 1930s, Bilma and Fachi salt was usually available in double the quantities of overseas salt: in 1936, for example, a year when salt imports to Niger were particularly high, overseas salt imports amounted to 683 metric tons as compared to 1246 metric tons of salt from Bilma. What has probably changed, is that the northern Nigerian market, on which the Kel Gress in particular are dependent, may have started buying more sea salt.

Another factor is the development of lorry transport. In 1972, for example, Libyan lorries on their way to Agadez collected large amounts of salt from Bilma and transported it south. The Nigerien road network has recently undergone a major upgrading and it is possible that lorries are transporting an increasing share of the salt trade.

In conclusion, available evidence suggests that the Bilma salt trade, as far as the Twareg are concerned, has become both less profitable and, in terms of camels and people involved, a less significant enterprise. These conclusions, and particularly the second, are based on little information for the 1970s and early 1980s. However, if they are valid, there is a further implication: that Twareg camel pastoralism, which among the Kel Gress has been

strongly geared towards providing pack animals for the Bilma salt trade, is of declining importance. This reinforces the likelihood that Twareg pastoralism is becoming more dependent upon cattle and sheep.

Although the salt trade has always been seen as the most important Twareg involvement in non-pastoral activity, there are other areas in which they have participated.

Artisan production has always been a part of the Twareg economy. Inadan are the artisan caste of Twareg society, which has traditionally relied upon their products for subsistence. In the past, most inadan lived in the camps of their patrons - imajeghen, ineslemen, imghad - and, in exchange for their products, received milk and sometimes grain from them. More recently, inadan production has become highly commercialised: virtually all of their products are now sold, many of them in markets and towns, rather than in the camps themselves. Notable among these market items are leather sandals (of Agadez origin) and elaborate tamzak camel saddles. The inadan themselves often do not do the marketing but sell their products to traders. Finanlly, it should be noted that the inadan are not the only category of Twareg involved in artisanal work; several lower status groups also produce craft products and sell them on the market.

Many Twareg, most commonly those of low status, market bush products. Wild grain is often available on the market. Another common item, during the cold and early hot seasons, is a baked loaf of jujube berries (fruits of Ziziphus mauritania). A gum of several Acacia species is another product sold on local markets. The marketing of these bush products is almost always confined to ex-slave women, who also gather most bush items. Although the marketing of bush products seems to be less common among the central Niger Twareg than it is among the western Twareg it is nonetheless a source of income to many eklan.

From this section it can be seen that higher status Twareg do participate in non-pastoral activities. The salt trade however, is only controlled by the imajeghen because of their firm grip on camel ownership, and because of that can be seen as a direct adjunct to their pastoral economy. Other

commercialised activities are not for high status Twareg, and are largely restricted to lower status people, indicating once more that their pastoral base is insufficient for subsistence.

Bureaucracy and political activities

Since 1960 Niger has had full political independence. As a nation-state Niger has its own Nigerien-staffed civil service and although a large proportion of public sector employees are Hausa and Songhay-speakers there are many Twareg employed by the state.

The main avenue to employment in the state sector is formal education. During the colonial period many Twareg were unwilling to allow their children to go to the schools established by the French administration; one of the reasons for this was that prior to Nigerien independence there was little perceived benefit in sending one's children to school. Independence, on the other hand, has meant that real power and obvious benefits can be gained through a school education. But it seems that not all the sons in a given family are sent to school. There are many reasons for this but a striking implication is that it does imply a division of labor within the household. This interpretation is further reinforced by the fact that many Twareg sons return every year to their parental camps. Many sons also send gifts and money, at regular intervals, to their kin in the pastoral zone.

Once educated, these young Twareg men can take up full employment in the state sector as teachers, livestock agents, administrators. Some remain in Niamey, participating in central administration; others return to work in the pastoral zone. Wherever they go they almost always become points of contact for visiting Twareg, especially kinsmen and other members of their own tawshit. This Tamajaq-speaking section of the state sector is not particularly powerful. It is nonetheless an important representative of the Nigerien Twareg and something that is quite lacking in the case of the WoDaaBe. Twareg civil servants are in a position to communicate the needs of their kin and, less certainly, to act in their favor. It is not clear that the lower status Twareg population shares this influence to the same degree.

The political position of the lower status Twareg population is weakened by another consideration. Most central Niger Twareg are administered on the basis of divisions and groupings inherited from the colonial administration. The Kel Dinnik, for example, are still organised into seven Twareg groupements, four of which are headed by imajeghen chiefs and three by ineslemen chiefs. When the state deals with the Kel Dinnik Twareg it does so through these chiefs who, in turn, represent their groupements before the government. The traditional chiefs enjoy considerable political power, in so far as they are consulted by the state and often administer benefits dispensed by the state, and this position seems likely to be reinforced by the new political structure of the Development Society (see chapter 6). Inevitably, such chiefs are more likely to represent the interests of their high status kin (rather than their low status subordinates) and allocate benefits to them, rather than to others. The benefits administered by the state are important, an example being rural credit which does appear to have benefitted higher status Twareg more than the rest of the pastoral population.

High status Twareg participation in state employment and domination of local administrative structures has not been the result of conspiracy. On the contrary, it has been an almost natural process, a modern extension of the intrinsically inegalitarian structure of Twareg society. The important point is not how this has occurred but what it means for future development. High status Twareg occupation of positions of power can only imply that access to new resources, provided by the state, is likely to be uneven, with the low status population receiving less than its share of development benefits.

Conclusion

This section has described the nature of Twareg involvement in non-pastoral economic sectors. With the exception of the salt trade and public sector employment, it is apparent that the main participants in these non-pastoral activities have been, and are, lower status Twareg. It is the low status population from which most of the agropastoral and migrant communities have been drawn. Equally, artisan production and petty marketing are mostly confined to this population.

In contrast, higher status Twareg have often been able to avoid involvement in non-pastoral sectors. The Bilma salt trade is a major exception but Kel Gress participation in this trade is entirely consistent with their pastoral activities, predicated by it even, as a result of their camel holdings. The other area into which high status Twareg have moved is the bureaucractic sector, and it is obvious that there are substantial payoffs to be made here.

A tentative conclusion is that there is an inverse relationship between range of economic activities and status: the higher in status, the smaller the range of activities. This is especially true if the Bilma salt trade has declined or if an increasing share of it is now transported by lorry. A corollary of this proposition is the new political and bureaucratic activities entered into by high status Twareg, and the greater representation and power they enjoy.

DEVELOPMENT AND CHANGE

This section is about development and change among the Kel Dinnik. Not much is said about the 1973 drought, not because it was unimportant but because other changes are also important, and have not been adequately discussed in the literature. The way in which the Kel Dinnik social and economic formation has evolved in recent years has been conditioned by several factors. The decline of traditional systems of dependence and the way that this decline has interacted with the systems of dominance are one of the main factors fuelling change among the Kel Dinnik. This section explicitly contrasts the way in which changes have taken place among the Kel Dinnik on the one hand, and the WoDaaBe, on the other. Here, as in so many things, a comparative analysis does much to explain the particularity and specificity of tendencies in different populations.

The logic of exodus

Most Kel Dinnik seem, based on casual observation, on a per capita basis to be better off than the WoDaaBe (there are poor Twareg but, equally, there are many relatively wealthy Twareg). At first one might try to explain this by reference to a generally higher level of livestock accumulation among the

Twareg. However, there does seem to be evidence that the apparently greater wealth among the Twareg is a relative effect, the consequence of two culturally different ways of dealing with poverty. Among the WoDaaBe, as has often been noted, there is a considerable reluctance to take up cultivation even when people have very small herds; equally, as Chapter 4.2 described, there are mechanisms in WoDaaBe Society to maintain nonviable units within the system, and to regenerate the herds of very poor households with animals from within the pastoral economy. In short, the WoDaaBe, almost regardless of the status of their livestock base, all remain, more or less, pastoralists. This does not appear to be the case of the Kel Dinnik. As we have seen, livestock reconstitution mechsnisms only help the unfortunate in so far as they are of relatively high status, the pattern being one of retention and denial of access to the means of production on the part of the higher status tiwsatin. The poorer, low status members of the Kel Dinnik population are consistently in a position of limited access to livestock. And, in the period following a major drought and livestock losses they cannot viably remain within the pastoral economy: they must, if they wish to survive, leave it. The structure of the Kel Dinnik economy, then, is such that non-viable members are pushed out of the pastoral system. If haBBanae epitomises the WoDaaBe way of coping with drought, then exodus is the distinctive feature of the Kel Dinnik mode. The result of this exodus is that only viable members of the system remain in the pastoral economy, a tendency that results in the impression of greater Twareg animal wealth. The reality however is that the poor are, quite simply, not there.

If, then, the Kel Dinnik economy is structured in a way that results in the "export" of the poor (a notion first formulated by Stephen Baier (1980) in his economic history of central Niger), where are the poor going? In a modern context there are a number of possible options. The most radical is total departure from Niger, emigration to the more developed countries to the south, and remaining there for several years, if not longer. By doing so, poor Twareg might hope to obtain cash with which to buy livestock and thus re-enter the pastoral economy. Alternatively this emigration might represent a more or less permanent phenomenom with families remaining in Niger, living off what they can, while the family head lives and works abroad, sending back cash to support his dependents. The second less radical possibility is for poor

Twareg to join urban communities - Maradi, Tahoua, Niamey - and then obtain work on a more or less casual basis. The third, and probably the most historically important, option is for destitute Twareg to take up rainfed millet cultivation in the southern agro-pastoral zones. In principle one could view all three alternatives as methods by which poor Twareg can obtain the non-pastoral means to regenerate pastoral wealth (cash to livestock, millet to livestock); one could also interpret the exodus phenomenom as marking a permanent outflow from the pastoral sector. Either way the important thing to note is that poor Twareg do not have a great deal of choice: exodus is the only way of avoiding sustained destitution in the pastoral zone. And the exodus system has its logic in the self-reproducing tendencies of Twareg class and status structure.

Thus far the exodus has been discussed in terms of its economic logic. There is, however, a critical feature of the exodus that does need further discussion, namely the issue of which section of the population emigrates; we know that it is most likely to be the poor but beyond that nothing has been indicated. The main participants in these (historical and exoduses have been the eklan populations, the low status domestic slaves. There is no reason to suppose that the eklan exoduses out of the pastoral economy have not been long-established, as Baier (1980) suggests. Turning to more recent emigrations, however, the picture seems a little clearer. Large eklan exoduses took place from the end of colonial rule (internal self-government) until the first few years of Nigerien independence, a period that would seem to correspond to a time of rising class consciousness, a realisation (partly activated by external state agents) that slavery was over, in short, a time when the dominant ideology of natural hierarchy underwent severe stress. Eklan at the time must have questioned the terms of the dependence and undergone a rise in aspirations which the propertied illelan tiwsatin did nothing to satisfy, the latter being firmly rooted, for their own obvious self-interest, in a class-sustaining system. Faced with a situation of intolerable terms of dependence, and having no means of obtaining livestock for themselves, the eklan must have been left with little option but to leave. As Bernus (1962) documents for the Tengeregedesh groups of the Nigerien Gurma, some eklan successfully contested ownership of the livestock entrusted to them by their illelan; but, in many cases, the eklan must have found

themselves with the choice of remaining in a traditionally subordinate position or moving into the agro-pastoral zone and tnere, with their labor, making an independent living. The historical events and the exact nature of this belated process of emancipation remain vague and largely undocumented, but the central factor which concerns us here is that the Twareg system did not allow for the poor eklan to obtain, within the pastoral economy, their own pastoral means of production.

More recently, the 1973 drought rendered many of the illelan destitute, unable to support their remaining eklan. The exodus following 1973 represents the inability of the Twareg system to sustain widespread herd reconstitution, the result being large movements out of the pastoral economy. As usual, the eklan, being of lowest status, are the last to receive any aid (on acceptable terms) from the wealthy and so, once again, it is the eklan who make the majority of the emigrants.

Hence, although the precise determinants of exodus are variable and complex its general logic seems to be found in Twareg class structure, a system that, rather than allowing the destitute to reconstitute, merely pushes them out of the pastoral economy.

The decline of traditional political economy

The Kel Dinnik, as many authors have pointed out, are traditionally the most pastoralist of all the Nigerien Twareg; unlike the Kel Gress, for example, the Kel Dinnik practise little in the way of intensive cultivation or long distance caravan trade. The reasons for this monopastoral nature of the Kel Dinnik economy are probably partly of a geographical and ecological order; their zone is neither suited to intensive cultivation nor well-placed for the development of a non-livestock trading system.

Whatever may have been the case historically it does seem that the Kel Dinnik are beginning to diversify their economic base. At the moment it is a very limited process, confined to a few wealthy Twareg; it is nonethless a trend which looks like continuing. The diversification consists of an investment by Twareg in non-pastoral activities: the purchase or construction

of houses, subsequently rented out, in the zone's market towns; the purchase of vehicles subsequently used as commercial transport; increased involvement in small scale com. .ce and trading. This gradual process of diversification recalls to mind some Middle Eastern pastoral societies where, in many cases, rich herders invest heavily in non-pastoral sectors.

There must be several reasons for this diversification. In the first place, the development could not have occurred had no opportunities for diversification existed. In this context, one can note that the rapid emergence of a well organised marketing system (itself a result, in part, of a massive improvement in the national transport network) has provided these opportunities. Urban communities such as Abalak are thriving market centres, offering plenty of entrepreneurial opportunities. In the second place the Nigerien government, through its UNCC rural credit scheme, has, albeit unwittingly, given many Twareg access to large sums of cash. In theory the loans extended were for livestock reconstitution but, in practice, the money has been used for anything; moreover, it seems to have been high status, wealthy Twareg who have had easiest access to this credit. Market development and the availability of cash have helped the process of diversification but there remains the question of why the Twareg should be deliberately channelling wealth into non-pastoral sectors.

In the past surplus wealth was, for all intents and purposes, surplus livestock. The motivation for and logic of livestock accumulation among pastoralists are often described as being found in the need to have a cushion against disaster: the more animals one has, the more one can afford to lose in a bad year, and the more will be left at the end of it. While there can be no denying that this insurance function is important there is also another, less frequently discussed, rationale for accumulation: the wealthy pastoralist is also in a position to accrete dependent clients, using surplus accumulated livestock as the basis for a series of patron-client relationships. For the Kel Dinnik, large herds would have meant lots of dependent and subservient eklan, even low status illelan, with a subsequently greater political power. The circuit of accumulation can be seen as being part of the political power structure. Today, however, the traditional political structure has changed; many eklan are no longer there and they are certainly not the client

population they once were. And, moreover, in the context of a traditional political system undergoing encapsulation within a larger Nigerien state system, the rules of the political game have changed; power is no longer resident in exclusively livestock based patronalism. The circuit of power is now external to the pastoral system. The result of all this is that one of the major rationales for livestock accumulation is of diminished importance, and surplus animal wealth is less easily transformed into political credit. Wealthy Twareg may now construe the non-pastoral circuits as being more (financially and politically) fruitful channels for their surplus wealth; in the process, they are locking themselves into the state-oriented power system and a more capitalist economy.

The explanation given here for the limited diversification of the Kel Dinnik economy is very provisional; while it may turn out to be flawed it still seems that one must examine changes within Kel Dinnik political economy if one is to fully understand what is going on. Diversification does not simply occur because the opportunities for it exist; there must, ultimately, be some cogent reason for the Twareg effectively to transfer wealth out of their pastoral economy, and to understand that one must analyse what their pastoral wealth was used for and how such conditions have changed.

Change among the Twareg and the WoDaaBe

Much of what is currently known about recent changes in the pastoral economy in the project zone, as outlined in the previous chapter, relates to the WoDaaBe. That said, it is important to know whether such WoDaaBe-based observations hold true for the Kel Dinnik.

For the WoDaaBe one of the most significant post-drought developments has been the appearance of "entrusted" cattle in WoDaaBe-managed herds. These jokkere cattle do not belong to other WoDaaBe but to other categories of people: Hausa cultivators, traders, bureaucrats, Twareg. The jokkere system represents a partial proletarianization of many WoDaaBe, the terms of the contract being such that the herdsman receives only milk from lactating females as payment for his labor, and no reproductive or productive animals. To that extent, the WoDaaBe with such jokkere cattle have become suppliers of labor (rather than livestock) to the regional economy, a change that has many implications for the future.

Among the Twareg no comparable tendency is observed; no Kel Dinnik informants asked could think of any non-Twareg animals being entrusted to Twareg herders. From the point of view of the entrustors several things might explain their preference for WoDaaBe rather than Twareg herdsmen; for one, the Kel Dinnik are not renowned for the amount of herding that they do and there can be little doubt that in the eyes of an outsider the BoDaaDo is a much better, more diligent herder. For another, there may well be a great deal of mistrust, even dislike, of Twareg on the part of outside investors. The jokkere system, however, seems to involve a degree of soliciting on the part of the herder himself and it is here that one feels the real answer must lie: the Twareg simply do not want to take on entrusted animals from outsiders and thus make few attempts to look for such herding contracts. Again the probable reasons for this are several. To begin with there is the question of distrust, Twareg not being willing to take on entrusted animals because of what they perceive as the enormous potential for conflict between Twareg herder and non-Twareg "employer". And, bearing in mind that destitute Twareg usually seem to leave the pastoral economy, this exodus option might be preferable to remaining a proletarian pastoralist. Thus, while many low status Twareg are willing to take up cultivation, and thus have an alternative to outsider entrusted animals, the WoDaaBe, who are reluctant to cultivate, have a more restricted choice. Then there is the fact that the Twareg are much more numerous than the WoDaaBe, which means that there may be more Twareg in a position to loan milk animals (under the shiyat system) to destitute Twareg. Despite the patronal nature of shiyat loans they are undoubtedly less conflict-ridden and more flexible than the jokkere contract, and must be seen as preferable to taking on outsider animals. Thus one hypothesizes that in the period after 1973 for those Twareg who did not leave the pastoral economy altogether there were sufficient surplus animals available among the wealthier Twareg for them to live off.

In the context of this discussion of entrusted animals there is also the issue of whether increasing Twareg involvement in the state and commercial sectors has not generated a new class of salaried Twareg, living in the main Nigerian towns, which has entrusted animals to those Twareg still in the pastoral economy. The problem here is that although it is clear that Tamajaq

speaking bureaucrats are purchasing livestock and entrusting such animals to other Twareg, both class and kin relationships operate. A Twareg working in Niamey often has animals with his kin up at Abalak, but he may also put them in the charge of a salaried herdsman, often an akli. It is apparent that the inflow of Twareg into public sector employment was, in part, a response to poverty (and thus a more privileged form of exodus); Twareg civil servants do appear to remit considerable sums of money to their kin in the pastoral camps, and are also investing in animals in the bush.

Finally, there is the phenomenon of Twareg themselves entrusting cattle to non-Twareg, specifically the WoDaaBe. As with all these questions of livestock arrangements it is difficult to assess the extent to which such is the case; nevertheless there is evidence that some wealthier Twareg are entrusting cattle herds to WoDaaBe. Why some Twareg should be entrusting their animals to outsiders is a question best answered by remembering that the traditional system is breaking down; many eklan may be unwilling to take on illelan herds for ideological reasons and, moreover, the wealthier Twareg may no longer wish to have dependent eklan.

With regard to developments in the pastoral zone, it has been found that the WoDaaBe are becoming increasingly involved in seasonal labor migration, with herders leaving for the south during the dry seasons and returning for the wet seasons. This migration pattern has been interpreted as a way of reducing consumption pressure on a diminished livestock base, the dry season absentees, by definition, not having to be fed with grain purchased with cash from (debilitating) cattle sales. For the Kel Dinnik the pattern seems to be more variable, with the emphasis less on seasonal migration (although this might be the case for the agro-pastoral eklan); the dominant pattern is one of either complete withdrawal, or a long period of emigration, during which the Twareg attempt to accumulate cash.

The key difference between the Twareg and the WoDaaBe is that the former are far more likely to take on non-pastoral occupations, to the extent of almost entirely abandoning livestock, while the latter manage, albeit precariously, to maintain a pastoral livelihood. As argued above, this stems from a Twareg social system that regularly exports sections of the population

out of the pastoral system, largely because the system aims at controlled retention, rather than redistribution, of its principal means of production. The resulting impression, as already noted, is one of relative wealth among the pastoral Twareg and of considerable poverty among the WoDaaBe; the reality of it, however, is that the poorer Twareg are not pastoralists, and that what we find in the pastoral zone is only half the story.

4.4 FARMERS AND AGROPASTORALISTS

Pastoral production systems in the project zone cannot be considered independently from other types of production. Patterns of resource use and economic exchange must be understood in a broader regional context of interaction between agricultural, agropastoral and pastoral production systems. Current trends in farming within and to the south of the project zone have significant implications for the future of pastoral economies, first because of the expansion of agriculture into formerly pastoral land, resulting from population pressure in traditional farming areas, and second because of economic exchanges between farmers and herders. This chapter considers contemporary developments in farming systems in and around the project zone, and their implications for future patterns of interaction between farming and herding.

AGRICULTURAL POPULATION DISTRIBUTION AND GROWTH

Though the project zone is primarily a pastoral region, agriculture is practiced in some areas. The aerial survey conducted by the project revealed that, overall, approximately 3 percent of the project zone is under cultivation (Milligan 1982a: 26). As figure 2.2.4 in Chapter 2 above showed, the main farmed areas lie in the southeast and southwest corners of the project zone, where over 25 percent of the land is under cultivation. Gardening and farming are practised on a smaller scale in the north, around the town of Agadez and in the Ayr Mountains. Pockets of agriculture are also of growing significance in central parts of the the project zone, such as the area between Abalak, Kao and Tchin Tabaraden.

The development of agriculture on a significant scale within the project zone is a recent pheonomenon related in part to population trends. While exact information is lacking, available figures indicate that, since the turn of the century, the Tahoua region has experienced steady increases in the size of its sedentary population. In 1900, de Rivières estimated that Tahoua contained merely seven villages and a total of 10,000 inhabitants. The following year, Joly enmumerated 21,00 people in the Cercle of Tshoua, with

Previous Page Blank

6,650 people in the sector of Tamaske and 7,350 in that of Guidan Bado. In 1907, Peignot found a total population of around 110,000, of which 70,000 were Hawsa. By 1958, the sedentary population had grown to 249,000 Hawsa and 29,000 Twareg, with an additional 12,490 FulBe and 11,400 Twareg censused as nomads but actually in the process of sedentarization. By the early 1970s, the population of the Ader region of Tahoua Department was estimated at 430,000 of which 350,000 were Hawsa.[1]

This rapid growth in the region's sedentary population has resulted from a combination of factors: natural population increase, sedentarization of previously nomadic people, and migration into the area of farmers from the south seeking new land. The original cultivators in the Tahoua area were sedentary elements of the various Twareg confederations, including the Kel Gress, the Kel Aghlal Enneger, and slave (eklan) communities; they settled in the region largely in the course of the 19th century (see Bernus 1981). Their descendants are found mainly in the southwest part of the project zone where they practise a system of mixed farming and herding. In the 20th century, many Twareg previously dependent on nomadic livestock-raising have taken up agriculture. Some of these were domestic slaves attached to pastoral households who, upon gaining their freedom under French colonial rule, left their masters to establish small farms. More significantly, many eklan who initially chose to remain within their masters' households were later forced to leave when the 1968-1974 drought made many households no longer able to support dependents. The drought had a similar effect for certain Igdalen and Fulfulde-speaking groups, as well as other non-eklan Twareg; heavy animal losses obliged them to turn to farming - at least temporarily - to meet their subsistence needs.

Hawsa farmers from the southern Gobir and Ader regions began to move into the Tahoua area at the turn of the century. From 1900 to 1930, Hawsa farming communities were rapidly established in the zone now refered to as "transitional" between agricultural and pastoral regions; it is this influx that largely accounts for the sudden increase in the Tahoua region's population in the first decades of the 20th century. Although reasons given

1. All population estimates quoted in Echard (1975).

for this migration vary from community to community, it seems that population pressure on traditional farmlands to the south played an important role in the large-scale extension of agriculture into these lower rainfall areas with poorer soil conditions. Since the 1930s, and particularly in the 1950s and 1960s, small groups of "pioneer Hawsa" have moved into the pastoral region north of Tahoua, settling around administrative centers such as Kao, Chadawanka and Abalak. The type of marginal agriculture practised by Hawsa farmers in the transitional and pastoral zones has tended to be extensive in nature; relatively large areas are cultivated though productivity per hectare is low, and fallow periods are the main method of restoring soil fertility.

This contrasts with areas, such as northern Nigeria, where high population pressure, involving a fragmentation of land holdings, is necessitating a shift to continuous cropping systems making use of fertilizers and other techniques that raise productivity per land unit cultivated. Table 4.4.1 gives figures on the average number of cultivated hectares per person in villages in Niger and northern Nigeria. The data collected in northern Nigeria are ten years older than those collected in Niger, and continued population growth in the former region may have led to further reductions in the average amount of cultivated

Table 4.4.1 Ratio of cultivated land to people in Hawsa villages, Niger and Northern Nigeria.

	Cultivated hectares/person	Regional average
Niger:		
Chadawanka[1]	1.0	
Magaria[1]	1.3	1.3
Sharken Hawsa[2]	1.5	
Nigeria[3];		
Sokoto	0.75	
Zaria	0.50	0.65
Bauchi	0.70	

Notes:

1. Tahoua Department, 1980-1982 (this study).
2. Maradi Department, 1977 (Raynaut 1980: 9).
3. Averages of sample villages around each town, 1966-1968 (Norman, Pryor and Gibbs 1979: 19).

land per person. Nonetheless, it is possible to see that in Niger in the late 1970s and early 1980s, the average number of cultivated hectares per person was roughly twice as large as it was in northern Nigeria ten years earlier.

However, while pressure on land may currently be less intense in Niger than it is in Nigeria, evidence suggests that the practice of extending land under cultivation without modifying productive techniques as a solution to population growth may be reaching its limits. Recent air photo studies in Niger (Raynaut 1980), Mali (Haywood 1980) and by IEMVT in Upper Volta, which compare land use patterns in the mid-1950s with those of the late 1970s, show that clearance of new land for rainfed farming in the Sahel is proceeding at the same rate as rural population growth. For the Maradi region of Niger, part of which falls within the project zone, Raynaut (1980) has calculated that 70-90 percent of the region's arable land is already under cultivation, and if this trend continues, almost all suitable land will be farmed by the year 1990. Although statistics available for Tahoua Department are less reliable, it has been estimated that 80 percent of total cultivable land is presently farmed, and that during the 1970s the department's cultivated surface area increased by an average of 5.5 percent per year.[1] Though the rate of increase was probably higher during the 1970s due to the large number of herders who turned to farming after the drought, it is nontheless clear that Raynaut's projections for the Maradi region equally apply to the situation in Tahoua Department.

The implications of this trend for pastoral economies are many. Full occupation of farm land in the southern part of Tahoua Department is likely to increase demand for land to the north, that is, within the pastoral zone; this is in spite of the fact that agriculture in this region is highly risky and indeed not particularly profitable, as will be seen below. As herders have no legally recognized rights to the land they habitually use, they are unable to stop the agricultural settlement of important dry season pastures. Within the farming zone, the steady decrease in the amount of land left fallow each

1. Five-year Plan, 1979-1983, p. 511.

year has meant a reduction in the space and productivity of pastures adjacent to cultivated fields; this places constraints on livestock-raising in agricultural areas, making it absolutely necessary to remove animals during the growing season to avoid crop damage, and limits the availability of manure. Competition between farmers and herders over access to land - as reflected in, for example, conflicts about damages to fields caused by livestock - has increased markedly in recent years and will probably continue to do so. As a result, the traditionally symbiotic relationship between herding and farming in the southern Sahel and Sudanic zones appears to be in the process of breaking down. It is therefore important to examine the nature of farming systems in and directly to the south of the pastoral zone, in terms of both their internal dynamics and their interactions with the pastoral sector, in order to be able to hypothesize about future directions of current trends and plan appropriate solutions to identified problems.

TYPES OF AGRICULTURAL PRODUCTION SYSTEM

The purpose of this section is to describe briefly the main types of agropastoral production systems found in the project zone and immediately to the south of it. Many people in the zone gain part of their livelihood from farming, but the circumstances under which they farm, the use they make of animals, and the extent to which they see farming as a way to build up their herds in order to return to a more purely pastoral production system differ considerably. This section characterizes some of the main variations on these themes found in and around the project zone.

A typology of pastoral and agropastoral production systems was set out in chapter 4.1, based on the degree of dependence on livestock and the type of agriculture practised. Within this framework, this section is concerned with the following broad categories of production systems: (1) pastoralism associated with rainfed agriculture, including both occasional and systematic cultivation, and (2) agropastoralism. While cases of "pure agriculture" exist in the project zone, their incidence is not important enough to merit discussion here.

Pastoralism associated with rainfed farming.

Occasional or temporary farmers.

The least intensive form of farming in the project zone is practised by those Bernus (1981: 268) has termed "occasional agriculturalists." Cultivators of this type are in fact true pastoralists who sporadically engage in small-scale cereal cultivation in proximity to their semi-permanent or temporary camping areas. For these people, agriculture comprises a very minor, almost experimental component of their subsistence strategy.

Occasional agriculture usually arises in situations of temporary hardship, and when it occurs it is practised in an opportunistic way. Bernus (1981: 268-271) reports several cases of occasional agriculture among the Twareg, particularly freed eklan n eguef of Tahoua, Dakoro, and Tanout. Now poor nomads whose subsistence needs are no longer met from pastoralism, they sometimes clear small fields near their rainy season camps to meet some of their food requirements and reduce the need to sell animals to purchase millet. The example of the Illabakan, though they are an imghad not eklan tribe, illustrates the almost haphazard nature of occasional agriculture, and was described in Chapter 4.3. Traditionally occasional agriculture has served as a mechanism for recovery from the effects of drought or animal disease epidemics. Since the drought of the early 1970s, many herders who suffered heavy animal losses began to cultivate fields in this way as a means of contributing to subsistence while attempting to rebuild their herds.

Impoverished herders who have taken up agriculture since the drought are found in various parts of the project zone, particularly in the area within a 50-60 km radius around Tchin Tabaraden, including the Kao region. Eddy (1979) studied one former eklan group which, between 1970 and 1975, left their masters and went south to the village of Kao in the hope of receiving emergency food and medical care. At the time of the study, these families were attempting to reconstitute pastoral herds by raising small ruminants and undertaking marginal wage labor, but to contribute to their food needs, they also cultivated small millet plots. As they were newcomers in the area, they occupied the most marginal land; this, along with their lack of agricultural experience and allocation of labor to other activities, meant that their

efforts produced results that were well below average for the region. Table 4.4.2 shows that for these recently settled eklan families, refered to as "village Twareg", average land holdings were much smaller and yields per hectare much lower than for the region's systematic farmers, including Hawsa who had immigrated to the region in the 1950s, and independent eklan groups ("bush Twareg") with a long history of settlement and agropastoralism in the Kao area.

This low annual agricultural output of less than 200 kg meets an average of only 10 percent of a "village Twareg" household's annual cereal requirements. Moreover, while the farming techniques used by these people fit

Table 4.4.2 Land holdings, total cereal production and yields per hectare for various farming groups in the Kao region

Group	Average land Cultivated per household (ha)	Average total cereal production (kg)	Average yield (kg/ha)
Occasional farmers:			
village Twareg	2.7	167	59
Systematic farmers:			
bush Twareg	4.7	924	195
Hawsa	5.9	567	113

Source: Eddy (1979: 24)

the description of occasional agriculture - dominance of millet in the cropping scheme, a low labor input, virtual lack of other inputs such as fertilizer, small plot size, and very low yields - there are indications that cultivation is not facilitating their return to more purely pastoral production; the extent of their poverty appears to have put them in a position where the diverse economic activities they undertake, including farming, permit them only to subsist, without generating a surplus for investment in livestock. This suggests that many of those who adopted casual agriculture after the drought will not be able to abandon this practice as has traditionally happened after disasters in the past.

Systematic farming.

A more even balance between agriculture and livestock-raising is found among groups who combine pastoral production with systematic farming. Whereas for occasional cultivators, agriculture is an intermittant activity, for pastoralists who farm systematically, it is a significant and integral part of the production system. This entails the allocation to agricultural activities of a much larger share of available factors of production. Though this type of farming is still quite extensive, agricultural knowledge and techniques are considerably more elaborated than they are among occasional farmers. Animal manure is used to improve the productivity of the land. Instead of leaving the fields on rainy season transhumance as occasional farmers often do, pastoral groups who systematically farm use geographical separation and residental division to accomodate the needs of both the pastoral and agricultural components of their production system; during the growing season, one part of the household - usually young men - take the herds on transhumance to benefit from rainy season pasture and avoid crop damages by animals in the area of cultivation, while the rest of the household remains behind to take care of the fields. Groups with this type of production system in the project zone include semi-sedentary Twareg households throughout the region to the north of Tahoua, west of Abalak, and south of Tchin Tabaraden, and certain FulBe groups particularly around Chadawanka, Tamaske, Dakoro, and Kao. Also important are the Twareg and FulBe groups who spend the dry season south of the project zone but who bring their herds into the zone for the rainy season.

While there is significant diversity among pastoral groups practising systematic farming, a few examples will serve to illustrate the basic principles of the production system. The FulBe of the Dallol Bosso area, studied by Beauvilain (1977), combine extensive cultivation of millet with raising cattle and small ruminants. The average land holding is almost 4 hectares, though there is a high level of variability in the amount of land cultivated per household. Over one-quarter of the production units own cattle, with an average of 11 head per unit; 7 percent own sheep, and 15 percent own goats, with an average of 7.8 small ruminants per household.

Ninety eight percent of the cultivated area is planted with millet, of which the FulBe recognize several early and late varieties. Manuring is regarded as an important practice, and is accomplished by rotating animals through the fields during the dry season. To enhance the efficacity of natural manuring, the droppings left by the animals are broken up. Fields are distinguished according to whether or not they are manured, and a fallow system is also used to restore soil fertility. Labor is predominantly familial though extra-familial labor - either collective work parties or wage laborers - is mobilized during the two weedings. Animals are usually sent out of the area to the region around Abala when the growing season begins, accompanied either by the young men or a hired village herder; the rest of the family often rejoins the herd after the second weeding as no further work is required until the harvest.

For many Twareg groups, both within and to the south of the project zone, cultivation has been a part of their subsistence strategy for several generations, complementing transhumant livestock raising. For example, several eklan n eguef groups have cultivated in the Ader region since the imposition of colonial rule (Bernus 1981: 271). An impressive assortment of varieties of millet and sorghum are recognized; their growth cycles of differing lengths allow the farmer to control to a certain extent the timing of the harvest and to tailor his crop mix to annually variable rainfall conditions.[1] Knowledge of different crop varieties, as well as the practice of intercropping cowpeas with the millet, give systematic farmers a substantially greater risk minimization capacity than occasional farmers who, as Bernus (1981: 271) writes, "merely help nature along."

Both the technology and the calendar of agricultural activities for systematic farmers closely parallel those of their Hawsa neighbors. Twareg in this production system divide the agricultural cycle into seven periods: aghatas, in January and February when fields are cleared with hatchets or by burning; anabel, the planting, which is done at the onset of the rains with a Hawsa-style long-handled hoe; agayak, the weeding season, which starts when

1. Echard (1975) reports that Twareg groups in the Ader region recognize 6 varieties of millet and 34 of sorghum.

the plants are around 10 cm high and continues till before the harvest, and again is done with Hawsa-style tools adapted to local soil conditions; a period of surveillance to guard the fields from predators and pests; alley, the harvest proper when millet pannicles are cut, tied into headloads, and stored in straw or banco granaries; a period in November and December when animals return to graze on the millet stubble; and aboraz, a summary clearing of the fields in the dry season.

The household tends to divide after the first weeding, when younger members of the family lead the herds north to rainy season pastures and older people stay with the youngest to attend to the second weedings. The transhumant group returns from the north around the time of the harvest. Shelter types change with the seasons: the rainy season hut is replaced from October to March by a leather tent, which among some groups is in turn replaced by a temporary hot season dwelling.

Twareg farmers differentiate between large, family-owned fields, and small, individually-owned fields. Labor is largely familial, though communal and wage labor is sometimes used to compensate for labor shortages. Fertilizer is applied either through a system of rotating the animals through the fields (as described above for the FulBe) or by gathering manure from areas of concentration (such as the evening pen) and distributing it in selected fields. Fallow periods are also used to restore soil fertility.

In sum, pastoral proudction systems with systematic farming components integrate livestock-raising with extensive cultivation of millet and other crops. Agricultural knowledge and technology are elaborate and similar to those of neighboring Hawsa agropastoralists. The complementarity of the two productive activities is reflected in such activities as fertilizing the fields with animal manure and dry season grazing of animals on crop residues. Households divide in the rainy season and the animals are taken north to profit from the good pastures and to avoid crop damage in the area of cultivation.

A major problem now confronting such production systems is the reduction of open pasture between fields in the transitional zone (Raynaut 1980). The rapid expansion of land under continuous cultivation means that areas previously used to graze animals are less available. Raynaut (1980: 27) suggests that this introduces a considerable stress on pastoral production systems with a systematic farming component: as land is absorbed into continuous agricultural use, the need for manure to maintain soil fertility rises while, at the same time, herding between the fields becomes less viable because of lack of space. The extent to which this process is already underway in the southern part of the project zone is not clear, though the increased frequency of crop damage disputes in recent years suggests that it has already begun.

Agropastoralists

Extensive agropastoral systems share many features of pastoral systems with systematic farming; agricultural knowledge, techniques and tools are similar; the size of land holdings and productivity per hectare are in the same ranges. However, the nature of livestock use differs significantly between the two production systems. In general, for agropastoralists in the project zone, livestock-raising is secondary rather than an integral part of their productive strategy. Small ruminants are predominant in agropastoral herds, and the cash income generated by the sale of animals is more important than milk and meat, which play little role in the diet.[1] Members of the production unit do not take the animals on rainy season transhumance; rather, the animals are either kept near the household fields, or put in the care of a hired herder who takes the animals out of the cultivated region during the growing season. Since, as mentioned above, pastoral space around cultivated areas is becoming increasingly scarce, the practice of entrusting animals to hired herders and the use of feed supplements (cottonseed, cowpea leaves) are growing in importance.

1. For example, Eddy (1979) found that among Hawsa farmers in the Kao region less than 1 percent of daily energy intake was provided by milk and meat, though many households owned small ruminants.

The majority of agropastoralists in and to the south of the project zone are Hawsa farmers, belonging to a broader ethnolinguistic group that encompasses some 20 million people in northern Nigeria and southern Niger. Hawsa production systems display significant regional differences in crop mixes, agricultural techniques, labor allocation and use, and levels of intensity of cultivation; this is not surprising considering the environmental diversity of Hawsaland, which extends from the northern Guinea zone to the southern Sahel and involves a high level of local climatic and soil variation. Agricultural knowledge is highly detailed as reflected in, for example, the elaborate taxomony for soil types. The Hawsa soil classification system categorizes soils according to their color, texture, capacity to retain water, and to some extent location; in addition, natural vegetation is seen as an indicator of soil fertility.[1] As Schultz (1976: 98) has remarked, "you simply do not need to tell (Hawsa) farmers much about their soils... they already know where to go and where not to go"

Hand tools are the main means of cultivation for Hawsa farmers, and different types of tools are used to accommodate specific local conditions. For example, a long-handled mattock (kwaasaa) is used for planting in heavy or rocky soils while, in less difficult soils, the farmer may use a short, narrow-bladed hoe (sunguumii). Similarly, though short-handled hoes are more common for weeding (such as the short, triangular kalmi favored in heavy soils like those of the Ader-Doutchi plateau and Maggia Valley, long-handled weeders with lunate blades (hawya) are used for superficial weeding of light sandy soils, particularly in the Dogon Doutchi and Zinder regions.

In areas where farming is more intensive, animal-powered implements may also be used. Animal traction, thought to be a vital part of reversing the trend toward declining productivity in West African agriculture, is not widespread in Niger; it is used in some peanut and cotton-producing regions but is virtually non-existant in the project zone itself. The reasons why animal traction is not being generally adopted in Niger, despite government efforts to promote it, are dealt with below.

---

1. Thus for example, Pennesetum pedecellatum, Ziziphus jujuba, and Piliostigma indicate fertile soil which Cassuis mimiosoides, Leptadentia purotechnica, and Aristida indicate that the land is poor (Watts 1979: 704).

Hausa farming systems exploit a variety of econiches: dune (tudu), plateau (dabagi), and valley floor (fadama) land forms. Upland areas (tudu and dabagi) can only be cultivated in the dry season and must periodically be left fallow unless large quantities of fertilizer are available to restore soil productivity. Fadama land is particularly valued as it can support continuous rainy season cultivation as well as irrigated, dry season gardening of onions, peppers and tomatoes. Access to fadama land provides opportunities both for risk-avoidance, as fadama areas can be more intensively cultivated when other regions fail to produce, and for an additional source of income, as those farmers with holdings in fadama land are less likely to need to undertake migrant labor to see the family through the dry season.

Access to land can be obtained in a variety of ways. Clearing new or abandonned farmland gives the person usufructory rights to the area. Traditionally, transference of use rights was effected through inheritance (gado), borrowing of a plot for a specified period (aro), token gifts (kyauta), entrustment (amana), and joint friendship (abokin aiki). In recent years, however, leasing (haya) and outright sales (sayou gona) of use rights have dramatically increased in areas where a large proportion of the arable land is already under cultivation. For example, in three villages in the northern Nigerian province of Zaria, Norman (1973: 6) found that almost one-quarter of all land was obtained through leasing, purchasing and pledging. Raynaut (1976) reports that sales of land in the Maradi area have increased since the drought due largely to the monetization of the economy and the expansion of cash needs. It is not clear to what extent this process is occurring in the project zone, but it is undoubtedly underway in southern Tahoua Department.

Labor in Hausa farming systems is largely familial though again significant changes are now occurring. The traditional farming unit, the gandu (an extended family based on a father and his sons or a group of adult brothers), appears to be becoming a less important form of labor organization, as is the case with collective work parties (gayya) used in peak labor periods. In contrast, contract arrangements (jinga) and casual day labor (kwadago) are becoming ever more frequently encountered forms of labor

recruitment (see Raynaut 1980: 43-51). The reasons for these trends are discussed below. Here it can be said that the creation of a factor market in land and labor presently occurring in Hawssland - and indeed in many West African production systems - is part of the larger process spurred by pressure on land whereby those farmers with better access to factors of production are becoming relatively richer while those with poor access enter a cycle of indebtedness and growing poverty, forcing them to turn to wage labor or even sale of their farms to meet their subsistence needs.

Summary

Production systems involving farming take a variety of forms in the project zone, differing in terms of the intensiveness of cultivation, the range of crops grown, tools and techniques used, the size of land holdings, the amount of labor applied to the farming enterprise, yields levels, the types of livestock raised and the uses to which they are put, and ways of balancing farming and livestock-raising in terms of available resources. Table 4.4.3 summarises the general characteristics of the farming systems identified in the preceding discussion: pastoral production with occasional farming, pastoral production with systematic farming, and agropastoral production. Categorizing the different farming systems in the project zone, however, should not obscure the great diversity of individual adaptations or the fact that these adaptations are in a period of flux.

HOUSEHOLD PRODUCTION IN AN AGROPASTORAL ECONOMY

In order to have a better understanding of the dynamics of farming in and around the project zone, the project conducted budget and labor use studies in farming communities in addition to those among herders. Particular attention was paid to how productive cultivation is in the pastoral zone in terms of the extent to which it contributes to the livelihood of those who practice it, its relative effectiveness as a resource use strategy, and how its production parameters compare to similar systems located in more fully agricultural areas to the south. The study was originally intended to cover the different farming systems found in the project area, as described above, but difficulties encountered in efforts to set up samples in Twareg and

Table 4.4.3 Characteristics of farming systems in the project zone.

System	Agriculture			Livestock	
	Type	Productivity	Farming knowledge, tools, techniques	Types and purposes of livestock	Livestock management during growing season
Pastoral:					
Occasional farmers (Twareg, Fulfulde -speakers)	Extensive rainfed millet cultivation.	Low	Limited	All types of animals kept for dairy products, market value, transport.	Regular transhumance except for impoverished herders with only a few animals.
Systematic farmers (Twareg, FulBe)	Extensive, rainfed cultivation of millet, sorghum and beans with manuring.	Medium	Elaborate	Same as above with animals also also used for manuring fields.	Residential division with one part of family taking herd out of farming area. Some use of hired herders.
Agropastoral: (Hawsa)	Extensive or intensive cultivation of staple grains and cash crops with manuring; gardening on *fadama* land.	Medium	Elaborate	Predominantly small ruminants raised for sale or slaughter. Also some cattle for manuring, transport, fattening, some traction.	Use of hired herders to lead animals into pastoral areas; or animals kept around household, fed on supplements or allowed to graze in pasture spaces between cultivated fields.

Fulfulde-speaking communities meant that the final sample of the farming study consists solely of Hawsa agropastoral villages. This section presents some of the study's findings with respect to the sample itself, the Hawsa agricultural cycle, labor, land, livestock, and household production and consumption patterns.

Sample description: Chadawanka and Magaria

Two villages in Tahoua department formed the sample for the agropastoral research. The first, Chadawanka, is located in the project zone proper in what is sometimes designated as the "transitional" area between the pastoral and agricultural zones (see figure 4.4.1). The second, Magaria (Madaoua arrondissement) is located to the south of the project area in the agricultural zone.

The village of Chadawanka is located to the north of the Ader Doutchi plateau, roughly 50 km northeast of Keita and 60 km south of Abalak. Annual rainfall is low: Chadawanka falls roughly between the 300 and 350 mm isohyets

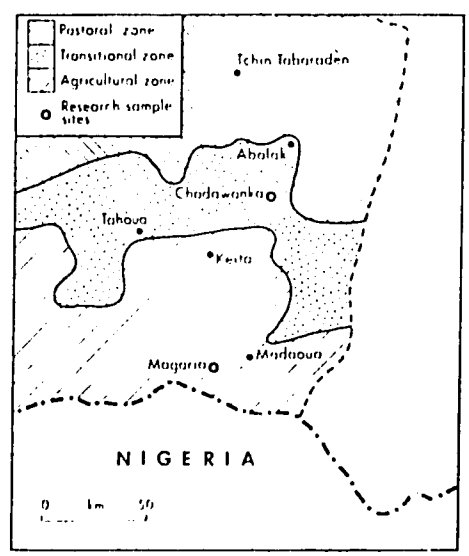


Figure 4.4.1 Location of agropastoral study villages

and as such is slightly above the legally-determined northern limit of agriculture.

According to the villagers' testimonies, Chadawanka was populated by successive waves of migrants during the course of the 20th century (see figure 4.4.2). Between 1900 and 1915, several Twareg groups moved into the area from the west, south and east, settling in hamlets around what is now Chadawanka. Some of these were long-established agropastoralists who were already practising agriculture at the time of their arrival. For example, the Ighalen Enneger came to the Chadawanka region from Loudou, northeast of Keita, after the French deposed their leader and installed a chef de canton with whom they became involved in a dispute; they report that they "left their fields, scattered, and came to where there was nothing but bush". Other groups - in fact, probably the majority - adopted farming upon settling in the area. This was the case for the hamlet established at Imajet by metalworkers (eneden) and marabouts (ineslemen) of the Kel Azar; they left In Safari, about 20 km north of Keita, at the time of the "arrival of the whites" and began to cultivate millet and sorghum in a low-lying inundated area northwest of Chadawanka.

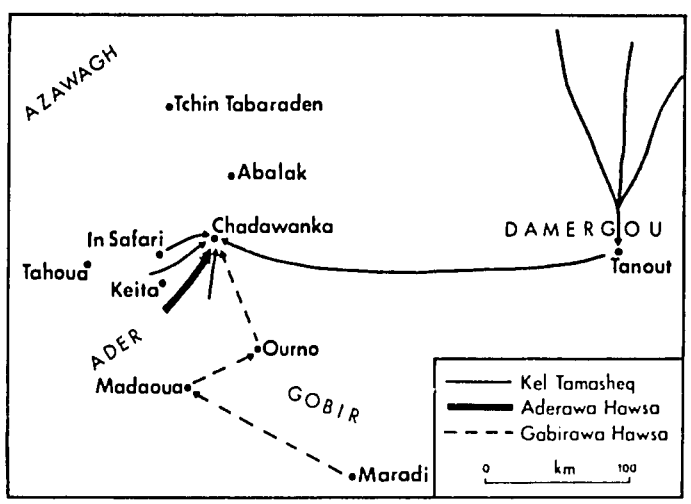


Figure 4.4.2 Settlement of Chadawanka

Hawaa immigrants began to arrive after 1940, when the Chadawanka market was founded at its present site. The first Hawsa were Aderawa, that is, from the Ader region near Keita, who report that they were drawn by the opportunities for commerce preaented by the new market. In the mid-1950s a second group of Gobirawa Hawsa began to arrive; originally from the Maradi area, they moved to Madaoua and Ourno in the 1930s in search of new farmland but, unsatisfied with what they found there, continued north twenty yesrs later to settle in and around Chadawanka.[1]

The diverse origins of Chadawanka's population are reflected in the village's political and spatial organization. The population of the weatern part of the village is predominantly Aderawa Hawsa and continues to be censused as part of their original area, Keita arrondisaement, although Chadawanka is clearly within the arrondissement of Tchin Tabaraden. The eastern part of the village is more ethnically diverse, composed of Gobirawa Hawsa, some FulBe families, Twareg from the 5th Group; it is administratively under the jurisdiction of Abalak and Tchin Tabaraden. Each side has its own headman (hakimi), and a seasonal river course separates the two sides. The market is located in the river bed and becomes an island during the rainy season. Thus, Chadawanka fits Raynaut's (1980: 33-34) description of villages on the northern fringe of the agricultural zone: it is only recently established and is characterized by a high degree of ethnic heterogeneity.

The sample households for the project agropastoral study were choaen from the eastern section of Chadawanka in order to have the sample under the same political jurisdiction as many of the pastoral study samples, that is, the administrative post of Abalak. Sixty-eight families were censused by the research team at the outset of the study in Chadawanka, and 22 of theae were selected at random to form the core of the sample. Household budget and labor

---

1. Indeed, when interviewed in 1980, one group of Gobirawa Hawsa in a hamlet 20 km southeast of Chadawanka indicated that they were not satisfied with the Chadawanka region either; they complained of inadequate water, and were contemplating moving to northern Nigeria to seek better farmland and relief from incessant water problems.

use data were collected bi-weekly from these 22 families. This core sample is exclusively Hausa, though shorter-term, less intensive surveys were also conducted in Tamasheq and Fulfulde-speaking hamlets outside Chadawanka itself.

The Magaris sample - which is discussed only minimally here - consisted of 44 out of the 242 households identified in the area. The final Magaris sample was also exclusively Hausa, though again less-intensive, shorter surveys were conducted among households of other ethnic groups living near the village.

The agricultural cycle

The seasonal round of agricultural activities in Chadawanka and Magaris follows the general pattern found throughout much of Hausaland. The growing cycle commences with the first rains. Rains may begin as early as May in Nigeria and as late as late June or early July for parts of Niger. Clearing of fields usually occurs in April or May, with the return of migrants from towns and the end of the previous year's gardening activities. Millet is ordinarily sown before sorghum, and cowpeas are planted when the young cereal plants have reached several centimeters in height. Pairs of planters do the work: the person using the planting hoe is followed by the seeder, who drops a few seeds into the hole made by the hoe and fills it in with his foot. Women and children help men in planting in some areas, usually doing the seeding. The most successful planting is done shortly after a rain, followed a few days later by another shower. If no rains follow planting in fifteen days or so replanting may be necessary. If there is an extended dry spell, farmers may resort to dry planting, hoping for rains within 5 to 7 days. Such variations in planting behavior often produce uneven stands of millet and sorghum, thereby affecting yields.

Soon after the seed has germinated and plants have reached a sufficient height, weeding begins. The first weeding is frequently undertaken in mid-to-late June. A second weeding follows a month or so later. If rains are

heavy, and aufficient labor is available, a third weeding may be done. Hoeing between the rows eliminates weeda that compete with the crops for moiature and also aeratea the soil. The first weeding ia particularly important to promote effective water capture by plants necessary for good, early growth. Dramatic differencea in plant heights between weeded and unweeded adjacent fields can be observed after the early rains, as unweeded plots have higher ratea of runoff due to their compacted soil structure.

Cultivation ia a continuous process from June to September, as farmers rotate through their fields, commencing the next weeding shortly after the cycle is completed. This weeding period is the most important period of peak labor requirements, particularly for production systems which do not employ animal traction. It is the time when communal labor parties are most likely to be organized or wage labor employed.

After the rains cease, often in September, the harvest of early millet begins. The ripened grain heads are cut with a small blade held in the palm of the hand, and the stalks are left to dry. Sometimes the stalk is slashed and the head allowed to dry for a day or so before the removal of the head. The harvested grain is allowed to dry on the head, and then is bundled and carried from the field to the granary for storage. Some time later, the dried stalks are removed, bundled, stored in thorn enclosures to be used as construction material or animal fodder.

The later varieties of millet, sorghum and cowpeas are harvested after the early millets have ended the "hungry period". The work continues into November, depending on the length of the rains and the crop mix used by the farmer. Gourds, planted after these crops, are also harvested at this time. Labor for the harvest is usually familial though some work parties are organized. Granaries may also be constructed during this period.

After the cereal crops are harvested in fadama areas, work begins on the preparation of irrigated gardens. Plots sre measured, the ground is broken and smoothed with a mattock, and stalk fences are erected to protect the garden from animals. After that, labor is devoted msinly to watering, weeding and manipulating the canal system; these tasks are usually performed by two

people. Onion gardens such as are found in Magaria require frequent watering, usually every two to three days. Harvest occurs for most garden vegetables within about 90 days from transplanting. Processing and marketing of garden products occupies gardeners' time throughout February and March, until the time for clearing fields arrives, and the cycle begins anew.

Those farmers without fadama land or the resources to start a garden turn to other forms of employment during the dry season. These include a variety of traditional artisan occupations such as tanning, dyeing and weaving. For many, however, the harvest's end signals the beginning of the period for migration to coastal areas in search of wage employment as construction workers, stevedores, petty commodity traders, griots and musicians, and watchmen.

Labor: households and production units

Household types.

The domestic unit - however composed - provides the major source of labor for most productive activities among Hawsa agropastoralists. The minimal social unit which forms the basis of household organization is the iyali, which consists of a man, his wife or wives and their children. Far more central to the organization of production for the Hawsa are numerous kinds of residential groups. Here the minimal unit is the 'daaki (literally "room" or "hut") which is a food production, preparation and consumption unit, each with its own grain bins. A 'daaki can be simple (a man, his wife and children), plural (a man with more than one wife and their children), or stem (a man, his spouse(s), their children, and one or more grandparents). Members of the same 'daaki possess and work on a common set of fields, and the grain produced is stored in collectively owned granaries. Food is prepared and consumed largely within the 'daaki.

The primary residential unit is that of the compound or gida, which may contain more than one 'daaki (for example, the household head, his parents, wife or wives, dependent sons and their families, household clients, and children loaned from other households). The gida is not fixed in composition

but changes across the course of the household's life cycle. The household head is responsible for organizing labor on the household's fields, and storing the grain in his 'daaki grain bins from which other members of the gida may draw when their own stocks are exhausted. The household head also provides all animals required for ceremonial occasions (births, marriages, Muslim feasts). On the death of the household head, the family holdings are divided among his heirs. Brothers may remain together for a time, though they eventually separate to form their own gidaje.

The labor relationships formed by kin ties within a gida are known as gandu. A gandu can be paternal, that is, a man, his adult sons and their families, or fraternal, composed of adult brothers and their families; the distinguishing point is that they work family fields in common. The persistence of gandu arrangements is a fragile matter. As married sons grow older and their own families increase in size, they tend to leave to establish their own independent residence and production units. After this, sons are no longer required to devote the majority of their agricultural labor to the gida fields (depending on the area, from one to five days per week); rather, they work their own fields, acquired through inheritance, loan pledge, or purchase. Though fraternal gandu after the father's death is a culturally prefered arrangement, brothers usually want to establish their own independence so the gandu eventually dissolves.

Clans (zaari'a) and clan segements (also called gida but different from the residential unit described above) are composed of people united by the same ancestor, and form the larger social units from which communal work parties (gayya) are recruited. Member families of the same zaari'a tend to live in the same ward of the same village. Although the clan is the sphere of much social and economic interaction (marriage, giving and receiving of gifts), it figures in production only in periods of high labor requirements during the agricultural cycle (especially weedings).

Table 4.4.4 gives the breakdown of households in the Chadawanka and Magaria samples in terms of their residential type. It can be seen that almost one-half of the households in Chadawanka and one third of those in Magaria are of the simple 'daaki type, that is, single nuclear families.

Gandu forms represent only 15 percent of all households in Chadawanka and 23 percent of those in Magaria. Plural and stem 'daaki households represent 36 percent of all households in Chadawanka and 44 percent of those in Magaria. The implications of this breakdown are dealt with below.

Table 4.4.4 Types of household: Chadawanka and Magaria (percent)

	Chadawanka (n=22)	Magaria (n=44)
Gandu:	15	23
Paternal	8	13
Fraternal	2.5	5
Other	4.5	5
'Daaki:	85	77
Simple	49	33
Plural	25	18
Stem	11	26
Total	100	100

Division of labor

Work is organised according to the workers available and the task at hand. All household members participate in productive activities, and outside labor is resorted to only when domestic sources are inaufficient. Planting is done by two persons from the household: usually a man and a woman move through the fields together, the former using the planting hoe and the latter sowing the grain. Thinning of plant stands and weeding of fields may be done by individuals, gandu groups, or work parties (gayya) depending on the amount of land involved and the resources available to the household; it is for weeding activities, which are done one to three times during the growing season, that

outside labor is most likely to be recruited. During harvesting, both men and women fell the stalks, cut the grain heads, and carry the grain in headloads from the fields.

Dry season gardening requires much smaller work forces than are needed for farming. In general, ownership and operation of garden enterprises are highly individual in nature. Pairs of gardeners prepare the garden plot, sow and transplant seedlings, build fences, water garden beds, maintain irrigation works, and harvest the crop. Supplementary labor, if used, may come from the gardener's household or through contractual wage arrangements.

Women and children are mainly responsible for domestic tasks, including the threshing and winnowing of grain, food preparation, gathering firewood, carrying water, and general maintenance of the compound. Women perform these tasks together, assisted by children. Men occasionally contribute to domestic work.

Livestock-related work is performed by all family members. Care of small ruminants - feeding, watering, milking and tethering animals - is often incorporated into women's domestic chores. Children usually lead animals to pasture and prevent them from damaging cultivated fields. Large ruminants, if kept for traction or transport, are often the responsibility of men.

Labor availability

The age and sex structure of the household is an important variable in determining the availability of labor. As a household moves through the life cycle, its age and sex structure changes, which modifies the quantity and composition of the domestic labor supply and therefore the potential scale and productivity of agriculture. For example, a household formed by a man, his adult sons, and their wives and children disposes of a large pool of domestic labor. Upon the death of their father, the sons may remain together for a time, but they eventually separate to form their own smaller residential and production units. A simple household headed by a man whose sons are too young to make a significant contribution to farm work may experience difficulties in accomplishing labor intensive tasks such as weeding on his own. As his sons mature, however, the supply of labor from within the household expands,

improving the production unit's ability to meet labor needs in a timely and effective way.

Household size is also important in this respect. It was shown above that 'daaki forms represent a large majority of households in both Magaria and Chadawanka. Table 4.4.5 shows that, as one would expect, the average number of people in gandu houaeholds (9.2-10) is larger than in 'daaki households (6.2).

Table 4.4.5 Average number of people in gandu and 'daaki households: Chadawanka and Magaria

	Chadawanka	Magaria
gandu	9.2	10
'daaki	6.2	6.2
Average household size, entire sample	6.5	6.7

The overall average number of people per household is between 6 and 7, which is within the same range as figures reported for northern Nigeria.[1] This suggests that the much-discussed proliferation of smaller production units, found elsewhere in Hawsaland, is alao occuring in southern Niger. The reasons for this are related to trends in the monetization of the village economy. In the past, young adult men remained in their father's household till his death or beyond, as they had no means to establish farms of their own. With growing opportunities to earn caah through migrant or farm labor, however, sons can demand their inheritance before their father's death,

1. Norman, Pryor, and Gibbs (1979: 31) report an average family size of 6.7 for three study areas (Sokoto, Bauchi and Zaria).

marry more easily, and establish new domestic and production units at a much earlier stage in their lives. This results in a reduction in the average amount of labor available at the household level and a concommitant growth of households' need to use other forms of labor recruitment at critical times in the production cycle.

As mentioned above, there are several forms of labor recruitment that may be used when the household cannot itself meet labor requirements, either in the short-term to relieve seasonal labor constraints or for longer periods in the domestic life cycle. The most common forms are collective work parties (gayya) and wage labor. A household's ability to recruit outside labor is dependent on its social and economic position. Those who hold traditional office or possess extensive patron-client relationships within the community rely on their superior social position to mobilize work parties to accomplish certain tasks; they are expected to provide members of the work party with food during their work, and possibly offer cigarettes or "kola nut money" as additional incentive. This labor form is reported to have been more common in the past but now is relied upon in Magaria almost exclusively by the socially prominent people in the village, namely the village headmen, farming chief, and more prosperous merchants.

On the other hand, since the introduction of cash into the village economy, wage labor - whether on a day basis or through longer-term contractual arrangements - has become an increasingly important way of easing labor bottlenecks. Informants in Chadawanka relate that they prefer hired labor to reciprocal labor arrangements as tasks can be accomplished more quickly and efficiently. This is particularly important for the first weeding which, if completed rapidly, greatly facilitates moisture retention and good early plant growth. The second weeding, perceived to be slightly less critical, can be completed over a longer period of time through more casual and less costly forms of labor recruitment. Of course, only farmers with cash available can afford to engage wage workers. Poorer households must compete with richer ones for labor, and often contribute to the labor pool from which wealthier households draw. Indeed, for the many poorer households that must buy millet during the growing season, having exhausted their stocks from the previous year, the demand for wage labor provides an opportunity to earn some

much needed cash but draws them away from work on their own fields. In Chadawanka in 1981, for example, 13 of the 21 sample households spent an average of 700 person hours per household looking for work during the growing season; while a large portion of this time involved migration out of the village, this figure nonetheless illustrates how households with pressing cash needs must leave their own farms in search of work at a time in the production cycle when their presence is required, adding a further constraint on the availability of labor at the household level.

Land

The amount and quantity of land to which a household has access plays an important role in determining the scale and productivity of the farming enterprise and its ability to provide subsistence and employment to household members. This section discusses land use and ownership patterns in the village of Chadawanka, both with respect to farming and pasture areas for livestock.

In Chadawanka, farms are found in valley floor (fadama) and especially dune (tudu) areas. Soils in fadama areas range from reddish-brown to dark brown in color and are clay or sandy clay in texture. Tudu soils, deposited by wind action, are light-brown to reddish-brown and sandy. Table 4.4.6 gives information on the distribution of fields in Chadawanka in terms of the crop or crops cultivated; data for Magaria are given for comparison. It can be seen that in Chadawanka 83 percent and in Magaria 76 percent of the cultivated land is sown with millet, either alone or in association with other crops. In contrast, sorghum is grown on 54 percent of all land in both villages. Farmers' preference for millet over sorghum is due to its lower moisture requirements which make it better suited to upland soils that do not catch water run-off as well as fadama areas. Cowpeas are grown on one-quarter of all land in both Magaria and Chadawanka; this crop is valued for several reasons: it fixes nitrogen within the soil, keeps weeds down, and is a popular food in the form of fried bean flour cakes.

Millet alone is cultivated on over one-third of all fields in Chadawanka but less that one-quarter of those in Magaria. Sorghum alone is more common in the latter village, possibly due the greater availability of fadama land on

which sorghum is best grown. In terms of crop combinations millet and sorghum is the most popular mix in both villages, followed by millet with cowpeas.

An immediate point that emerges from table 4.4.6 is that, while there is no systematic relationship between crop mix and average field size between the two villages, average field sizes in Chadawanka are roughly twice as large as they are in Magaria. However, as table 4.4.7 shows, this difference in average field sizes does not imply a smaller average cultivated area per household in Magaria; the average household land holding was almost identical in the two villages (3.6 - 3.7 hectares) in 1981, but the average household had 1.9 fields in Chadawanka compared to 3.8 in Magaria. This can be compared to the situtation in northern Nigerian villages; in the late 1960s, Norman, Pryor and Gibbs (1979: 25) recorded that the average household in their samples had 3.9 hectares of cultivated land in more than six different fields.

Table 4.4.6 Distribution of fields by crop type: Chadawanka and Magaria

Crop mix	Percent of total fields	Percent of total area	Average field size (ha)[4]
Chadawanka[1]			
Millet	35	27	1.47 (±1.27)
Sorghum	10	11	2.03 (±2.63)
Millet-sorghum	25	31	2.37 (±1.28)
Millet-sorghum-cowpeas	8	12	2.93 (±1.51)
Millet-cowpeas	18	13	1.42 (±1.29)
Fallow	5	6	2.13 (±0.60)
Magaria[2]			
Millet	22	20	0.85 (±0.60)
Sorghum	18	16	0.88 (±0.78)
Millet-sorghum	24	22	0.90 (±0.61)
Millet-sorghum-cowpeas	12	16	1.25 (±0.91)
Millet-cowpeas	15	18	1.21 (±1.55)
Other[3]	3	1	0.46 (±1.17)
Fallow	6	7	0.38 (±0.10)

Notes:

1. 21 sample households, 1981; total of 40 fields and 75.46 hectares.
2. 23 sample households, 1981; total of 89 fields and 86.89 hectares.
3. single stand millet or sorghum with calabashes, pumpkins or condiments
4. standard deviation in parentheses.

Table 4.4.7 Average number of fields and amount of land cultivated per household: Chadawanka, Magaria and northern Nigeria.

Area	Average number of fields per household	Average amount of land cultivated per household
Chadawanka	1.9	3.6
Magaria	3.8	3.7
Northern Nigeria[1]	>6.0	3.9

Note:
1. Norman, Pryor and Gibbs (1979: 25).

The fact that average amounts of land cultivated per household in the sample villages are strikingly similar to those reported for northern Nigeria (with similar mean household sizes) is difficult to interpret, particularly because land holdings in villages elsewhere in southern Niger are considerably larger than in these areas; for example, average household land holdings in Maradi villages are 6 to 10 hectares in 5 or 6 fields (Raynaut 1980). In northern Nigeria, the tendency toward cultivation of a large number of small fields is thought to be linked with population growth and resulting pressure on land; as full occupation of arable land is approached, the continuous division of estates between heirs causes a reduction in average amounts of land cultivated per household and an increasingly scattered distribution of the household fields. While this process may be underway in Magaria, a long-established farming community reaching the limits of agricultural occupation, it seems unlikely that population pressure on arable land explains the small size of household farms in Chadawanka, a newly settled area preaumably with virgin, albeit not particularly productive, land available for the expansion of cultivation. It may be that, first, the tendency toward smaller production units in Chadawanka, as discussed in the previoua section, means that the limited supply of domestic labor makes households unable to bring more land under cultivation even though family production is not sufficient to meet subsistence needs (see below). Second, in communities on the northern fringe of agriculture, people may decide not to enlarge their farms as the returns to such an expansion would be low and unpredictable;

instead, they choose to diversify their sources of income, engaging in such activities as wage labor, petty trade, commerce, and crafts to ensure that immediate cash needs are met and to minimize the effects of the potential failure of agricultural production during any given year.

It may also be possible that fallow land was not adequately accounted for when field measurements were taken in the sample villages. Only 5 percent of cultivated land was recorded as fallow in 1981 in Chadawanka and Magaria, in contrast to villages in Maradi Department which include areas of intensification, where 18-47 percent of the land was left fallow (Raynaut 1980). If, however, the 5 percent figure for fallow land is accurate, this would suggest that the rhythm of land exploitation in parts of Tahoua Department is quite accelerated; without the use of techniques to restore soil fertility (fallow periods or fertilizer), this would imply that already-low levels of land productivity would be subject to further reductions.

In this regard, none of the households in the Chadawanka sample reported that they applied organic or chemical fertilizer to their fields. However, they do rely on droppings of animals belonging to village herds or pastoral herds in the area during the dry season. A study was conducted in May 1982 to determine the amount of manure applied to the fields in this casual manner. The thirty-seven fields sampled displayed a mean of 752.5 kilograms of manure per hectare, with a standard deviation of 824 kg and a range from 31.3 to 3,868.7 kg/ha.

While the data from the study must be considered with caution due to the small sample size and high sample variance, some interesting results are suggested. The Chadawanka sample was divided into the same categories as those used by Schultz (1976) to measure the "distance decay" effect of manure application in the northern Nigerian village of Soba. His data are compared to those obtained for Chadawanka in figure 4.4.3. As expected, the values for Chadawanka are substantially lower than those for Soba, where population pressure has prompted the development of a system of intensive manuring of permanently cultivated fields close to the village itself; thus, highest fertilization levels, exceeding 17,936 kilograms per hectare (8 tons/acre), are found on fields within 0.5 km radius of the village, and the level of

fertilization declines further away. In contrast, rates in Chadawanka are highest in the two most distant categories (more than 2.2 km from the village), both of which are absent from the Soba data. Fields in these categories are located to the north and northwest of Chadawanka, in proximity to the settlements and pasture areas of Twareg agropastoralists; they thus have access to manure from the sizeable agropastoral herds. This suggests that, where agriculture is still largely extensive and coexists with more pastorally-oriented farming systems, fertilization rates do not necessarily follow the pattern described by the ring theory of Hausa settlement; while there is a fertilized area around the village, manured by village herds, the highest (though still low) rates may be in the outer ring where agropastoral herds are present.

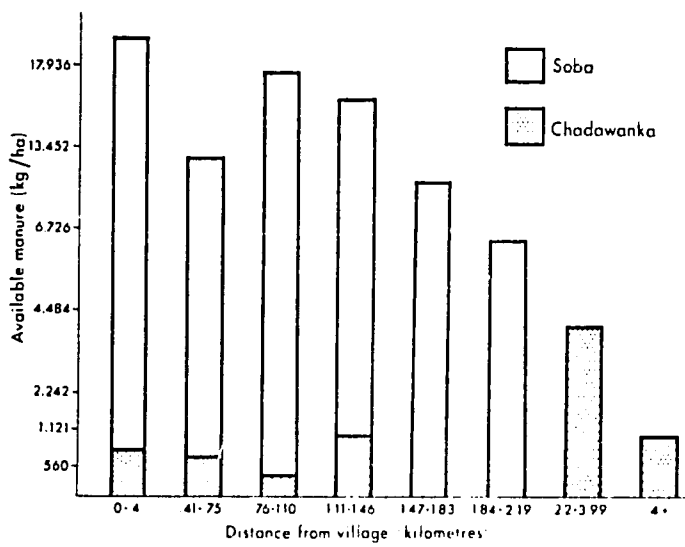


Figure 4.4.3 Intensity of manuring of village fields at Chadawanka compared to Soba, northern Nigeria

Access to pasture lands.

In agropastoral systems, the need for adequate pasture land between cultivated areas poses particular problems for both farmers and herders. Patterns of availability and use of pasture differ between Magaris and

Chadawanka, reflecting differences of habitat, land use and political control.

Magaria has rather little pasture. This is due partly to the lateritic outcroppings of the Ader-Doutchi plateau, and partly to the high rate of agricultural occupation of available land. Pastures do exist between the fields, and at various times of the year are used by both herders and farmers, particularly farmers wishing to fatten a goat or ram before slaughter or sale. During the rainy season, animals are led by a village herder to rough grazing from 2 to 5 km north of Magaria; this prevents animals from causing damages to cultivated fields. After the harvest, animals are permitted to roam freely, grazing on household garbage, crop residues, and available vegetation, though onion gardens in fadama areas are protected by millet stalk fences. As the dry season progresses and forage disappears, animals, especially small ruminants, enter compounds or approach fences or sunshades made of millet stalks and nibble voraciously until chased away by the owner. There is a surprisingly casual attitude toward this mode of foraging (which results in the frequent destruction and need to rebuild fences and sunshades), probably because it is recognized that there is little else for animals to eat.

In Chadawanka, pasture is more accessible due to less intense cultivation and the lack of natural barriers to vegetation. However, the greater number of animals and the higher proportion of cattle in Chadawanka (see below) mean, in effect, that Chadawanka's pasture requirements are greater than those of Magaria. It is therefore not surprizing to find that livestock owners employ a village herder (a resident FulBe) to take the animals away from the fields and into the bush for the entire rainy season. The herder normally leads the animals to a seasonal water pool about 40 km north of Chadawanka; this area is fully pastoral, far from cultivated fields, so there is no possibility of animals causing crop damages.

However, at the time of the harvest, Chadawanka is the scene of frequent crop damage disputes. Residents of Chadawanka and its environs claim that their fields are trampled by transhumant herds returning from their northern

rainy season pastures. Pastoral groups who systematically farm are particularly vehement in their denunciation of such herds, claiming damage not only to crops but also to pasture areas they set aside for dry season use by their own animals.

In spite of the fact that Chadawanka is north of the line above which fines for crop damages cannot legally be levied against herders, members of the Republican Guard are often called down from the administrative post at Abalak to help settle disputes. Reliance on representatives of the state to solve problems and maintain peace between farmers and herders is perhaps indicative of what Raynaut (1980: 33) describes as "a weak social cohesion of forms of village organization" characteristic of recently-established, ethnically heterogeneous communities. In contrast, in Magaria as is typical of most Hawsa villages, crop damage suits are brought before a public moot, with the village headman acting as arbiter; damages are assessed and a fine is levied according to the number of animals involved, their type, and a standard rate for each animal that is well-known to villagers.[1] In both villages, however, judgements in favor of herders appear to be rare.

The role of livestock

Hawsa farmers tend the full range of Sahelian livestock, including sheep, goats, camels, cattle, donkeys and horses. Table 4.4.8 shows the number of animals of each type reported to be owned by all villagers in Chadawanka and a sample of 39 households in Magaria.[2] It can be seen that small ruminants repreaent over 80 percent of all animals in Chadawanka and 92 percent of those in Magaria. Several factors account for the overwhelming preference for small ruminants in agropastoral villages. Initial capital investment for goats and sheep is considerably lower than for other types of livestock; though prices vary across the year and according to the age and sex of the animal, small

---

1. From 1980 to 1982, rates ranged between 150-250 CFA for damage cauaed per small ruminant, 400-500 per donkey, and 500-1000 per large ruminant. The overall fine, however, can vary according to the severity of the damage.

2. It ahould be noted that precise information on animal holdings is difficult to obtain, due to peoples wish not to disclose the extent of their livestock wealth. It is therefore possible that these figures underestimate the number of animals owned by villagers. In particular it is likely that cattle entrusted to Twareg or WoDaaBe herders are underreported.

ruminants cost between 3,000 CFA and 10,000 CFA, while mature cattle and camels range between 60,000 and 100,000 CFA. Moreover maintenance costs of small ruminants are low, due to their ability to use a wide variety of sources of forage within village settings; this reduces the need to buy additional feed or devote labor to taking care of animals.

Table 4.4.8 Composition of household herds in Chadawanka and Magaria; numbers of animals reported.

Species	Chadawanka[1]	Magaria[2]
Goats	228	154
Sheep	239	70
Cattle	88	17
Camels	0	2
Donkeys	9	2
Horses	4	1

Notes:
1. 65 households
2. 39 households

Though fewer in number, cattle nonetheless make in important contribution to household economies, particularly in Chadawanka where they represent at least 15 percent of all animals. In fact, the average number of cattle per household in Chadawanka is higher than figures reported by Raynaut for other agropastoral villages in southern Niger, as can be seen in table 4.4.9.

Table 4.4.9 Average number of head of livestock by species per household: villages in southern Niger

Village	Sheep	Goats	Cattle	Camels	Other
Chadawanka	3.6	3.5	1.3	0	0.20
Magaria	1.8	3.9	0.4	0.05	0.02
Dan Kullu	1.9	9.3	1.1	0.19	0.42
Gurjae	2.4	8.6	0.4	0.20	0.25
Sharken Hawsa	0.9	6.8	1.1	0.06	0.11
Magami	1.2	7.5	0.7	0	0.51

Sources: This study and Raynaut (1980: 16).

In addition to their investment value, cattle can provide significant revenues, especially for women, through sale of cows' milk. Large oxen are also used for transportation in Magaria; 6 out of 17 of the cattle reported to be owned by sample households were used to transport agricultural produce, especially onions, to the market or haul construction material such as bricks around the village. However, neither in Magaria nor in Chadawanka were cattle used to clear fields, plow or weed.

Household production and consumption

Since farming occupies an increasingly significant place in the project zone, it is important to assess its productivity, its ability to provide for those who practise it, and its relative soundness as a resource exploitation strategy. In particular, this section discusses two main issues: the productivity of land and labor, and household consumption patterns.

Methodology

In order to obtain information on these issues, household budget and labor use studies were conducted in the Abalak segment of Chadawanka and the Guidan Ma'Kera section of Magaria; these samples and the criteria for their selection have been described above. Out of the 68 households censused in Chadawanka, 22 were randomly selected to participate in the study, as well as 44 of the

242 households censused in Magaria. Participation was voluntary.[1] The original sample frames were reduced to 21 in Chadawanka and 39 in Magaria during the study period by migration and changes in household structure.

After baseline censusing and selection, twice-weekly interviews were carried out. Questions were asked about the activities of all "productively active"[2] members of the household for the 3- or 4-day period between interviews; Muslim prayer times were used to help calculate the number of hours spent in each activity. For the same period, all sales, purchases, and other transactions made by the household were recorded. Additional questions were asked about land holdings, crop yields, and livestock marketing to provide a context for interpretation of budget and labor use data. Land holdings, surveyed for all sample households at the end of the 1981 growing season, were measured with a compass and tape measure, and the areas calculated. Estimates of harvests in threshed headloads were obtained by questioning household heads at the end of the 1981 and 1982 growing seasons;[3] in addition, at the outset of the survey, participants were asked to estimate the number of headloads produced in 1980. Headloads were converted to kilograms using a coefficient derived from threshed weights of headloads sampled across the course of the survey.

---

1. Not all households contacted agreed to participate. If a given household refused, it was replaced by the next one on the random selection list.

2. "Productively active was defined as all those performing tasks in support of the household's production activities. This included for example, children over the age of six who undertake such tasks as tending animals and carrying water.

3. The study ended in October 1982, before the completion of the sorghum harvest, so yields are probably underestimated.

Productivity of land

Table 4.4.10 gives data on average crop yields per household for the Chadawanka sample for the 1980-1982 growing seasons. A total of just over 60 hectares were cultivated by the 18 to 20 households for which data were available during this three-year period. Average reported yields per hectare fluctuated relatively little in the survey yesrs: 194 kg/ha in 1980, 221 kg/ha in 1981, and 198 kg/ha in 1982.

Table 4.4.10 Crop yields in Chadawanka, 1980 - 1982.

	Millet/sorghum threshed grain yields		
	1980	1981	1982
Number of households	19	20	18
Total cultivated area (ha)	60.5	60.3	60.7
Total production (kg)	10,827	15,659	12,292
Mean yield (kg/ha)[1]	194	221	198
Standard deviation	(122)	(145)	(110)

Note:
1. Average of individual household yields/ha

Large standard deviations within the sample indicate the wide variation in the productivity of individual household's farming enterprises; yields ranged from 50-500 kilograms per hectare. Figure 4.4.4 shows the distribution of household yields in 1981 in terms of the number of households within each productivity category. Twelve households, or 60 percent of the sample, obtained yields of less than 200 kg/ha, 6 households or 30 percent between 200 and 400 kg/ha, and 2 households or 10 percent over 400 kg/ha. Not only is there wide variation in yields between households within a given year, but individual household's yields are likely to fluctuate greatly from year to year. Figure 4.4.5 gives a general idea of the extent of these fluctuations. Between 1980 and 1981, 9 households, or over one half of the 17 for which data are available for all three years, experienced changes in their yields of 50

percent or more; 4 of these households' yields doubled. Between 1981 and 1982, the majority of households saw decreases in their yields, though the magnitude of the decrease ranged from under 10 percent to over 90 percent; at the same time, 3 households experienced increases in yields of more than 100 percent.

number of households	100	100-199	200-299	300-399	400-499	500-599	600+
8		X					
7		X					
6		X					
5		X					
4	X	X		X			
3	X	X		X			
2	X	X	X	X			
1	X	X	X	X	X		X

Household yields: kilograms/hectare

Figure 4.4.4 Distribution of household yields: number of households within each kg/ha category, 1981 (n=20)

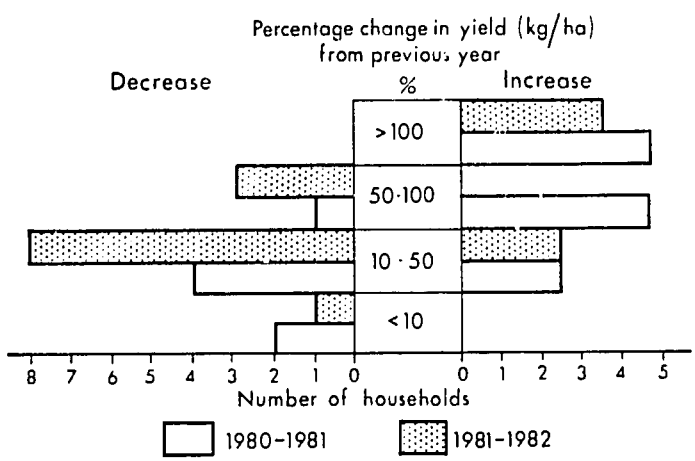


Figure 4.4.5 Percent changes in household yields (kg/ha) between survey years, Chadawanka (N = 17)

These fluctuations in households' yields from one year to the next result from the interaction of several factors: the amount and timing of rainfall, the availability of labor, the farmer's production decisions (when and what to plant); all of these factors can vary from year to year, depending on the circumstances and to a certain extent the luck of the household. The high level of interannual variability in the productivity of family farms in Chadawanka illustrates that farming in the transitional zone is a very risky activity for which returns cannot be accurately predicted.

Though comparisons are difficult to make, it appears that yields per hectare in Chadawanka are much lower than in areas further south in Hawsaland, where rainfall and soil are more generally favorable to farming. Table 4.4.11 presents data from various studies on average yields per hectare in several Hawsa villages in Niger and northern Niger. A few problems with this table should be mentioned: some of the figures given represent averages of averagea, and therefore may be somewhat different from the real mean; the atudies contain differing assumptions so the comparability of some measurements may not be exact; and, as the figures derive from short-term studies, they tend to reflect the situation in the village concerned for only one or a few years. Nonetheless, in the interest of placing Chadawanka yields in a comparative perspective, it can be assumed that the figures give a sufficient estimate of the general range of productivity per hectare for the given villages.

Mean yields per hectare in villages in Niger's transitional zone, namely Chadawanka, Kao, and Dan Kullu, are lower than those found in more properly agricultural areas of the country such as Sharken Hawsa, Magami, and the village in Matameye arrondissement discussed by Sutter (1979a), and are around one-third of those reported for northern Nigeria in the late 1960s. Many climatic, soil and other factors account for this apparent tendency for land productivity to decline from south to north. The point to be stressed here is that in villages along the northern fringe of the agricultural zone, yields are presently well below those in traditionally agricultural areas, in spite of the fact that the productivity of farming in these latter areas is thought to be steadily decreasing.

Productivity of labor.

The returns to labor as well as those to land appear to be low in Niger's transitional zone, although available data are not conclusive. Table 4.4.12 gives some figures on returns to land and labor in Hausa villages, though again the northern Nigerian figures represent approximate ranges of productivity rather than true means. Moreover, it is difficult to compare Chadawanka labor data with those of other villages because in the present study "labor hour" was defined to include agriculturally-related activities such as time spent walking to and from fields, women carrying meals to the fields, and threshing of grain; these are in direct support of production and therefore should be considered as a vital part of the labor input. However, other studies do not include such activities which probably explains the fact that mean labor hours per hectare in Chadawanka appear to be much higher than in Kao or northern Nigeria.[1] Also, in the northern Nigerian studies, labor by women and children was weighted; it is not clear to what extent this reduces the total amount of labor spent by household members in farming as women's contribution to agriculture in northern Nigeria may anyway be less than in Niger due to the greater prevalence of the purdah in the former region.

1. Cleave (1974) has reported that in some parts of Africa farmers spend as much as 30 percent of time devoted to farming in walking to and from fields.

Table 4.4.11 Average cereal yields in villages in Niger and northern Nigeria.

Location	Village	Mean yield (kg/ha)
Transitional zone:		
Tahoua, Niger	Chadawanka[1]	204
	Kao[2]	113
Maradi, Niger[3]	Dan Kullu	180
Agricultural zone:		
Maradi, Niger[3]	Sharken Hawsa	285
Zinder, Niger[4]	Magami	375
	Village Y	350
Northern Nigeria[5]	Sokoto	550
	Zaria	600
	Bauchi	675

Notes:

1. This study, average of mean yields, 1980-1982
2. Eddy (1979:24), Hawsa subsample.
3. Raynaut (1980: 20). Orginal mean yield figures were disaggregated in terms of relatively "extensive" and "intensive" farming systems. Here we have presented a combined mean based on the possibly inaccurate assumption that roughly 25 percent of the land was under intensive cultivation and the remaning 75 percent under extensive techniques.
4. Sutter (1979a: 37).
5. Norman, Pryor and Gibbs (1979: 60). Original mean yield figures were disaggregated in terms of millet and sorghum under sole and mixed cropping schemes. Here we have averaged together the different mean yields in each study area to provide ballpark estimates.

Table 4.4.12 Mean returns to land and labor in villages in Niger and northern Nigeria.

	Labor hours per hectare		Kilograms per labor hour		Kilograms per hectare	
	Millet	Sorghum	Millet	Sorghum	Millet	Sorghum
Niger						
Chadawanka[1]	1,407		0.35		221	
Kao (Hawsa)[2]	209	437	0.1	0.9	113	
Northern Nigeria[3]						
Sokoto	485		1.4	0.2	686	122
Zaria	586		0.6	1.1	366	644
Bauchi	597		0.6	1.2	480	498

Notes

1. This study 1981. Note that labor hours include activities excluded from other studies (see text).

2. Derived from Eddy (1979: Table 1.3 and Annex V). Here yield and labor data have been recalculated without the household of the mai gari who planted 49 hectares, utilized 3,500 labor hours, and produced 815 kg of cereals. A similar household is excluded from analysis of Chadawanka data.

3. Derived from Norman, Pryor and Gibbs (1979: 60). Average kilograms per labor hour were calculated by dividing the average yields per hectare for sorghum and millet in mixed crop enterprises by the average number of labor hours per hectare for each study area; this is a less than accurate estimate.

Nonetheless, the table indicates that farmers in Chadawanka appear to devote more labor hours to each hectare cultivated than their Nigerian counterparts; this is true even if one reduces the mean figure by 40 percent to exclude activities other than direct farm work. Using the original figure, returns to labor in Chadawanka in terms of mean kilograms of grain produced per labor hour are roughly one half to one-fourth what they are in northern Nigeria, that is to say it would take a farmer in Chadawanka two to four times to produce the same quantity of millet as a farmer in Sokoto, Zaria or Bauchi. However, if one makes the same downward readjustment in labor hours of 40 percent, returns to labor in Chadawanka would be within the same range as the rough estimates for northern Nigerian settings. The situation in Kao, another village within the project zone, is somewhat different from Chadawanka. With respect to millet, the "average" Hawsa farmer in Kao devoted less than one-half the amount of labor per cultivated hectare compared to farmers in northern Nigeria, and the Kao farmer would work four to ten times as long to produce the same quantity of millet. With respect to sorghum, however, mean labor hours per hectare and kilograms produced per labor hour in Kao are similar to those realized in the Bauchi and Zaria regions. In short, presently available data do not show any clear differences in returns to labor between farming systems in transitional and fully agricultural areas. It is probable that local circumstances play a major role in determining the amount of labor devoted to farming and its productivity.

Household consumption

It is important to ask the question: to what extent do farming systems in the pastoral zone provide subsistence for producers or generate a surplus for exchange with herders? Data from Chadawanka on household grain production and consumption strongly suggest that agriculture in transitional areas has a very limited capacity to support those who practice it. In the course of survey interviews, household heads were questioned over a six-month period about the amount of grain consumed by the household in the preceding days. The households' total annual production for 1980-1982 was then divided by households' reported daily rates of consumption to determine the number of days for which households needs could be met by their harvests; results are given in table 4.4.13. It can can be seen that the average period for which households' consumption rates can be sustained by their own production is

alarmingly low: between three and four months. Moreover, while there is some variation within the sample, 10 out of 21 families produced an average annual cereal supply to last 90 days or less during the three study years. Another six could last for 3 to 5 months, 4 for 6 to 11 months, and only one family produced enough to get through till the next harvest. Eddy (1979: 278) found a similar situation in Kao, where the average Hausa household met only 40 percent of its annual consumption needs through its own production. Lack of self-sufficiency in cereals has often been noted as a major problem for farmers

Table 4.4.13 Average capacity of household production to meet household consumption requirements, Chadawanka (1980-1982)

	1980	1981	1982
Number of households	19	20	18
Mean annual grain production per household (kg)	569.8	782.9	682.8
Mean number of potential support days from harvest	98.4	123.4	112.5

in Niger, and indeed throughout the Sahel. It would seem that the situation in the study zone villages is acute in this respect.

SUMMARY AND CONCLUSIONS

The major points about farming in the project zone discussed in this chapter can be summarized as follows:

(1) The expansion of land under cultivation within the project zone is a fairly recent phenomenon prompted by two distinct historical trends: (a) population pressure on traditional farming lands to the south, causing Hausa farmers to move north into previously uncultivated marginal areas, and (b) the need for people in the pastoral economy to turn to cereal cultivation to meet their subsistence needs, either on a short-term or more permanent basis.

(2) The different historical, economic and ethnic origins and present objectives of farming groups in the project zone contribute to the considerable diversity of farming systems with respect to agricultural knowledge, techniques and tools; the scale and productivity of production; resource use patterns; and the way in which the two components of the system (farming and livestock-raising) are balanced.

(3) Hawsa farming systems within the project zone, of which Chadawanka is assumed to be representative, are characterized by small farms with low productivity, a high degree of risk and variability, and a low capacity to meet households' grain consumption needs or generate a surplus for exchange with herders. As such, these newly-installed production systems are only precariously viable and are particularly vulnerable to the destabilizing processes underway throughout Hawsaland: the fragmentation of traditional production units, the pressing need for cash to acquire basic neceasities drawing labor away from household farms, growing social and economic inequality with respect to access to factors of production.

The nature and extent of farming in the project zone make it essential to take agriculture into consideration in the formulation of development programs and policies. At present, its existence is only minimally acknowledged, since it represents a secondary productive activity within what is defined as the pastoral zone. Given that even more pasture land is likely to be brought into cultivation by both farmers and herders in the years to come, a laissez-faire attitude toward pastoral zone farming could ultimately have serious consequences for all categories of producers involved. Two issues should be the points of departure for the formulation of policy on farming in the pastoral zone:

(1) Curbing the expansion of agriculture. Should agriculture in the pastoral zone be curbed? On one hand, efforts to dissuade people from farming in the pastoral zone have had little or no effect.[1] On the other, the very existence of farming in such an agriculturally marginal area indicates the level of stress in traditional production systems, suffering in particular

1. See chapter 6 of this report .

from pressure on land without the capacity for intensification which exists in higher rainfall areas farther south, and from the impoverishment of increasing numbers of herders. Attempting legally to restrict the expansion of agriculture without addressing these problems is like trying to eliminate the symptoms of a disease without identifying or treating its cause. The establishment of conditions to permit intensification of cultivation in southern Tahoua department, while not within the realm of a livestock project, would undoubtedly slow the northern migration of Hausa farmers. Programs to improve the viability of poor herders, especially ensuring access to millet at reasonable and stable prices and promoting herd reconstitution, would remove most of the incentive for these herders to establish small independent farms that make poor use of available land and labor. Moreover vesting rights to pastoral land in herder organizations could provide a forum for people to protect their claims to land they habitually use and to control further changes in resource use in the area.

(2) Improving the integration of farming and herding. Discussion above showed that there is growing tension between farmers and herders in the project zone due to competition for resources and the particular way in which their production systems interlock. In order to stop further deterioration in the traditionally symbiotic relation between farming and herding, and to strengthen the interaction of both groups of producers, new approaches are necessary. Four main problem areas merit special attention:

(a) Conflicts over crop and pasture damages between farming and herding groups are increasing in intensity. In the transitional zone, the lack of traditional mechanisms for resolving such conflicts require the state - in the form of the gardes nomades - to intervene, and decisions are rarely rendered in favor of herders, despite the fact that a 1961 law makes it illegal to levy fines against herders for crop damage above the "northern limit of cultivation." The farmers' rights to land are thus tacitly recognized and actively protected, while herders are treated as trespassers. All this fuels mistrust and a sense of incompatible interests between the various groups of producers.

It is unlikely that the 1961 law will ever be enforced on any kind of systematic basis, nor is pastoral zone farming likely to disappear, so alternative methods of defining mutually acceptable rights and access to resources, and ways of applying these, must be sought. In this regard, the development of local-level institutions capable of facilitating communication between producer groups, represented on an equal basis, would be appropriate. The herders' associations developed by the project provide for the first time a form of organization on the herders' side able to do this.

(b) The steady disappearance of pastoral space within cultivated areas is leading many farmers to hire herders to take their animals into the bush to reduce the possibility of crop damages. This system has been used for a long time in the Sahel, and, in the past, had advantages for both farmers and herders. Since the drought of the last decade, however, many of the herders who enter into the arrangement do so because of impoverishment; with few animals of their own, they are willling to work for negligible rewards, which increases the attractiveness of investing in livestock for agropastoral farmers but is highly disadvantageous for herders, as described in the WoDaaBe chapter above. Programs to rebuild pastoral herds will reduce herders' need to accept such work but farmers will be left with the problem of how to keep animals out of the fields during the growing season. In this case, perhaps more equitable arrangements can be made to satisfy both parties; herding groups willing and able to take care of farmers' animals during the rainy season could receive payment for their services commensurate with the value to farmers of having their animals away from the fields and profiting from lush rainy season pasture, in the form of a cash wage determined by the economic demand for this service.

(c) Agropastoral farmers' demand for animals, especially young animals for growing out, is likely to increase in the near future since livestock-raising represents an important, low-risk way of generating income to meet pressing cash needs (including purchases of millet after family stocks are depleted). At present the supply of young animals available on the market is probably adequate to meet farmers' demand, largely because herders are constrained to sell very young animals due to their own need for cash at certain times of year. Programs to improve herders' capacity to retain

animals until they reach their optimum market value may slow the southward flow of animals, thus pushing up the price of such animals to agropastoralists. Nonetheless, it may be possible to set up exchange agreements between, for example, herder associations and farmer cooperatives whereby each year a certain number of animals of specified types are traded for an agreed-upon amount of millet (or any acceptable service or commodity offered in exchange if millet is too scarce). This type of regular barter exchange could, for both groups of producers, (a) contribute to reducing the need for cash (through monetization of their labor or its products) to obtain essential goods or make small investments, and (b) provide a buffer against the wide inter and intra-annual fluctuations of Nigerien markets.

(d) Farming systems in marginal areas are characterized by very low land productivity and therefore very low output that meets only a small portion of household needs. While animal traction is presently unfeasible for most pastoral zone farmers, higher rates and more systematic methods of manure application in the southern part of the zone could make a significant improvement in cereal yields. The expansion of traditional arrangements whereby after the harvest pastoral herds are allowed to graze on crop residues while providing manure to the fields would be beneficial for both farmers and herders. The fact that this system is falling into disuse at a time when the need for it would seem to be increasing suggests that conditions are not adequate for spontaneous adoption of manuring agreements; for example, farmers may not want to exchange crop residues, prefering to save millet stalks for their own animals or for use as construction material; or crop residues may not be sufficient in quantity or quality at the right time of year to provide an attractive source of forage for pastoral herds; or village watering facilities may not be able to accommodate additional animals. New institutions and incentives are needed to encourage such cooperation between herders and farmers over manuring.

CHAPTER 5 LIVESTOCK MARKETING

CHAPTER 5 LIVESTOCK MARKETING FROM THE PASTORAL ZONE OF CENTRAL NIGER

Livestock marketing at household level has been discussed in chapter 4 above. This chapter gives a more general picture of the flow of livestock from the project zone to the major markets of the south. Accurate data on the macro-economics of the livestock trade are difficult to obtain; although the livestock service gathers statistics on important markets throughout the country, this information is not systematically aggregated or analysed. As a result, this chapter is more qualitative than quantitative in orientation and should be read as a preliminary statement about the dynamics of the livestock trade requiring further investigation.[1]

The market for livestock from the project zone appears to have undergone considerable change in the past 10 years. Four recent developments are particularly important: the growth in demand for meat in Nigeria; changes in transportation; the increased use of animal traction in southern agricultural areas; and changes in the markets through which animals from the project zone pass.

NIGERIAN DEMAND FOR MEAT

Markets for livestock from the project zone can be categorized in approximate order of importance. Nigeria is the dominant ultimate destination for cattle from the project zone. A distant second is the regional domestic market in major towns like Maradi and Tahoua, but also includes sporadic slaughter in villages on market days. Third, there is some beef consumption by herder families themselves, though this is generally limited to last-resort killing of dying animals and to ceremonial slaughters during the annual rainy season gatherings. Algeria receives a few truck loads of small ruminants during Tabaski. Finally, Arlit and the uranium mines are small market for

---

1. For a more detailed discussion, see Makinen and Ariza-Nino (1982).

cattle from the project zone, although of much greater importance for sheep and goats.

Continuing and steady economic growth in Nigeria over the past few years has brought about a rapid expansion in demand for cattle from Niger. Major cities in Nigeria, such as Lagos, Ibadan, Kano and Port Harcourt, have increased in population at rates exceeding 7 percent per annum for several years, and show few signs of abatement. Income per capita has similarly increased, particularly in the urban sector, despite the lower rate of expansion in oil revenues over the last couple of years. Since beef consumption is particularly concentrated in urban centers, the prognosis over the 1980s is for beef demand to expand faster than the livestock herd. Resulting high meat prices in Nigeria have benefitted Niger pastoralists, although of course they have also led to high prices for urban consumers in Niger.

Fears that high Nigerian prices for cattle and meat will cause Niger to sell off its breeding stock are probably unwarranted, because as Nigerian prices rise, so does the value of holding onto breeding stock. To the Nigerian herder, reproductive females are future producers of high-priced items, so the herder will not sell them unless he is constrained to do so. Indeed, a strong Nigerian market can be considered as a positive force for livestock sector development. It allows Niger the flexibility of exporting more or fewer animals as local circumstances warrant, without significantly affecting prices.

However, recent economic developments in Nigeria do introduce a note of uncertainty in an otherwise optimistic short-term forecast. A drastic decline in the price of crude oil in the world market has led Nigeria into serious balance of payment difficulties. As a result, severe import and currency exchange restrictions have been imposed by the Federal government. Until recently, these policies have affected mainly international trade that uses banking channels to clear payments. However, the recent expulsion of illegal immigrants may signal a trend to impose restrictions on what has been until now an open-door policy toward neighbouring countries. Since the well-being of Niger's livestock sector is so closely tied with the economic health of Nigeria, further developments in that country would have significant impact on the project zone, and thus should be carefully monitored.

TRANSPORT

Changes in the transport systems in both Niger and Nigeria have dramatically affected the livestock marketing system. Future changes in the transport sector and in policy affecting transport could have similarly far-reaching consequences. The extensive Nigerian road construction in the 1970s has reduced the cost of trucking animals from the Niger frontier to the coastal consumption markets, so that long-distance trekking has tended to be replaced by trucking. The construction of the Uranium Road from Birni N'Konni to Arlit has facilitated the communication of economic information within the project zone, and the zone will be probably influenced by further road construction.

The Government of Nigeria has spent some of its booming oil revenues on the network of high quality highways criss-crossing the country. The consequent reduction in trucking costs has had a considerable impact on the movement of northern cattle to southern markets. Trekking of animals long distances within Nigeria has disappeared and rail transport of animals is greatly diminished. The almost month-long trek or several-day train ride from border markets has been replaced by a 24- to 36-hours truck trip. The advantages of this form of transport over trekking are underlined by the observation that loading ramps are a prominent feature of the Niger-Nigeria frontier assembly points at Illela, Jibiya and Maigatari. No cattle destined for the coast walk beyond these points. Weight losses involved in trekking are avoided and turnover time for capital invested is greatly reduced by trucking.

Cattle loaded at these points tend to be large, mature males with a few relatively-healthy old cows. They are destined for slaughter in the markets of Lagos, Ibadan, Enugu, Port Harcourt, and others along the densely populated Nigerian coast. Lagos is the dominant destination. Nigerian authorities do

not impede the flow of cattle from Niger into their country, but are strict in requiring imported cattle to report to the nearest control post for vaccination and to get a transport permit.[1]

Within Niger, trekking remains the dominant form of livestock transport. There is trucking of sheep during the legal export period before Tabaski. Most of this sheep trade goes to Nigeria, with some going to Algeria. There is some trucking of animals within Niger, but trekking is much more common.

Indirectly, the uranium road has affected the livestock trade within Niger. The road gives traders direct access to the pastoral zone, especially the project zone which is cut diagonally by the road from Tahoua to Agadez. It is now easier for export traders to penetrate the pastoral zone. The combination of more buyers for their output and greater availability of goods for their consumption has attracted herders to markets along the road.

The Abalak market shows the effects of proximity to the road. Established in 1975, it appears to have become one of the most important markets in the project zone. It was mentioned prominently by export traders in the Birni N'Konni, Illela, and Maradi areas as an important source of export herds. Abalak was also cited frequently by herders as a good place to find a variety of consumption goods. Abalak is now at least on a par with the traditionally important nearby pastoral markets of Kao and Tchin Tabaraden, which are less accessible because of their distance from the road.

Continued growth of the Abalak market is to be expected. A similar magnet effect will likely affect other markets along the road. Abalak is currently monitored erratically; it merits regular surveillance. As other markets develop or become important, they too should be under regular observation.

---

1. Processing costs for these animals are minimal - the equivalent of 300 CFA per head. Vaccination certificates issued by the Niger Livestock Service are honored in Nigeria. Transport costs from Illela to Lagos vary from 3,600 to 4,500 CFA per head depending on supply and demand conditions for trucks, or about 2-3 percent of the purchase price of the animal.

The penetration of export traders into the pastoral zone may have brought about changes in the marketing system. It is now possible for one export trader to buy animals directly from herders in the pastoral zone, have them trekked to the Nigeria border, load them into trucks for shipment to the coastal consumption market, and sell the animals to butchers. Thus, the marketing chain may have far fewer links than in earlier times. There are now essentially three links: the herder, the trader and the butcher, with dillalis acting as brokers in the herder-trader and trader-butcher transactions.

A shortening of the chain would have a favorable impact on the prices received by producers for their animals. Fewer middlemen in the system means that there are fewer people taking their share out of the transactions. Moreover, competition would be enhanced by this improved access. For example, the Nigerian livestock service post in Illela, which issues transport permits for trucks taking animals to the coast, reported that nearly all new permits were issued to Nigeriens from the Tahoua department and that there were at least 20 new entrants into the business in 1981. The combination of a shorter marketing chain, increased competition among buyers, and shorter capital turn-over time should improve producers' share of final sale price.

An additional benefit from the improved transport system is in the communication of price and other demand information from coastal markets. It is now possible for information about price changes to pass from the coast to the pastoral zone within 48 hours as traders, transporters and convoyers return by bush taxi from the coast. This would allow quicker response to price changes which acts to smooth fluctuations as high prices can be quickly met by increased supply and low prices by a holding back of animals.

With the advantages that road construction has already brought and potentially could bring to the project zone, the Livestock Service should be sure that any new road construction in the zone be planned with its impact on the pastoral economy in mind.

ANIMAL TRACTION

The use of animal traction in and around the project zone is reported to have increased in recent years. Animals are used for pulling and carrying water within the zone and for pulling carts and ploughs in the agricultural zones of southern Niger and northern Nigeria.

Animal traction to pull oxcarts is common in the farming areas to the south of the project zone, especially in the Maradi area. During the growing season oxen are used in ploughing and other heavy field work. These developments have probably created a growing demand for young males of 2-3 years that are trained and kept until 5-6 years of age both in southern Niger and northern Nigeria. Farmers benefit further from the increase in value of the animals kept in the meantime. The use of crop residues to feed these young bullocks or to fatten cattle during the dry season appears to be increasingly widespread in the southern zone.

The Azawak breed seems to have been the main beneficiary of the demand for young males. Bororo males are considered unsuitable for animal traction because of their frisky temperament, huge horns, taller stature, and lanky conformation. By contrast, Azawak bullocks are stockier, milder in character, and easier to train and lead.

The pattern of sales for Azawak cattle may be shifting with this increase in demand though it is difficult with available data to test this hypothesis. Whereas cattle owners in the pastoral zone formerly sold adult males predominantly for slaughter, they may now be selling more young castrated Azawak males to small traders who trek them south for sale for farmers. For example, southern livestock markets like Maradi and Sabon-Machi have many young males for sale to farmers. Possibly, the price for young Azawak males has increased sufficiently, relative to the adult price, to induce some livestock owners to sell at an earlier age. Farmers would later on sell the same animals either for slaughter or export.

However, evidence on whether these changes in herd management and sales patterns of Azawak cattle are taking place is inconclusive. Given the

importance of these issues in future pastoral zone development activities, additional market studies are essential.

LIVESTOCK MARKETS

A market survey was conducted between 25 December 1981 and 14 February 1982 in order to collect information on the markets handling animals from the project zone. A total of seventeen markets were visited: six in the project zone, one to the north of the zone, seven in southern Niger, and three export assembly points in northern Nigeria. Table 5.1 summarizes the results of this survey. For each location the market day, the sources and destinations of animals, the main function of the market (meat supply for local consumption, collection point for herds bound for other markets, transit market, etc.), and its role within the larger pattern of livestock flows from the project zone are indicated. Figure 5.1 shows the general directions of these flows. Since only a brief visit was made to each market, the survey's results are necessarily impressionistic. Nonetheless, it is possible to draw the following tentative conclusions:

(1) Most markets serve more than one function: local demand for meat and animals, collection and replacement of animals for export or for larger markets, and truck loading assembly points. The relative importance of each function seems to be determined by a combination of factors, including proximity to major roads, the nature and extent of demand from the local population, the position of the market with respect to the general southward flow of cattle, the relative attractiveness of neighbouring markets.

(2) As mentioned above, the construction of the Uranium Road has contributed to the growth in importance of some markets in the project zone and a corresponding decline of others. Markets which appear to be growing are due to the road construction are Tahoua and Abalak; conversey, Tchin Tabaraden and Kao, not located on the paved road, are declining in importance.

(3) The general movement of marketed animals in Niger is from north to south toward urban consumption centers like Tahoua, Maradi and Zinder an further south to Nigeria. The tremendous pull of demand for meat i Nigeria is demonstrated in figure 5.1 showing livestock flows. Animal from northern markets, especially large, mature Azawak males, are brough to intermediate collection markets like Tahoua, Abalak and Tanout. Fro there they are trekked to transit markets along the border with Nigeria of which the major assembly points are Birni N'Konni, Sabon-Machi an Zinder.[1] The export herds are then brought across the border to assembl points in Nigeria namely the markets at Illela, Jibiya and Maigatari where they are loaded onto trucks and brought to consumption centers.

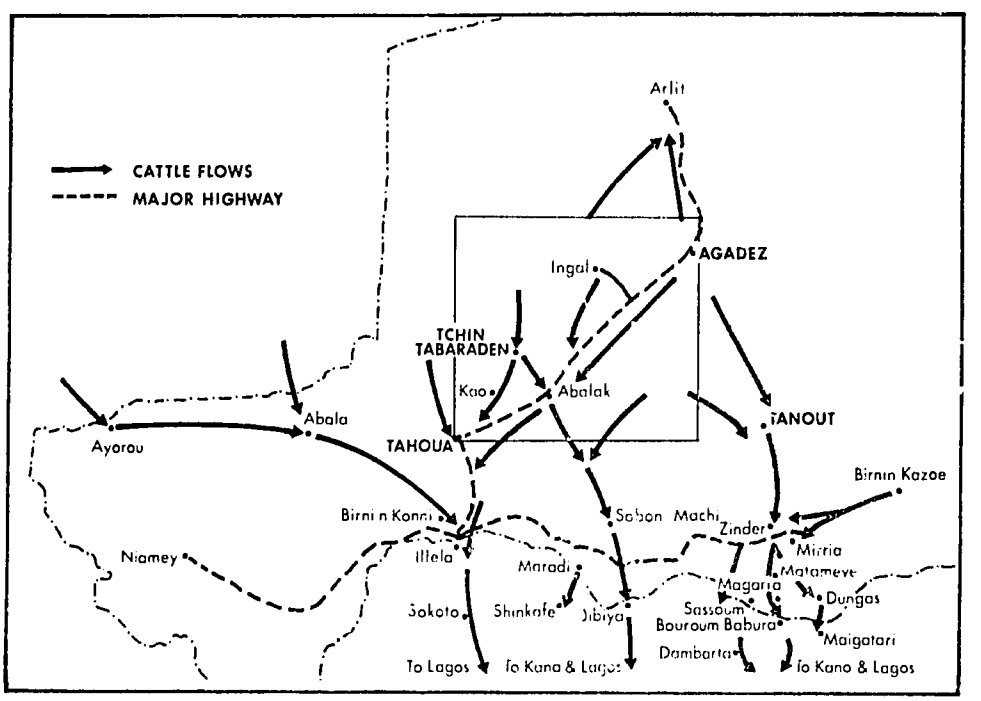


Figure 5.1 Livestock market flows in and from project zone

1. Three other assembly points were mentioned by informants but their importance was not confirmed by actual visits: these are Shinkafe, Dambarta and Babura.

Table 5.1 Important livestock markets for animals from project zone

Market	Market day	Main function	Source of animals	Destination of animals	Comments
Abalak	Friday	Collection, transit	Surrounding area, Kao, Tchin Tabaraden, Ingal, Agadez	Maradi, Tahoua, Nigeria	Good location on Uranium Road; probable rapid growth.
Agadez	Daily	Collection, consumption	Surrounding area, Ingal	Arlit, Abalak, slaughter	Primarily small ruminants for local consumption. Potential gradual market expansion with population growth.
Arlit	Wednesday	Consumption	Agadez, Ingal	Slaughter, fattening	Small ruminants to meet local demand. Chilled beef trucked in weekly.
Birni N'Konni	Tuesday	Transit	Tahoua, Abalak, Abala, Ayorou	Illela, Lagos	Major assembly point for exports.
Illela (Nigeria)	Sunday	Transit	Abala, Ayorou, Ababak, Tahoua	Lagos, Sokoto, local animal traction	Major truckloading point for exports to coast from western Niger.
Ingal	Daily	Collection	Surrounding area, Agadez	Arlit, Agadez, Abalak	Small market, off main highway.
Jibiya (Nigeria)	Sunday	Transit	Sabon-Machi, Maradi	Lagos, local animal traction, Kano	Major loading point for Nigerian cattle destined for coast.
Kao	Tuesday	Collection	Surrounding area, Tchin Tabaraden	Abalak, Tahoua	Declining importance as transit market since construction of uranium road.

Market	Market day	Main function	Source of animals	Destination of animals	Comments
Magaria-Zinder	Saturday	Consumption	Zinder, surrounding area	Slaughter, fattening, animal traction	Mainly small ruminants to meet local demand.
Maigatari (Nigeria)	Thursday	Transit	Zinder, Mirriah	Lagos, Kano	Same function as Illela but for cattle from eastern Niger: major truckloading point.
Maradi	Monday & Friday	Transit, consumption	Abalak, Dakoro, Aderbissinat	Slaughter, animal traction, Jibiya	Major domestic consumption market.
Matameye	Friday	Consumption	Zinder, surrounding area	Slaughter, fattening, animal traction	Predominantly consumption, some replacement for export herds.
Mirriah	Sunday	Transit	Kazoe, surrounding area	Zinder Maigatari	Possibility of becoming major embarkation point with improved road and free exports. Large number of goats presented.
Sabon-Machi	Tuesday	Collection, transit	Abalak, surrounding area	Maradi, Jibiya	Important assembly point on middle-southern edge of project zone.
Tahoua	Sunday	Collection, transit, consumption	Kao, Abalak, Abala, Ayorou	Birni N'Konni, Illela, slaughter	Important market, well well-located, potential for rapid growth.

Market	Market day	Main function	Source of animals	Destination of animals	Comments
Tchin Tabaraden	Sunday	Collection	Surrounding area	Kao, Abalak	All cattle destined for resale; small ruminants meet local demand for meat. Probable decline in importance with growth of Abalak market.
Zinder	Thursday	Transit, consumption	Tanout, Mirriah, Kazoe, surrounding area	Slaughter, Magaria, Matameye, Dambarta, Maigatari, Gabura.	Major consumption and transit market.

CHAPTER 6 INSTITUTIONAL FRAMEWORK: GOVERNMENT POLICIES AND SERVICES

CHAPTER 6 INSTITUTIONAL FRAMEWORK: GOVERNMENT POLICIES AND SERVICES

This chapter gives an overview of government services and policies relevant to pastoral development in Central Niger. In the first section institutional profiles are given of the services that play a role in pastoral zone development. In the second section, government policies that have implications for pastoral development are outlined and examined.

GOVERNMENT SERVICES

Pastoral development is necessarily multi-disciplinary, since social, economic, ecological, cultural and technical issues are involved. So several government agencies are involved in the definition and execution of pastoral development strategies. Eight government services are described here because of the particularly important role they play.

Livestock service

Pastoral development projects in Niger are part of the livestock service, one of four major divisions of the Ministry of Rural Development. Figure 6.1 shows the structure of the national livestock service. The service undertakes activities in a variety of fields, including animal health and production, research, processing and marketing animal products, and training of technical staff. Traditionally, the livestock service has focused (and to a certain extent continues to focus) on the eradication of important animal diseases through annual vaccination campaigns. After the 1970s drought, however, it became clear that a broader scope of activities was necessary to ensure the livestock sector's long-term viability and contribution to the national economy. So the livestock service is now responsible for encouraging the structural transformation of livestock production: this involves new resource strategies, the encouragement of greater livestock productivity and offtake rates, and efforts to improve animal health.

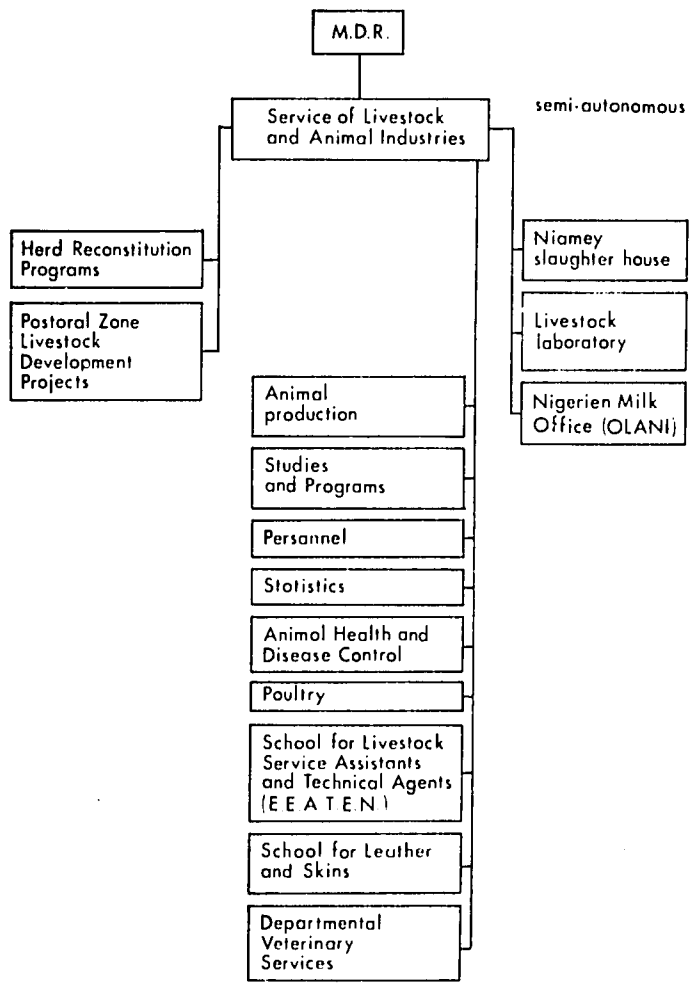


Figure 6.1 Structure of the livestock service

The livestock service is mainly concerned with providing the infrastructure and technical services for this transformation; collaboration with the donor-funded livestock projects and other government agencies, expecially the UNCC, is considered necessary to bring about the institutional changes - principally the organization of herders into cooperative groups - which will make the technical inputs effective and sustainable.

Within the project zone, the livestock service's most important activity is the annual vaccination campaign against rinderpest and contagious bovine pleuropneumonia.

The livestock service maintains a staff of livestock assistants and technical agents at veterinary posts throughout the zone for general assistance in animal health. The service has faced problems in providing adequate, cost-effective animal health care cover in the pastoral zone, where the population is mobile, dispersed, and often great distances from livestock service posts. In the past, resources have been strained by efforts to deliver services and drugs over a very large area; a large part of the budget has been spent on the vaccination campaign and on visits to the bush to treat specific urgent problems. The substantial decrease in government revenues in the early 1980s has obliged the Livestock Service to explore more cost effective methods of delivering animal health care, such as the veterinary auxiliary system described in chapter 7.3 of this report.

Health Service

The government regards the delivery of adequate human health care to everyone as an essential part of national development. Niger has a pioneer primary health care program in the agricultural zone, but the scattered distribution, low density and mobility of herders make primary health care delivery much more difficult in the pastoral zone. At present the Health Service has three types of activities in the project zone:

(a) Medical Centers (CM) and dispensaries, which are located in the villages and have several functions, including curative and preventative medicine, out-patient consultations, and supervision of health auxiliaries and midwives. Figure 6.2 shows the distribution of these facilities in the project zone.

(b) Department Mobile Hygiene and Medicine Teams (EDHMM), which intervene in epidemics, conduct vaccination campaigns, and provide health coverage at large public gatherings of herders such as the annual salt cure.

(c) Village Health Teams (ESV), which are composed of voluntary auxiliaries and midwives recruited among local populations and trained to treat the most common diseases with a limited number of easily-administered medicines. At present, only a small number of herder auxiliaries have been trained in the pastoral zone.

The project surveyed the use of health facilities in the project zone (Loutan 1982a: 117-124). Although Health Service infrastructure was found to be adequate, the level of coverage was not. The main reason for this is the great distance between most nomadic camps and dispensaries. In the pastoral zone, a visit to the dispensary takes at best several hours and at worst several days; most herders cannot afford to leave their animals this long. Loutan (1982a) found that only 8 percent of the subjects in his sample went to the dispensary for consultation per trimester, and there was no increase in the rate of consultation corresponding to the seasonal increase in illness.[1]

---

1. For example, in February 1981, when 29 percent of the subjects in the sample were bed-ridden for at least one day with cough, only 2 percent of consultations were for this reason.

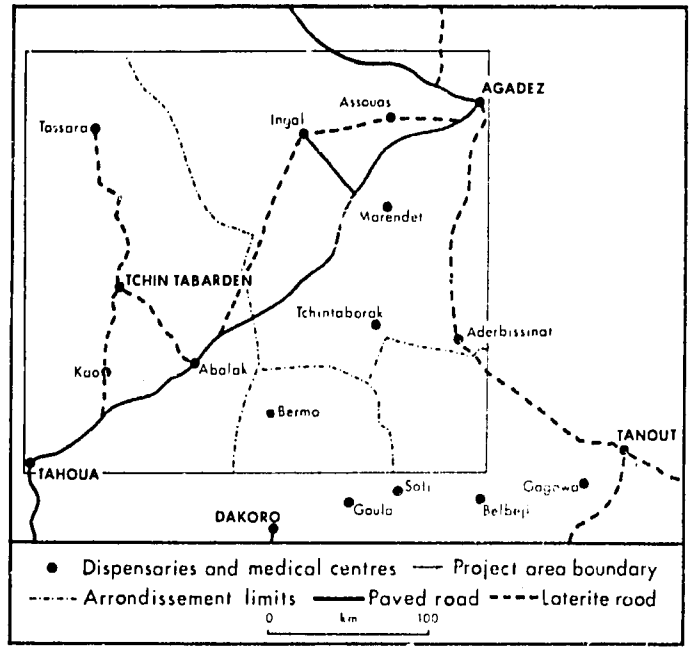


Figure 6.2 Medical facilities in project area

Herders are most likely to visit the dispensary on a market day, when they anyway go to market to sell animals and buy cereals and other goods. A survey of the Tchin Tabaraden and Abalak dispensaries found that on non-market days an average of 12 percent of new patients were Twareg or WoDaaBe herders who had come in from the bush, compared to 49 percent on market days. The vaccination campaigns were also found to have only limited impact on the pastoral population. Only 15 percent of subjects over 5 years old and 3 percent of those under 5 had vaccination scars from the health services.

Thus in spite of a relatively well-developed health infrastructure, the pastoral zone faces particular difficulties in the delivery of health care. Proposed methods of dealing with these problems are discussed in chapter 8.4.

Nigerien Credit and Cooperative Union (UNCC)

The Nigerien Credit and Cooperative Union (UNCC) is the government agency responsible for establishing cooperative institutions in the countryside. Created in 1962, the UNCC received a new impetus with the introduction of the Development Society Policy (see below), which emphasizes self-management and cooperation as the basis of rural development organizations.

Although until recently, UNCC's activities were largely confined to the agricultural zone, there is now considerable discussion about how the cooperativization of the pastoral zone should proceed. A 1981 decree[1] which gives responsibility for the economic activities of pastoral cooperatives jointly to the UNCC and to livestock projects operating in Niger, acknowledges the need for a period of experimentation in cooperative actions in the pastoral zone, since models of organization developed in the agricultural zone cannot be directly applied to the different circumstances of the pastoral economy and society. Nonetheless the basic units of organization for both regions are similar:

Mutual Groups (Groupements Mutualistes) are to represent the grass-roots units of organization, or "development cell": these are to be incorporated into progressively higher levels of organization (local, departmental, and ultimately national cooperative unions), with the initiative coming from below throughout the process. In the pastoral zone, emphasis is at present placed on the formation of Groupements Mutualistes Pastoraux (GMP), which will consist of herders from one or more nomadic camps sharing the same pastoral

1. No. 18/MDR, 3/4/81.

space for all or most of the year. The GMP are to be multi-purpose organizations undertaking a variety of activities, including collective marketing, provision of producer and consumer credit, and establishment of stores with basic commodities.

Several GMP in the same region can join together to form a pre-cooperative, or Groupement à Vocation Cooperative (GVC). The organization of the GMP and GVC are to be proposed regionally and locally by the COTEAR and COTEDEP, committees made up of representatives from technical and other services at the arrondissement and department levels.

National Bank for Agricultural Credit (CNCA)

The National Bank for Agricultural Credit (CNCA) was originally created as the credit arm of UNCC. It is now an autonomous banking establishment which provides credit to Groupements Mutualistes supported by the UNCC for a variety of agricultural development purposes (short- and medium-term loans, financing for UNCC agricultural commodity buying campaigns, feasibility studies, etc). It also provides a small number of loans to individual farmers and herders. Though now administratively autonomous from the UNCC, CNCA shares a headquarters building with it and works through UNCC departmental offices and UNCC agents in making and recovering cooperative loans.

CNCA has faced great difficulties in establishing a viable credit system that will both guarantee its solvency and promote agricultural and pastoral development. Loan repayment rates are very poor; in Tahoua Department in 1979-80, for example, only 52.2 percent of all loan installments due were repaid (Thomson 1981). In an effort to improve rates of repayments, the loan approval process has been made more strict, with emphasis placed on loan candidates' solvency and credit history; the administrative procedures for obtaining a loan require substantial costs in terms of time and effort on an applicant's part. The CNCA's concern for financial reliability means that loans are more readily granted to wealthier people with proven credit records, and poorer applicants are more likely to be refused.

CNCA is at present being reorganized, and it is hoped that the development of cooperative groups will provide an institutional framework that will improve the credit system's viability and effectiveness.

Nigerien Staple Grains Office (OPVN)

OPVN was created in 1970 as a price stabilization mechanism, designed to counter the large seasonal and interannual swings in prices of staple grains. During the 1970s drought, OPVN took on the administration of famine relief. Its current mandate is to stabilize prices while assuring adequate availability of grain in areas, such as towns and the pastoral zone, that do not meet their grain consumption needs from their own production. In addition, it is committed to maintaining cereal security stocks in preparation for future droughts.

In recent years, OPVN has managed to buy only 3 percent of domestic grain production, or approximately one-sixth of domestic grain sales to consumers. However if imports are included, OPVN has in some years marketed as much as one-third of Niger's total grain supply. Nonetheless, the amount under government control has not been enough to stabilize prices or to guarantee supplies to herders.

Given recent strains on the government budget, it has been suggested that OPVN should avoid trying to monopolize domestic grain sales and confine its activities to its original price stabilization function. Greater rural cooperative involvement in marketing cereals throughout the country has also been proposed. If OPVN activities were in fact scaled back, open competition between cooperatives and the private sector might provide herder organizations with an opportunity to make arrangements to buy millet for resale to members at favourable prices. It may be noted in this regard that the Five-Year Plan (1979-1984) advocates more decentralized storage of security stocks and a greater role for each peasant family in taking measures to ensure its own grain reserve. Of course, peasants who are able to, have been doing this for centuries. Pastoral cooperatives should enable herders to do the same, thus giving them greater control over their own grain supply, enhancing their ability to meet their own urgent needs in times of grain scarcity and relieving the burden currently placed on over-extended government services.

Rural Extension Service (Animation)

The Rural Extension Service is supposed to facilitate the implementation of the Development Society by encouraging the growth of a popular consciousness among rural people and mobilizing them to find effective solutions to their problems. While its orientation is more social than technical, the technical services concerned with rural development are supposed to draw on Animation's particular communication and teaching skills to improve their own contacts with rural inhabitants. This presents a particular problem for the Extension Service: although it is supposed to play the role of catalyst in initiating a bottom-up approach to development, it is often called upon to facilitate the implementation of top-down technical activities. As a result, Animation is often not effective. The fact that administratively it is part of the Ministry of Plan rather than the Ministry of Rural Development further reduces its influence on the latter ministry.

Nonetheless, the multidisciplinary approach and emphasis on organizing rural populations that are implicit in the Extension Service's mandate make this agency an appropriate participant in pastoral development. It could be a useful participant in the creation and supervision of herders' cooperative groups, and should take a leading part in programs to train such groups' technical advisors.

Adult Literacy and Continuing Education Service (Alphabétisation)

This Service is part of the Ministry of National Education and has a mandate to improve the level of literacy, particularly in order to encourage more effective participation in development. Niger's adult literacy program has existed since 1962, but it received new impetus with the introduction of the Development Society policy; self-help development depends on greater adult literacy, since people cannot effectively run cooperatives without minimal literacy. Though high priority has been placed on teaching functional literacy to a "critical mass" of adults who can act as a vanguard in development, the Service's efforts have been hampered by insufficient funding and a lack of trained staff. Scarce resources are allocated to the more

densely-populated southern regions, and those activities that have been started in the pastoral zone have been restricted to villages, where it is easier to build literacy centers and staff them with instructors who speak in local languages. Nonetheless, the Service encourages departmental and arrondissement literacy agents to seek opportunities to expand the program in the pastoral zone through development projects operating there.

Groundwater Office (OFEDES)

Created in 1963 and now an agency within the Ministry of Hydraulics, OFEDES is responsible for the construction and maintenance of wells in the countryside and the development and operation of water supply in smaller towns. OFEDES implements water policy set out in the 1979-83 Plan, which is founded on "the right to water for all." In the pastoral zone, OFEDES has constructed and maintained high-capacity wells and boreholes in order to make more pasture available.

National water development policy is discussed further below.

GOVERNMENT POLICIES

In this section government policies with implications for pastoral development are outlined and discussed. Five policy areas in particular are dealt with here: (1) the Five-Year Plan, (2) the Development Society, (3) pastoral zone land tenure, (4) pastoral zone water policy, and (5) livestock export policy.

Five-Year Plan (1979-1983)

To a certain extent, the Five-Year Plan is a dated document, as the period covered by the Plan is at a close; moreover, it was formulated at a time of optimism about uranium revenues. The government is now drawing up a new interim plan, adapted to the current situation of greatly reduced revenues and the apparently unfavourable prospects for recovery in world uranium prices. While the next plan promises to be considerably more conservative in the allocation of resources, it is probable that the main strategies,

priorities, and objectives of Niger's development efforts will remain largely the same. For this reason, a brief examination of the 1979-83 Plan is useful here.

The Plan defines three major objectives of national development: (1) the achievement of food self-sufficiency, (2) growth in economic self-reliance, and (3) the establishment of a Development Society. The achievement of self-sufficiency in food is perhaps the overriding priority of the Plan; it is to be achieved by a wide variety of production and marketing activities designed to meet national food requirements, as well as to develop the nation's capacity to cope with a future major drought. The need for economic self-reliance is closely related to food self-sufficiency; both objectives indicate a strong interest in reducing external dependence. But food, and self-reliance in particular, are not simply seen as a matter of eliminating dependence or easing pressure on limited foreign exchange: they are also a matter of continued employment for a majority of the population.

The main strategies of the Plan are, in order of importance:

(1) modernization of farming and herding production systems,

(2) intensive investment in certain sectors (mines, industry, energy, irrigated agriculture, construction, and transportation) which have potential for rapid growth and as such can generate capital for long-term development,

(3) investment in social and economic infrastructure which will ensure the sustainability of development, and

(4) establishment of social services in such a way as to guarantee that all sectors of the population benefit from development.

Specifically with respect to the livestock sector, the Plan states that the principle objective of livestock development is to increase milk and meat production to meet expanding domestic demand for these products. Another expected benefit of increased production is an increased contribution of the livestock sector to export earnings, though this is given second priority, reflecting the strong emphasis placed on satisfying domestic food needs first. In concrete terms, interventions in the livestock sector were intended to increase annual per capita meat consumption from 18.2 kg in 1978 to 22 kg in 1983 (a 21 percent increase) and milk consumption from 68 liters in 1978 to 74 liters in 1983 (a 9 percent increase).

Noting the ambitious nature of these goals, the Plan states the need for major changes in the management and exploitation of livestock capital. The long-term strategy for the development of the livestock sector involves the stratification of production into three zones. The pastoral zone is to be devoted to a cow-calf herding operation with the main goal of producing young animals. These are to be grown-out at the next level of production in the intermediate zone. Finally, animals are to be fattened before sale in the agricultural zone. This reorganization of production is to take place within the context of the cooperative structure, with credit made available to cooperatives.

The livestock sector was allocated 18.5 billion CFA for the 1979-1983 period or slightly under 5 percent of total public investment.[1] Table 6.1 shows the allocation of expenditure in the livestock sector by type of activity. It can be seen that the three donor-funded pastoral development projects make a major contribution, about 40 percent to the total budget.

---

1. Agriculture receives 16 percent of total investment, the largest single portion of funding. Thus, agriculture and livestock together receive over one-fifth of the total budget.

Table 6.1 Planned allocation of expenditure in livestock sector by type of activity, 1979-1983

Activity	Amount (millions C F A)	% of total	% of total with out projects
Modernization of the pastoral zone[1]	7,311	39.6	-
Cattle-fattening projects	2,808	15.2	25.0
Milk development program	168	1.0	1.5
Poultry program	591	3.2	5.3
Herd reconstitution	1,812	9.8	16.0
Slaughterhouses	250	1.0	2.2
Animal health infrastructure	1,531	8.2	13.7
Animal health program	3,516	19.0	31.5
Research	482	2.6	4.3
TOTAL	18,469	100	100

Source: Five-Year Plan, 1979-1983, pp. 201-202

Notes:
1. NRL, Centre-Est (IBRD) and Sud-Tamesna projects.

Apart from these projects, the major activities planned for the livestock sector in the 1979-1983 period were, in order of importance, the animal health program (19 percent) cattle-fattening projects (15.2 percent) herd reconstitution (9.8 percent) and animal health infrastructure (8.2 percent).

Development Society

Niger's development policy is based on the concept of a "Development Society", first introduced by President Seyni Kountché in 1974, and given substance by the establishment of a National Commission for the Creation of the Development Society (CNSD) in 1979. The objective is the active, voluntary participation of the nation's population in formulating and carrying

out solutions to their own problems. Popular participation in development is to be achieved by the creation of voluntary decentralised development institutions; these institutions are to aggregate and channel popular energies into productive activities.

There are three basic units, or "development cells", of the new society: (1) the ssmaria youth organization, dedicated primarily to mobilizing communities for self-help undertakings, (2) the groupements mutualistes, farmer and herder groups organized to improve economic productivity, and (3) elected representatives of the cell to higher echelons of the Development Society structure. By channelling their aspirations and efforts through these institutions, rural people are to be full participants in decision-making about development policies and activities. It is not clear how this will fit with the existing tendency toward administrative centralization in Niger, a legacy of colonial administration. Administrative control results from fears that activities undertaken autonomously by local communities will be done wrongly, that they will fail to coordinate with overriding national goals, or that powerful local people will dominate local organizations and manipulate them to serve their own ends.

Growth of a true Development Society as laid out in the policy depends on a clear change from long-established pattern of centralized decision-making and resource allocation. Though the government states a firm commitment to decentralization, it remains to be seen whether or to what extent it will occur in practice.

Pastoral zone land tenure

A difficult policy issue is raised by increasing cultivation in the pastoral zone. The Sahelian steppe which makes up the project zone is ecologically best suited to extensive pastoralism, but farming is feasible in many places, especially in the south. Two types of people farm in the pastoral zone: residents who were once herders, and immigrant farmers and agropastoralists from the south. Some herders impoverished by the drought of the early 1970s have turned to cultivation to meet their basic needs. Traditionally, agriculture has sustained destitute herders while they

reconstituted their herds, and was no more than a temporary alternative to pastoralism. At present, however, many such herders have been unable to rebuild viable herds and must continue to rely on farming as their economic mainstay. There are also many former slaves of project zone Twareg who lack animals and who now farm instead. There are also increasing numbers of pure and mixed farmers who have migrated into the zone, as part of a general northward population movement due to demographic pressures which have brought most cultivable land to the south of the project zone into cultivation. This northern expansion of agriculture, as well as the adoption of farming by impoverished herders and ex-slaves, reduces the amount of land available for livestock-raising and takes important dry season pastures out of pastoral use.

As herders have no legally recognized claim to the pastoral areas they habitually use, it is difficult to challenge cultivation on land previously used only for herding. In an attempt to protect traditional pastures, a 1961 law[1] defined a "northern limit of agriculture" beyond which herders could not be required to compensate farmers for crop damages by their herds, as is the case south of the limit. The law also stipulated that only herders were permitted to cultivate north of the line. Finally, the area above the line is legally defined as a common property resource, with ownership vested in the government. Thus, the law theoretically gives priority of resource use to herders, since without the possibility of levying fines for crop damages, agriculture is a risky venture in the pastoral zone.

Several problems prevent the law from achieving its purpose. First, the law does not contain a definition of "herder" which would permit a distinction between those who are and those who are not; thus, it is not possible to distinguish between legal and illegal farmers in the pastoral zone. Second, for a variety of reasons, in certain regions the law is not enforced, and some local officials do levy fines for crop damages caused by animals despite existing legislation.

---

1. Law 61-05 (5/5/61).

One theoretical solution to this problem would be to grant private title to land to individuala or groups of herders. The government is justifiably reluctant to change the status of pastoral areas from a common property resource to privately-owned parcels of land because of the opportunities this creates for private accumulation of landed wealth. However the development of herder organizations which jointly occupy a well-defined pastoral space for all or most of the year provides an opportunity for introducing a degree of control by herder groups over the use of the areas they traditionally use. If herder organizations acquired some clearly-defined rights short of full title to particular pastoral areas, this would give the herders the responsibility for determining if and where farmers could establish new fields. Introduction of modified range use patterns would in many cases also be contingent on the ability of herders to control how and by whom their lands are exploited.

Pastoral zone water law

Pastoral zone water law is closely related to land tenure, because in the dry season access to a water point controls access to pasture. Before the introduction in the pastoral zone of machine drilling and pumping, only those pastures which lay within reach of a shallow water table (60-70 meters at most) could be used during the dry season. The person or group who built, inherited or financed construction of a well could determine within limits who watered stock at the well, thus indirectly controlling access to surrounding pastures.

Since independence, the government has undertaken large-scale water point construction in the pastoral zone, especially in areas where the water table cannot be reached by traditional wells. Construction of boreholes, borehole-wells, and cement wells has altered resource use patterns in the pastoral zone, in some cases significantly. Since traditional mechanisms determining access to water do not apply to these modern water points, Government policy states that every one has the right to water animals at wells constructed at public expense, which also means that there is free access to the pasture

around the borehole or cement well. As a result, large concentrations of herds occur around high-capacity water points, particularly as the dry season progresses.

There has been increasing recognition of this problem and of the need to modify water policy on the part of government officials, though there is no consensus on how to proceed. The government acknowledges that "the traditional system of wells constructed by the herders has the clear advantage of maintaining a natural equilibrium between pasture productivity and the number of animals kept in particular areas".[1]

There is some discussion of limiting access to public water points - primarily through technical means such as shutting down boreholes at particular times - to attempt to maintain the type of balance between livestock, pasture and water characteristic of the traditional system.[2] However, the idea of limiting access to public water points has been talked about since government well construction began in the early 1960s[3] and seems to be difficult to put into practice, due to the government's commitment to providing universal access to water free of charge, and to the expectations about free access that this has given rise to. However, recent discussions about allocating priority use rights to groups of herders who participate in new state-funded water point construction (for example, by providing labor) may signal a shift in government policy in this respect. This concept, known as "human investment", is still controversial, since it appears to run counter to a stated, although unrealistic, commitment to universal free water. However, these difficulties may diminish as cooperativization of the pastoral

---

1. Five-Year Plan p. 203.

2. See for example Livestock Service Annual Report (1980: 117)

3. See Livestock Service Annual Report (1955-1960: 145)

zone proceeds, since the government will be better able to attribute rights and responsibilities to organized and formally recognized groups forming a part of the structure of the Development Society.

Livestock Export Policy

Since 1977 Niger has legally restricted the export of cattle. The object of this policy was to allow the national herd to recover from the impact of the drought of the early 1970s: it was thought that by limiting exports, breeding stock would remain within the country, thus encouraging the national herd to rebuild rapidly to the carrying capacity of the pastoral zone.

It is likely that several benefits would result from a change in this policy in order to allow unrestricted cattle exports. First the real volume of exports is considerably higher than the legally established level, as the high prices offered for Niger cattle across the border in Nigeria are a strong incentive to evade export restrictions. In 1980, the livestock service estimated that over 200,000 head of cattle were exported though only 40,466 or 20 percent of these were legal. This means that large government revenues are being lost. For example, in 1980, the government earned 169 million CFA from the licenses issued and customs fees collected for the 40,466 legally exported animals; if the same fees had been assessed against the estimated total of 200,000 real exports, government revenue would have been 835 million CFA.

A second and related point is that the foreign exchange earnings of Niger are underestimated in national accounts as a result of export controls. At the official level of exports for 1980, Niger's livestock sector earned the equivalent of 5.4 billion CFA of foreign exchange; the real figure was probably nearer 27 billion CFA. The government has no way of measuring, directing or taxing these substantial foreign exchange earnings, and is severely handicapped in controlling the large flow of imports they finance.

Third it is questionable whether continued export restrictions are necessary, useful or even effective in terms of their original purpose. Available figures suggest that almost no reproductive females are exported, as Nigerian demand is above all for large Azawak males for slaughter or animal

traction. Moreover, it is probable that an effective ban on cattle exports would not in fact contribute to national herd reconstitution, since its most likely effect would be to depress the price of cattle and oblige poor herders to sell more animals to meet fixed cereal needs. A policy of free exports, leading to a rise in cattle prices, would be likely to induce herders to hold onto their reproductive females more carefully, since they are the capital stock which produces future high-priced assets, while at the same time enabling herders to meet their minimum cereal needs by sale of male animals at a profit-maximising age.

Fourth, easing export restrictions would probably lead to changes in the structure of the trade, bringing benefits to producers. An easing of the limit on and possibly the cost of licenses would permit the entry of more traders into the export business, thus increasing competition, lessening any monopoly power that might exist, and, by reducing intermediary costs, allow increases in demand for export animals to be reflected in higher producer prices.

Freeing cattle exports, and appropriate other legislation, would probably lead to an extension of the truck transport system into Niger. At present animals are trekked from the pastoral zone to points across the Nigerian border, where they are loaded onto trucks destined for Lagos and other major towns; the high cost of gasoline in Niger and the enccuragement to export animals clandestinely discourage trucking of animals within Niger. If Nigerian trucks were allowed to enter Niger with tanks full of inexpensive gas, more livestock traders would buy directly in the pastoral zone. The advantages of using truck transport instead of trekking are that (a) exporters' capital turnaround time (a critical factor in their profit margins) is reduced, (b) the weight loss that occurs during trekking is avoided, and (c) the damage to farmer's fields that sometimes occurs in the trek south is avoided. Traders would be able to increase the volume and decrease the cost of exporting; this could lead to higher prices for producers, lower prices for consumers, and better earnings for traders themselves.

Fifth and finally, the presently clandestine nature of a large part of the cattle trade means that figures used in planning and monitoring the development of the livestock sector are distorted. Changes in the age, sex, and race of animals exported may be escaping notice, and it is difficult to assess the full implications of the trade. It is especially important accurately to monitor animals exported since they make up more than 70 percent of the offtake of the national herd. Effective evaluation of development interventions in the livestock sector will not be possible without accurate export statistics, as results of many interventions are ultimately reflected in livestock marketing. Lifting of export controls would mean that more of the trade would pass through official channels, thus making collection of accurate data much easier.

7.1 PILOT HERDER ASSOCIATIONS

One of the main objectives of the Niger Range and Livestock Project was to experiment with an institutional structure to set in motion and administer a national program of pastoral development and participation. During 1982, 10 pilot herders' associations were formed for this purpose. This chapter describes the program.[1]

BACKGROUND

It has been recognized for some time that a principal constraint to development in the pastoral zone of Niger, as elsewhere in the Sahel, is the lack of an appropriate organizational structure through which government services can set development programs in motion, administer and monitor them, and conversely through which herders can express their aspirations, can participate in development decision-making and administration, and can make the sort of effective demands of government services that are likely to render them more effective. The village/canton/poste/arrondissement structure of the agricultural zone, built at the lowest level on villages with relatively stable populations of several hundred inhabitants, has no structural parallel in the pastoral zone. Here the basic resource-managing unit above the household level is a camp composed of from one or two to 10 or 20 households, rarely more, which makes up a population ranging from approximately 10 to 100 people. The composition of these camps varies from season to season or according to herding decisions taken individually by each household, so camps are not stable units. At a higher structural level, migratory groups, lineages and tribes meet a variety of important social organizational requirements, but these structures are unadapted to the needs of modern government and the administration of a development program. Some aspects of traditional tribal organization, for example the Twareg class structure, retain potentially exploitive elements inappropriate to a modern democratic country concerned with equitable and participatory development. And in any case, although traditional tribal chiefs do play some official role in local administration in the pastoral zone, this is largely because of the lack of any more appropriate administrative

1. See Swift and Maliki (1982) for a more detailed discussion.

structure. The history of traditional tribal power since colonial conquest at the start of the century has been one of constantly declining ability to fulfill even the limited decision-making and resource management tasks assigned to it under precolonial circumstances.

The result is that there is no real development structure in the pastoral zone; that development programs cannot easily be implemented; that the few, village-based, social services do not meet the needs of a mobile population; that it is difficult for herders to participate in development thinking and action; in short that it is difficult for the government to know what to do and how to do it. Particularly serious from the point of view of pastoral development is the fact that measures aimed at increasing pastoral productivity, especially animal production, routine animal health and range management, are impossible to implement with any chance of success.

An important aim of the project was to experiment with herders' associations as a first step to overcoming these problems. The thinking was influenced by ideas and policies being discussed at that time (late 1970s), in particular by the increased emphasis in national policy on cooperativization of the pastoral zone. In 1978, Dr. Ari Ibrahim, then Director of Livestock, later Minister of Rural Development, outlined the major national policy objectives for the pastoral zone. These were: improved herd productivity, improved herder well-being, improved herder wealth, better provision of basic necessities, especially food grains, and improved education. Taken in conjunction with a previous government commitment to herd reconstitution, and to effective participation by herders in national life through the "self-management" policies of the Development Society then being formulated[1], this effectively defined the agenda for pastoral

1. The national commission on the Development Society was set up in October 1979, in order to define a framework for accelerated development and to create new institutions based on the effective participation of the entire national population.

development. Already at that time the main institutional vehicle to accomplish these tasks was planned to be a multi-purpose herders' association.

Pre-NRL project thinking on herders' associations was dominated by the idea that it was essential to define "Pastoral Units" in terms first of spatial organization, and that discrete pastoral territories could be drawn on a map with use-rights unambiguously attributed to habitual user groups. The proposals for such a strategy in eastern Niger defined Pastoral Units (PUs) as:

> An area of rangelands which is traditionally exploited in a regular fashion by population groups as homogeneous as possible, and over which it is generally considered that those groups possess use rights opposable to other groups. Some areas, particularly some rainy season pastures, may be common to several PUs. A PU must offer an acceptable balance between livestock, pasture, and water. A PU must cover a large enough area, including, for example, 10 to 15 wells, to be independent of the normal risks of the pastoral environment. Establishing the boundaries of PUs will lead to the allocation, by the administration, of exclusive use rights governing pasture and opportunities for watering livestock (IEMVT 1978: 1).

The herders occupying such Pastoral Units were to be formed into Herders' Associations, to which would be attributed exclusive pasture and water rights:

> Once a PU has had its boundaries established, an association of herders is set up within the PU in order to group together the herders who use the zone, with the goal of improving animal production and marketing, as well as the herders' standard of living. Exclusive use rights governing pasturing and watering livestock inside the PU will be allocated to the herders' association. In return, the association will agree to make use of the pastures and watering facilities in a responsible fashion, and in particular to follow the advice and instructions of the technical services (IEMVT 1978: 2).

The first Herders' Associations proposed within this context would have contained on average about 2,000 to 2,500 people each (IEMVT 1978: 13-15).

THE ORIGIN OF THE NRL PROGRAM

Early fieldwork by the project socio-economic team indicated the difficulties in its project zone of an approach based on spatial delimitation with attribution of exclusive grazing or watering rights to specific groups. Without exception, the administrative and technical officials interviewed on early field trips considered that the creation of herders' associations with exclusive pasture rights in a particular area was politically and practically impossible in the near future. Almost all the officials were against the idea of attributing exclusive water rights at previously public wells to particular groups, and most of the officials were also against the idea of using the opening and closing dates of boreholes as a way of managing and conserving pasture. It was realised that a top-down approach, dealing with the traditional chiefs through the higher levels of the traditional administrative hierachy downwards, was unlikely to be successful, nor would an attempt to organize on the basis of tribes or groups of tribes work. It was also apparent that herders in the project zone had been approached too often, with too many open or implicit promises of development assistance which had led to nothing, for them readily to accept or participate in project interventions. In particular, the idea of range management raised widespread fears that the project was considering extending the existing fenced ranches, which are seen by herders as contrary to their own interests.

In view of this it was decided in March 1980 that the project should, initially at least, organize people rather than organize space; that the approach would be from the bottom up, starting with the smallest viable cooperative units, rather than from the top (tribes and confederations of tribes) downwards; that a primary task would be to establish confidence by encouraging herders to define their own interests and priorities, and as far as possible to respond to those as a matter of urgency in order to establish the project's credibility and a belief in its ability to respond to felt needs, and thus to deliver appropriate benefits, before moving in a later phase to implement programs the herders had doubts about or were even hostile to. It was felt essential to give small groups of herders experience of organizing and administering simple development inputs and

especially coping with accounting procedures, before providing inputs and programs on a larger and more complex scale. It was also considered that the experience of organizing and managing programs within small groups would provide a useful counterbalance to the danger, clearly spelled out by Keita (in IEMVT 1978: 109-130) in relation to another livestock project, that herders' organizations and project interventions could be captured by a few powerful people from the traditional tribal hierarchy and used by them to rebuild the influence of out-dated social structures. Such an approach also allowed time for NRL's range and animal science teams to come up with tested interventions which would raise herding productivity when applied through functioning herders' associations.

Project socio-economic team members talked to a variety of herder groups. especially the samples on which detailed household economics research was being conducted, through the rainy season of 1980, concentrating on the general concept of small-scale herders' associations, and identifying possible actions. In specifying what might be possible, the project team was influenced by a successful small-scale experiment in herd reconstitution and cooperative cereal buying carried out among WoDaaBe herders at Abala and funded by OXFAM-America[1]. The important national program of primary health care in the southern agricultural zone was also indicative of what might be done in the pastoral zone if appropriate adaptations could be made, as seemed likely from experiments in training and supervising veterinary auxiliaries carried out by a Livestock Service agent, later recruited by the NRL project, at Gadabeji in the late 1970s.

Detailed production economics research on representative samples of Twareg and WoDaaBe households began to give detailed insights, even in advance of full analysis of results, into the subsistence problems, particularly the problem of extreme poverty arising from an insufficient

---

1. Reported by A. Maliki to the International African Institute Seminar on Pastoralism in the West African Savanna, held at Amadu Bello University, Zaria, northern Nigeria, in July 1979.

household herd, faced at household level. Research into the nutrition and health of WoDaaBe herders likewise began to give information about major problems (Loutan 1982a). Discussions with government officials, especially from the Livestock Service and UNCC, at national, departmental, arrondissement and poste level, informed the project team about current government thinking, especially UNCC's approach to cooperative organization in the pastoral zone. Research on alternative institutional options in the national policy context helped clarify project thinking (Thomson 1981).

Herders were asked to discuss among themselves and report back a consensus. At a second round of discussions in October 1980, the herders reported their conclusions. Their major reported concerns were, in order of importance: constitution of a common herd to be managed by the association from which both male and female animals would be lent to association members in order to rebuild their herds; stocking of millet and other main consumption items at controlled prices for dry season use; training of human and animal health auxiliaries.

In the light of this, the project defined a strategy for the creation of a small number of pilot herders' associations. The long-term objective was to provide an organizational structure capable of managing interventions designed to raise the productivity of herding, in particular range management and animal production increases, and through this to achieve increased herder welfare and food security. In the short-term this mesnt organizing herders' groups in such a way as to provide a framework within which a variety of sectoral pastoral development programs, both existing and new, could be coordinated and improved. In other words the project would concentrate on institution-building, using as a stimulus a number of specific actions of primary concern to herders. The plan of action was: (a) to define potential herders' associations on the basis of geographical proximity, traditional social organization at the camp level, and common well ownership or use; (b) to discuss the aims and means of associations with a small and appropriate group; (c) to encourage a decision by the group to form an association on the basis of voluntary membership by those households interested in the proposed actions; (d) when this was done to elect office-holders. The priority activities were the training of human

and veterinary health workers,[1] a credit program permitting cooperative purchase of cereals for dry seaaon consumption, and a herd reconstitution and growing out program. It was agreed that no attempt would be made to define boundaries within which pastoral groups would have exclusive grazing rights, or to place any potential limitation on herder movement. The experience of collective action in uncontroversial actions such as cooperative millet buying, and health and veterinary auxiliaries, would prepare the way for the more difficult tasks of cooperative action in range management and animal production.

The wisdom of this approach was confirmed by the government decisions on pastoral zone development taken in early 1981. Decree No. 18/MDR of 3 April 1981 and its accompanying letter No. 0901/MDR/MI defined the first steps towards cooperativization of the pastoral zone. Pastoral mutual groups (GMP) were to be formed, composed of herders of one or several camps, using the same pastures for much of the year. Tribal or group chiefs had to give their approval. Several GMPs could join together to form a pre-cooperative group (GVC). It was specifically recognized in these texts that the difficult and relatively unknown conditions of the pastoral zone made necessary a "démarche progressive, prudente et participative." A high level commission on the development of a cooperative strategy for the pastoral zone, organized by the UNCC, also reported in early 1981 that in its view the most urgent technical actions were (a) to constitute an appropriate credit system at the level of groups of camps which allowed herders to dispose of a stock of cereals and other major consumption goods; (b) to put in place a group credit structure designed to reconstitute herds; (c) to form a small-scale, short-term credit system which enabled herders to meet

1. Although this training program preceded the creation of the first pilot associations, it was considered that the auxiliaries would most be viable within the association framework. The first auxiliary training programs however were conducted in such a way that the auxiliaries could operate even if the pilot associations failed, a possibility that could not be excluded at that stage. For an evaluation of the human health and veterinary auxiliary program, see sections 7.3 and 7.4 of this report.

urgent consumption needa without distress sales of animals, allowing instead sales at the most favourable moment of the year (UNCC 1981. 5). These conclusions closely resembled actiona proposed by the NLR team.

THE PILOT HERDER ASSOCIATIONS

The experimental zone and herder populations concerned

The NRL pilot program was launched in an experimental zone situated around the administrative post of Abalak, in the arrondissement of Tchin Tabaraden in Tahoua Department; it encompasses about 6,000 km^2 between Abouhaya to the east, Ekisman to the north, Tahirit to the west, and Bakr to the south. This region was chosen for its accessibility, its central location within the NRL project zone, and especially the variety and representivity of pastoral conditions and production systems found here, as reflected in the considerable diversity - ethnic, social, economic, and pastoral - of the local population.

During a normal year (with good pasture), this region has a total population of approximately 18,000 herders, of whom more than 20 percent are agropastoralists. Twareg make up 65-70 percent of the total population, and 25-30 percent are WoDaaBe. The average density is about 3 inhabitants per square kilometer (Milligan 1982c). Most of these herders live within the experimental region throughout the year, moving north or northwest during the rainy season. Some groups move outside the region to the north during the two months of the salt cure transhumance. In bad years, some groups (mainly WoDaaBe) move south of the region during the 2-4 months of the hot, dry season to the area between In Tawila and Chadawanka.

Field work

The organization of the pilot herder association program was a collaborative effort between the project and the government agencies involved in pastoral development, particularly the Livestock Service and UNCC.

The work described here took place between February and October, 1982. The core team of one expatriate and 5 local staff (4 of them Livestock Service agents techniques, the other from the Extension Service) spent the first four months in preliminary discussions with national, departmental, and arrondissement officials and with the traditional chiefs. At the same time, based mainly on previous project socio-economic field research, the first associations were identified. In June, the first two Twareg associations were created, and in the following month activities for these two associations were organized and several WoDaaBe associations were identified. In August, four WoDaaBe associations were created and activities of existing associations were organized. In September and October, four more Twareg associations were created, and work continued on the activities of existing associations. Thus, at the end of October, there were six Twareg and four WoDaaBe associations at different stages in the organization of their activities.

Criteria for choosing associations

The criteria adopted for choosing the first ten pilot associations were as follows: being situated within the experimental zone; the representivity of the families chosen with respect to administrative groupements, social classes and lineages in the region; a high degree of internal cohesion among these families; wealth and household size close to the average for the region; the representivity of their way of life (herding or agro-pastoralism).

With respect to administrative groups, the region chosen for the experiment was essentially the region of the 2nd group, and three of the first six associations belong to that group. The others belong to the 5th, 7th and 8th groups.

With respect to the tawshiten, or lineage groups, six of the most important tribes of the region are involved: Kel Eghlal and the Iderfan Kel Eghlal of the 2nd administrative group, the Iderfan Kel Azar of the 5th group, the Ayt Awari of the 8th group, the Idawatman of the 7th group, and the Ibadaydayen of the 2nd group.

In terms of social classes, it was assumed that the proportions among the various strata within the experimental zone correspond to the general proportions of Kel Dinnik society[1]. Of the first six associations, two are composed of ineslemen families, two are composed of families of former eklan (or iderfan, emancipated servants), one is composed of iberogan, and one of imghad undergoing a process of becoming ineslemen.

Although difficult to judge at the beginning, average family income in the first associations appears to be close to the average for the zone; in those cases where there was too little information, the team preferred to select associations poorer than the average.

Among the first six Twareg associations, there are three whose members cultivate fields. In this respect, it was intended that the associations should reflect local socio-economic characteristics. The Kel Dinnik population in the Abalak region includes many agro-pastoralists, who cultivate rainfed millet and sorghum. This type of agriculture is typical of people living at the edge of the pastoral zone, who cultivate fields while continuing to move. For them agriculture does not constitute the main activity (as in the case, for example, of the Kel Gress groups located to the south, inside the agricultural zone). Among herders who cultivate, a hierarchy can be established, ranging from those who began cultivating a small field within the past few years (mainly due to drought and poverty), to those whose families already worked the land and who consequently knew how to farm (Bernus 1981: 268).

---

1. According to Bernus (1981:188), the approximate numerical breakdown of the social categories is as follows: imajeghen, 1 percent; imghad, 3 percent; ineslemen, 25 percent; inadan, 3 percent; and eklan (domestic and independent), 68 percent.

Table 7.1.1 summarizes the main social and demographic characteristics of the 6 Twareg associations.

Table 7.1.1 Composition of the pilot Twareg herder associations, October 1982

Association	Tribe (social category)	Administrative group	Families	Persons	Mean family size
Muumin	Kel Eghlal (ineslemen)	2nd	21	232	11.0
Almuriden	Ayt Awari	8th	22	138	6.8
Inutaban	Ibadaydayen (imghad and ineslemen)	2nd	30	160	5.3
Win-Tahirit	Idawatman (iborogan)	7th	21	147	7.0
Karadat	Kel Azar (iderfan)	5th	30	180	6.0
Idal-Husseyni	Kel Eghlal (iderfan)	2nd	16	95	5.9
TOTAL			140	952	6.8

The first four WoDaaBe associations were formed among groups present in the experimental zone: the Bii Korony'en and Bii Hamma'en tribes (of the WoDaaBe Alijam lineage) and the Gojanko'en tribe (of the Degereeji lineage). The Bii Korony'en are the most numerous: associations were formed in the two fractions of the Bii Korony'en Koron and the Bii Korony'en Yisaw.

Most of the Gojanko'en live in the Tchin Tabaraden region, with the exception of the Gawwanko'en fraction, who arrived many decades ago in the Abalak region, which is also inhabited by a group of Bii Hamma'en, the Doosewol (although most of the Bii Hamma'en live in the Dakoro region).

The four associations reflect difference among the WoDaaBe with respect to the organization of production and pastoral techniques.[1] Thus, the members of the Doosewol and Ediindu associations have very few animals, but herd many jokkere cattle belonging to Hawsa and Twareg. The men of the Yuguda association often go south during the dry season on migrant labor, because they have so few animals. Conversely, among the Doosewol, it is primarily the women who leave on dry season labor migration.

---

1 For a description of differences among WoDaaBe groups with respect to the organization of production, see chapter 4.2 of this report.

Table 7.1.2 shows the main features of the 4 pilot WoDaaBe associations. One characteristic of the WoDaaBe associations is the relative youth of their members: the average age is about 35 years.

Table 7.1.2 Composition of pilot WoDaaBe herder associations, October 1982

Association	Tribe	Administrative group	Families	Persons	Mean family size
Doosewol	Bii Hamma'en Doosewol	9th	30	165	5.5
Abba	Gojanko'en Gawwanko'en	9th	21	172	8.2
Ediindu	Bii Korony'en Koron	Madaoua	22	157	7.1
Yuguda	Bii Korony'en Yisaw	Madaoua	24	206	8.6
TOTAL			97	700	7.2

Summary

Table 7.1.3 summarizes the situation of pilot association membership in October 1982. In terms of numbers of people, the WoDaaBe are slightly over-represented in the pilot associations, by comparison with the experimental zone as a whole.

Table 7.1.3 Population characteristics of the ten pilot associations

	Twareg	WoDaaBe	Total
Number of associations	6	4	10
Number of families	140	97	237
(percent of total families)	(59)	(41)	(100)
Number of people	946	700	1,646
(percent of total people)	(57)	(43)	(100)

STRUCTURE AND ACTIVITIES OF HERDER ASSOCIATIONS

In line with government policy, herders' associations (or Pastoral Mutual Groups - GMP - as they are officially known), are considered the basic unit in a pre-cooperative structure; eventually several associations will group together into a Pastoral Community (Pastoral Cooperative Group, or GVC). Several Pastoral Communities will have as their service and administrative base a Pastoral Center, which will for the most part be located at one of the important markets and existing administrative centres in the zone. It is planned that the NRL zone will eventually be divided into 8 Pastoral Regions, each with its own Pastoral Centre.

For the moment, only the most basic unit - the herders' association - exists, although, as the hub of this activity, Abalak is already taking on some of the characteristics of a Pastoral Center. This section describes the structure, internal regulations and possible activities of herders' associations, referring where appropriate to the proposed Pastoral Communities

and Pastoral Centres.[1] It should be remembered, however, that the present association regulations are not fixed or final; on the contrary, they are intended to evolve and be added to as greater experience is gained of the problems of creating associations, and as the associations themselves begin to take initiatives for their own activities and organisation.

Procedure for the establishment of an association

An association is made up of 15 to 30 families (between 100 and 200 people) related by overlapping criteria of kinship, geographical proximity and common use of an area's natural resource. These figures were chosen because a group of less than 15 families might be made up only of members of one extended family, while a group of over 30, which would probably necessarily include several camps, would be too large to act together on essential association business, given the mobility, scattered distribution and frequency with which camps divide and re-form. As such, the association corresponds to a cohesive traditional social unit, situated somewhere between the extended family unit (a man and his married sons or a group of brothers) and the lineage segment or agnatic group. The association consists of one or more camps, on condition that the members remain in close enough contact with each other for most of the year to take essential decisions concerning association activities together. Although some associations could be composed of a single camp, the camp as such is not an appropriate unit for an association since it has little stability over time, dividing and reforming with other households according to the management strategies or the changing personal choices of members.

---

1 The term "association" is translated as inimidihal in Tamasheq and kawrital in Fulfulde; "community" is translated as iniminak in Tamasheq and kawral in Fulfulde. All these words, which result from long discussions with the herders involved, express the idea of co-existence, cooperation, mutual aid and solidarity. The herders' association internal regulations have been translated into Fulfulde and Tamasheq, the latter written in Roman, Arabic and Tifinagh scripts.

The members of an association are individual restricted families or household production units. Membership is voluntary and is granted to any individual family with the unanimous consent of the group's members. A member can leave at any time after returning to the association any goods, money or animals he has borrowed. Traditionally the individual's right freely to enter and leave the group has acted to prevent leaders from taking advantage of their authority: this principle is similarly embedded in the association. By basing the association on a small group of families that habitually cooperate and communicate in all aspects of pastoral life, problems that would otherwise arise concerning sanctions, responsibility and authority are easily handled by the group itself. The members are well aware of what each is doing and internal social control reduces the chance of one member pursuing his personal advantage at the expense of the group. Traditional tribal leaders are not association members, but they are invited to attend the association's quarterly meetings.

After consultation with groupement and fraction chiefs, the association estsblished itself by verbal declaration and registration with the UNCC departmental office.

Association positions

Each association elects from its membership individuals to undertake certain responsibilities. The term of office is two years, and no individual can hold a position for more than 3 consecutive terms. Position holders receive no salary for their association activities. However, in unusual circumstances, especially if a given activity demands a great deal of time, the association may decide to grant an office holder certain privileges in recognition of his effort.

The principle behind association office-holders is one of power-sharing. The president serves as guide, spokesman and representative; technical advisers are the association specialists on production and development activities; section heads are responsible for association financial and credit

activities. Thus within each association, responsibilities are widely shared, with ultimate decision-making power remaining with the general assembly of all members.

Association positions are as follows:

President

The role of the president is to supervise the functioning of the herder association, ensuring that it conforms to the internal regulations. It is his responsibility to organize the association's quarterly meetings and the general meetings held every two years at which office-holders are elected and activities are planned.

Beyond the level of the association itself, the president has two additional responsibilities. First, he acts as intermediary between the association and the local administrative authority and technical services. Second, he will represent the association to the local organization of herder associations, the Pastoral Community, when communities are formed. At each biannual meeting of the Community council, the president will give a brief report of activities and will inform the council of the decisions taken by his association. The president does not handle any of the funds of the association.

A president can be removed from office only if an absolute majority of the association's members appeal to the Community council to remove him. He is replaced at the next quarterly meeting, at which a special election is held.

Technical advisers

Each association can designate technical advisers in certain areas: human health, animal production, animal health, literacy, water and pasture, crafts, etc. These advisers receive training from the relevant government service, in collaboration with the NRL project, as described in the following section. They act as immediately available sources of information, technical skills and in some cases commodities (for example human and veterinary medicine) for

association members. The technical advisers also provide a channel of interaction between herders and government services, increasing the flow of information and feedback between them.

Technical advisers are chosen at the association's general meeting, held every two years. Whenever possible, an individual will be selected who occupies a similar role in traditional society (for example, a traditional pasture scout would be encouraged to become the range management technical adviser). In this way, existing roles are built upon by improving individuals' technical expertise.

Section heads

Each association has a cereal credit fund and a revolving fund, divided into three to five sections, according to the members' decision (see below). The cereal fund and each section of the revolving fund is managed by an elected individual, who works in close association with the Pastoral Community accountant with respect to financial matters. At every quarterly meeting, section heads present brief activity reports to association members. Section heads will not be members of the Pastoral Community Council, but they will be invited to attend meetings, especially when the subjects of discussion are relevant to their activities.

As in the case of the president, section heads can only be removed from office at the request of an absolute majority of association members. The position is refilled by special election at the next quarterly meeting.

Technical programs

One of the main problems which has hindered efforts to bring development programs to herders has been the lack of an adequate institutional framework through which new techniques can be introduced to the herding community. The lack of a village structure makes even identification of a target population for interventions difficult, and supervision and follow-up are almost impossible. The dispersed herding community has no control over the programs

and has no organizational structure through which it can influence or support them. In many cases, the only contact government services have with herders is through the tribal chiefs, who may try to appropriate such programs to strengthen their own position.

The herders' associations are intended to provide a better framework through which technical interventions can be introduced to herders and conversely through which herders can better participate in and take control of such activities.

The following paragraphs describe both those programs which are already under way and those that are planned.

Veterinary auxiliaries.

Within each herder association, a member is chosen as the veterinary auxiliary or technical advisor for animal health. The choice is based on availability, willingness, and knowledge of livestock diseases.

During his first training program, the auxiliary learns to recognize and treat some of the commonest animal health problems. He is provided with a small stock of basic medicines, and is encouraged to have regular contact with the Livestock Service agent at the Pastoral Center. Within his own association, the auxiliary is a teacher and extension worker, helping to make others aware of treatments for particular diseases. During the annual vaccination campaign, he encourages the other herders to take their animals to be vaccinated. The auxiliary receives no salary or compensation for his work.

A pilot veterinary auxiliary program launched by the NRL is described and evaluated in section 7.3 below.

Animal production.

Veterinary auxiliaries will also serve as extension agents through whom technical interventions to increase animal production can be introduced.

The herders' association growing-out herd and its cow-calf herd (both described below) form a body of animals particularly suited to such innovations when they are first introduced.

In the medium-term the following are the kind of technical innovations in animal production that could be tested through herders' associations with the help of the veterinary auxiliary: (a) vitamin A and other nutritional supplements, to combat night blindness, provide salt and perhaps phosphorous and other mineral supplements, and to add protein to dry season diets; (b) increased control over reproductive cycles and raised total fertility by teaching simple pregnancy testing, combined with target supplementation designed to increase the proportion of cows which conceive in the late rains and give birth in the following late dry/early rainy season, thus optimising milk production and calf survival; (c) efforts at reducing mean age at first calving by target supplementation of heifers; (d) perhaps some genetic selection from within local races.

Range management.

Full range management in the classic sense requires range control which is unlikely to be feasible in Niger in the medium term. The range management program to be implemented through associations is thus designed to be accomplished without such control. In addition, further time is needed for range research to define potential interventions which can raise the productivity of range use in the context of nomadic pastoral production systems. However, as research defines and tests potential interventions, the herders' association technical adviser responsible for range management, who is chosen where possible for his competence as a traditional pasture scout, will provide the linkage between associations and the government authorities or the project for the introduction of such techniques by the associations.

In the medium term, the following are the kind of technical interventions that could be tested through associations: (a) heavy grazing or hay cutting designed to create a temporary soil moisture reserve as the basis for vegetation regrowth in the early dry season; (b) improving the knowledge and management skills of average herders to the standard of the most

successful ones; (c) experimental centripetal grazing schemes at waterpoints where associations exercise complete control of water; (d) experimental haymaking.

Water

If an association can dig its own well, perhaps helped by a cash loan to help buy materials, it could control access to the water. This would make possible control of grazing and some range management. Not enough is yet known about the water and pasture situation to plan a detailed water point construction program, but in the medium term it is likely that some associations will be able to dig wells or surface water tanks to improve pasture use in their cold or dry season areas. An association technical adviser will then be appointed and given technical training in the engineering and management techniques involved.

Human health auxiliaries

In each association, one member is chosen as the auxiliary for problems related to human health. As with other technical advisors, the human health auxiliary is chosen for his character, skills and availability.

During his first training session, the auxiliary learns to treat, or refer to the clinic, the most common ailments, with priority given to diseases that endanger children's lives, affect adults' capacity to work or are considered important by the people themselves: these include in particular malaria, fever, diarrhea, pulmonary disease, vitamin A deficiency, conjunctivitis, rheumatic ailments, and gonorrhea. For this, the auxiliary is supplied with a small number of essential medicines, and is taught to record details of his treatments in a note book. The initial training is followed by regular contact with the Health Service representative (a trained nurse) at the Pastoral Center, and by regular follow-up training sessions.

In addition to primary health care, the auxiliary may be involved in teaching and extension: for example, in helping the Health Service in a vaccination campaign, or in nutrition and health education. Like the other auxiliaries, the human health auxiliary is not paid for his work.

A pilot human health auxiliary program started by NRL is described and evaluated in section 7.4 below.

Childbirth and infant care

There are few traditional midwives in pastoral zone societies, due probably in part to the scattered distribution of camps. Few pastoral women will undertake training in such a role, and outsiders would not be accepted in the camps.

Within associations, periodic seminars may be organized for all association women on issues related to childbirth, infant and child care, weaning, and dry season child nutrition. No association technical adviser will be appointed for this task, which will be the responsibility of trained nurses based at the Pastoral Center serving several Pastoral Communities. The training of human health auxiliaries will incorporate some notions of these issues for cases where the husbands of women in childbirth or with small infants seek guidance.

Craft auxiliaries

Within each association, one member may be chosen as the auxiliary for all problems concerning crafts. The choice is based on the member's work skills and availability. Like the others, this auxiliary would receive no form of salary for the work.

During the first training period, the auxiliary would learn improved craft techniques relevant to a pastoral life: making mats, working with hides, weaving, braiding rope. The auxiliary would be responsible for adapting and

spreading these techniques among the other members of the association. This subject may particularly interest women, who in many pastoral groups are skilled makers of pastoral equipment.

CREDIT FUNDS

In order to encourage productive activities and to increase the associations' capability for sustained economic growth, each association is allocated a revolving fund and a fund for bulk cereal purchase, proportional in size to the number of member families. These funds are intended to resolve key constraints to pastoral production identified by herders and by NRL research. Responding in this way to problems the herders consider important also builds their confidence in the project, making easier the longer term introduction of resource management programs that are less immediately acceptable.

In the longer term, the credit program is intended to encourage the development of viable rural financial institutions which mobilise rural savings for pastoral development more efficiently than at present. The herders' association scheme is a first step in this process, and links continued credit disbursements to the progressive increase in savings made by association members. This introduces the discipline and mobilization of rural savings often lacking in rural credit, and, together with realistic interest rates and a group approach to credit through the association, is intended to provide the first elements of a new financial structure for pastoral development.

A credit program of this type is necessary because, although poverty is widespread in the pastoral economy, there is now no other source of credit for most herders; this is especially serious since capital in the form of a herd is essential to an independent production unit in the pastoral economy. The national herd reconstitution program reached few, if any, poor herders, and other sources of loans, such as CNCA, are available only to a very small number of relatively well-off people. The lack of a development structure has hitherto made pastoral credit a risky business, difficult to administer or to ensure repayment. Herders' associations provide this structure and make a

widespread program of pastoral credit feasible, while at the same time providing the accompanying technical inputs which are likely to make its use most profitable for herders.

Revolving fund

The initial revolving fund is a loan to the association from the project of 2 million CFA (about $6,000) for an association of 20 families. This fund is divided into several sections according to the activities association members decide to undertake. No section can take more than 50 percent of the revolving fund capital. The money is jointly managed by the people in charge of each section and the Pastoral Center accountant (a project staff member), who keeps records, supervises all large transactions and accompanies the association section heads when they buy or sell animals and millet. The president and the accountant maintain the general and monthly accounting sheets that show how the money is being used; copies of these sheets are kept by the project and by the association. Cash remains in the hands of association heads only as long as is necessary for them to carry out transactions. The rest of the time, section heads manage commodities (cereals or animals) not cash.

Underlying the division of the fund into smaller sections for specific purposes is an effort to make the association self-managing as far as possible. Once the fund is broken down, the sums involved are quantities the herders are used to handling. So the responsibility given by the association to elected section heads and their assistants is one these individuals can realistically accomplish. The Pastoral Center accountant serves as an additional check to the supervision of association members themselves. Because of the association's small size and close, generally kin-based relationships, and the fact that in some cases credit can only be made to one family when prior loans to another family have been repaid, the association itself brings pressure for timely repayment and financial probity; it is difficult for someone to mismanage his responsibilities.

The revolving fund supplied by the project is a loan, not a grant. It is paid back with interest, from revenue generated from two sources: growth in

value of membership dues, and a levy on the profit from association activities. For membership dues, the project haa designed a scheme appropriate to the herders' situation. Since the need for cash has been identified as an important constraint in pastoral production systems, membership dues in cash would add another burden to already strained herder budgets. Instead, upon joining an association, each new member must contribute one young ram to the association, and this contribution must be renewed every two years. The rams are kept in the member's herd for one to two years, during which time they increase rapidly in value. When the fattened rams are sold, the profit goes towards the reimbursement of the revolving fund; once the revolving fund is repaid in full, the sale of membership rams helps make the association self-financing.

In addition to membership dues, levies are made on the profit from association growing-out programs and the cereal fund; these schemes are described below.

The association credit funds make possible activities designed to address the main constraints to improvements in pastoral production and the herders' standard of living. Herders themselves decide the emphasis placed on each program. At the association's general meeting, held every two years, members vote on what activities should be undertaken and what proportion of the revolving fund each activity should receive. Three to five activities are chosen, none representing more than 50 percent of the association's total capital. The activities chosen, and the proportion of the revolving fund allocated to each, vary from association to association, depending on how members prioritize their problems. In the first place, NRL research and consultation with herders has identified the following major constraints, which are the basis for the pilot associations' credit activities.

Cow-calf herd.

NRL research suggests that many herding families do not now have herds large enough to meet their subsistence needs. Death and sale of animals in the drought of the early 1970s started this process; since then many herders have not been able to restore their herds to pre-drought levels for reasons

discussed in chapter 4 of this report. Because of poverty, herders are often forced to sell very young animals at bad prices in order to buy essential cereals. Poor families are also increasingly obliged to take care of animals belonging to farmers, merchants and civil servants. The only payment is the animals' milk, so they have little opportunity to accumulate savings to rebuild their own herds; since they have no rights in the calves, they are also encouraged to overmilk cows, to the detriment of calf nutrition and survival. These herders have little incentive to manage the animals in the traditional, labour-intensive way which optimises pasture use and production. NRL research suggests that, for these reasons, production from such entrusted cattle may be lower, and their mortality rate higher, than that of animals belonging to the people who herd them.

The herders' association cow-calf or reproductive female scheme is intended to provide association members with a minimum working capital by building up herds in herder ownership to a reasonable subsistence level. The aim is to raise the general level of herd productivity to that of herder-owned and managed herds. Since animals belonging to outsiders need no longer be accepted by herders (and most herders welcome the chance to be rid of such entrusted animals), this can be accomplished without a great increase in the total number of animals in the pastoral zone.

Since herders depend on animal sales for all bought goods, while farmers and other people investing in animals do not, an increased proportion of animals in herder ownership is also likely to result in a higher offtake from the pastoral zone than at present, when a significant number of animals, belonging to non-herders, are kept mainly as savings and investment.

Rebuilding a minimum herd for member families of the associations is also intended to reduce the need for migrant labour by herders to Nigeria and the West African coast. This migration takes place in the dry season and adds to the severity of the dry season labour constraint. By reducing migrant labour at this season, the herd reconstitution program run by associations will make more labour available in the herding economy at the moment when it is a critical resource.

The association herd of reproductive females operates as follows. An association can choose to allocate up to 50 percent of its revolving fund for the purchase of reproductive females. The activity is managed by a section head who is assisted by a purchasing commission composed of the association president, a NRL project member, and representatives of the civil administration, UNCC and the Livestock Service.

The section buys female animals (cows, camels, sheep or goats) on the market. The animals are association property, and are marked with the association brand[1]. They are loaned to the poorest members, according to a modified version of traditional animal loans: the female is loaned to a family until she has given birth twice. During this time the animal's milk is drunk by the family, and the herder keeps the two offspring. At the end of the loan period, the animal can be allocated to another herder for two further calvings, can be loaned for a shorter period to a very poor family to provide milk, or can be sold.

Growing-out herd.

The increasing poverty of many herders is also shown by the fact that they are often obliged to sell their young male cattle at one or two years of age, well before the economically optimal age for sale. The objective of the growing-out program is to enable these herders to take advantage of the rapid increase in value of young male animals over the first few years of their life, while preparing them to enter a later (peasant fattening or animal traction) stage of a nationally stratified livestock production chain. This program contributes in four main ways to the regional and national economy.

---

1. Each association choses its own brand for association animals and all association animals, including the rams paid in by each family as membership dues, are marked with it.

First, by putting preliminary growing-out operations more firmly in the hands of herders, rather than non-pastoral investors, the program encourages a more equitable distribution of the value added in the first few years of an animal's life. At present herders carry the full risk of mortality and the higher labour and other costs of the animal's first year (between 25 and 35 percent of cattle die before the age of one year), but they are often obliged to sell these animals shortly afterwards to meet necessary consumption needs, especially for dry season cereals. The animal's rapid increase in value in the following 3 or 4 years, which because of economies of scale in herding has a relatively low labour cost, benefits only the purchaser, who is often a non-pastoral investor in livestock who entrusts the animal to a herder in the pastoral zone; paid for his work only in milk, the latter benefits very little from the arrangement. The preliminary growing-out program, by allowing herders to capture a greater part of this value added, is designed to ensure a more equitable distribution of the value added in Niger's rangelands.

Second, the growing-out program will contribute to a rationalised program of national stratification of livestock production. Under the program, male cattle complete the rapid growth of their first 3 or 4 years in the pastoral zone, which is best adapted to this. Growing-out is impossible in the agricultural zone and the government ranches have limited capacity.

At present, herders try to hold on to very young animals but are often obliged to sell them in bad condition at the end of the dry season, while non-herders do not sell their animals at the economically optimal age since they are kept as an investment. The supply is thus irregular. Enabling herders to undertake preliminary growing-out will assure a more regular supply of animals for final growing-out and fattening in the agricultural zone.

Third, and related to the previous point, the growing-out program will contribute to a better overall balance between animals and pasture in the pastoral zone, and a greater ability of the pastoral zone herd to track changes in pasture more closely. The growing-out program will not increase the total number of animals in the zone, since association growing-out animals are either bought directly from members or at local markets where they would otherwise be sold to investors and kept in the zone; the program is a transfer

of ownership from non-herders to herders, not an increase in the number of animals. Indeed, since herders are under greater pressure than investors to sell male animals at an economically optimal moment (in order to meet their cash needs), herders are more likely than investors to sell animals at an appropriate time for them to leave the pastoral zone, thus contributing to a regular reduction of the pastoral zone herd. Further, since growing-out operations are timed so that most animals are sold in the cold season, when farmers have most cash and animal prices are high, a regular pattern of seasonal destocking is encouraged, which will optimise seasonal pasture use: the pastoral zone herd is large in the rains when pasture is abundant, and is then much reduced during the cold season before the pasture shortages of the dry season. This already takes place to a certain extent, but the associations' growing-out program, in conjunction with the cereal fund and other programs designed to attack poverty and increase food security, will improve and regularise these seasonal adjustments.

Association growing-out herds have the further advantage of making feasible a first round of rapid destocking in years of serious pasture shortage. NRL has started to develop an early warning system which will eventually, through a combination of rainfall, pasture production and relative price and market flow indices, give several months warning of major droughts. With such a system, associations can make a first round of destocking without immediately cutting into their reproductive capital, and well before the mass selling of animals which typically happens in a major drought and which, by destroying pastoral purchasing power, is the first step towards famine.

To tackle these problems, an association can allocate up to 50 percent of its revolving fund for the purchase of young male cattle, camels, sheep or goats for preliminary growing-out on the range.

The growing-out herd is managed by a section head who is also the association adviser on animal production. He works closely with the association's adviser on animal health and the local representatives of the Livestock Service.

The same purchasing commission as for the association cow-calf herd buys young male animals either at market, or directly from association members who are obliged to sell to provide cash for cereal and other purchases. In the case of association purchase of members' own animals, the member geta the immediate cash value, as well as a later share of the fattening profit. Since the share of fattening profit going to other association members and to repayment of the revolving fund (which is a joint responsibility of all association members) depends on a fair purchase price, there is little incentive for the purchasing commission to pay an unrealistically high price to a member for his animal.

The animals belong to the association and are marked with the association brand, but are distributed among the association's members, to be kept in their own herds, according to a vote at association meetings. The animals are kept for between three months and three years; in consultation with other association members, and using their knowledge of local and regional markets, the section head decides when and where the animals can be sold most profitably.

The money from the sale is divided into two parts. The first is used to meet repayments on the revolving fund as a whole, and also contributes to building up the association's own revolving fund so that once the money loaned by the project is reimbursed, the association is left with its own fund to continue the activities started with project credit. The second part is distributed equally between all the members of the association.

The proportion in which growing-out profits are divided between credit repayments, constitution of the association's own fund and dividends distributed to members is decided at association meetings in consultation with project staff. At the time of the initial loan, a minimum repayment schedule is jointly agreed between the association and the project, as described later in this section. The growing out herd is the main association profit-making activity, and thus has to bear most of the burden of repayment.

Short-term credit

An association can allocate part of its revolving fund to short-term, small loans to members. This facility was a response to one of the major needs expressed by herders during the discussions leading to the creation of the associations. NRL research has confirmed herders' vulnerability to market price fluctuations for livestock. Herders sometimes take an animal to a distant market or to a series of markets but are offered very low prices because few traders are there that week[1]. The herder may nevertheless have to sell in order to buy cereals. The short-term credit scheme gives herders the chance of delaying sale for up to about a month in the expectation of a better price for his animal, but to buy the cereals he needs all the same.

The credit can also be used to buy production inputs such as veterinary drugs, vitamin A, salt or other feed supplements such as cotton seed at the time the herders need them rather than when they have cash in their pockets from animal sales at the most profitable moment. Another use will be in connection with the associations' crafts program. Short-term credit enables women (who, particularly in Twareg society, often have no income of their own), to buy the raw materials for artisan products, such as palm fibres to make mats or leather and ink to make leather goods. An important function of this fund is to train herders to handle small credit sums, especially administration (including calculating and obtaining interest payments), accounting and repayment. Experience of this on a small scale is a training for administering and accounting for the larger sums of the main revolving and cereal funds. For these reasons short-term credit will be more important in the early life of an association than later.

---

1. Trivial events can cause this. For example, a shortage of gasoline or intensified checks on taxi drivers' insurance papers can momentarily halt taxi traffic to some markets, resulting in an absence of livestock traders.

Loans under this scheme can normally be no less than 5,000 CFA ($16-17) and no more than 15,000 ($45). Exceptional cases when a member asks for a loan of greater than 15,000 will be discussed at the association's quarterly meetings. Loans are repaid within a period decided when the loan is made, and sharply increasing interest rates are charged on loans of over one month. A borrower who does not repay his loan within the specified period is subject to sanctions decided by association members (for example, suspension of the right to buy millet through the association). A person who has already taken out a loan cannot apply for another until the first is repaid. Loans cannot be made to non-members.

Short-term credit is managed by an elected section head who makes the day to day decisions about ordinary loans, and who gives a detailed account of loans and repayments at each quarterly meeting of the association.

Cereal fund

Although herders meet part of their food needs by drinking milk from their herds, for most of the year they have to buy food from outside the pastoral economy, and during the dry season all herding families eat mainly millet. Poor herders especially depend on millet, since they have fewer animals and less milk. Terms of trade move against herders in the dry season, since cereal prices are high then and animal prices low. OPVN, which in theory sells cereals to herders at controlled prices, opens too late in the year, and in practice sells them only very small quantities at a time; so herders have to spend considerable time away from their herds, at a moment when watering labor is critical and the risk of mortality high, in order to buy cereals for their families.

The cereal fund is a seasonal loan which makes it possible for associations to buy cereals in bulk when prices are low and to store them under members' control near their dry season pastures. It enables herders to: (a) plan animal sales and sell when prices are best; (b) avoid wasting scarce dry season time buying small amounts of cereals; (c) have the security of knowing that dry season cereal supplies are assured; and (d) pay less for cereals.

The cereal program is not intended to cover the full annual millet requirements of association families, but to make possible forward bulk buying for the dry season when cereal prices are highest, animal prices lowest, and herder families can least afford to spend time travelling to market. The cereal needs of a herding family from March to July, when milk production is lowest, are estimated on the basis of the household budget and consumption studies reported in chapter 4.2 and other research as follows. A family of 7 people (2 adults, 2 teenagers and 2 small children) needs 14,700 kcal/day; this is met almost entirely by cereals in this season, which means 4.2 kg of millet/day, or 0.6 kg/person/ day. For March to July, this family thus needs 92 kg/person, or a total of 650 kg for the family as a whole. The cereal fund allows each association to buy and stock this quantity for its members' dry season use.

The cereal fund loan is made to associations for bulk millet purchase and storage. In the first phase purchase and transport is handled by the project; subsequently, associations or Pastoral Centers will make their own arrangements directly with OPVN, with agricultural cooperatives in the south, or with private traders. The cereal fund is managed by an elected section head. Associations store the millet in buildings they construct or rent. This millet is resold to members in the dry season, at the purchase price plus costs (including transport, storage, administration and losses) plus a contribution towards the constitution of the association's own cereal fund. The financial organization of the fund is described in the next section.

Credit administration, repayment and accounting

Repayment

As described in the previous section, associations are allocated two types of credit fund, the revolving fund and the cereal fund. They are independent, although associations can use the proceeds from one to service outstanding debt on the other.

In the case of the revolving fund, the principles are: (a) all money loaned is repaid by the association, with interest of 12.5 percent a year after the first year, or an appropriate alternative in the case of associations whose Islamic beliefs forbid interest; (b) the main sources of

income for repayment are the sale of membership rams and of grown-out males, and these subsidise the reproductive female and other programs; (c) at the original disbursement, the association agrees with the project a minimum repayment schedule; it can repay faster than this, thus reducing interest charges, but no slower; (d) during the loan disbursement-reimbursement cycle, the association builds up its own revolving fund from profits, so that when the loan is fully repaid to the project the association has also established its own fund in cash and kind for further productive investment; (e) the revolving fund can make a contribution to repayment of the association's own cereal fund and vice versa.

The revolving fund of a 20-family association is 2 million CFA (about $6,000), and is entirely disbursed over the course of the first year. Income for repayment comes from profits on the sale of membership rams according to the schedule shown in the annex to this chapter, and part of the profits of the growing-out program, the details of which are also shown in the annex. A grace period is allowed for the first year, since it is only at the end of this year that the fund is fully disbursed; subsequently interest is charged on the sum outstanding at the end of each year, at 12.5 percent[1].

At the disbursement of the revolving fund, associations sign an agreement with the project covering the minimum repayment schedule for the fund. They are offered two choices, one somewhat faster than the other, with the advantage of paying less total interest. The two detailed repayment schedules are shown in table 7.1.4.

---

1. The interest rate is calculated to cover inflation (6.5 percent), default including animal mortality (5 percent) and administrative costs, especially accounting, at the Pastoral Center (1 percent).

Table 7.1.4 Financial schedules for a 20 member herders' association revolving fund (1000 CFA)

Year	Disbursed	Reimbursed		Interest on outstanding loan at end of year (%)	Total outstanding at end of year	
		scheme A	scheme B		scheme A	scheme B
1	2,200	200	200	-	1,800	1,800
2	-	400	500	12.5	1,575	1,463
3	-	400	500	12.5	1,322	1,083
4	-	400	500	12.5	1,037	656
5	-	400	500	12.5	717	175
6	-	400	175	12.5	356	-
7	-	356	-	-	-	-

At the same time, profits from the growing-out and other association operations are also being used to build up the association's own revolving fund, especially through the regular purchase of a new growing-out herd and a new cow-calf herd. There is a greater element of individual choice in this process than in the repayment schedules, since each association is free, in consultation with the project, to plan the way it constitutes and manages its own revolving fund activities.

The principles of the cereal fund are: (a) money is loaned for a maximum of 9 months each year; (b) no interest is charged, but financial discipline is maintained by the requirement to reimburse in full each year and to constitute progressively from the first year the association's own cereal fund; continued disbursement of the cereal fund each year depends on this; (c) in years 7 and 8 the cereal fund receives a contribution from the revolving fund.

The cereal fund of a 20 household association is 1.5 million CFA (around $4,500). It is replenished at around harvest time each year, and is entirely reimbursed at the latest 9 months later. The income of the cereal fund comes from sales of the millet at cost (including transport, storage, administration

plus an allowance for losses) plus a levy of 1,000 CFA per 100 kg sack, which is used progressively to constitute the association's own cereal fund. The cereal fund is reimbursed in full each year (next year's disbursement being dependent on this), but the sum disbursed in the following year is reduced by the cumulative total of the association's own fund. Project disbursements to the cereal fund are entirely phased out in year 9. Details are shown in table 7.1.5

Table 7.1.5 Financial schedule for a 20 member herders' cereal fund (1000 CFA)

Year	Disbursed and repaid	Association sales profit	Subsidy from revolving fund	Association's own cumulative cereal fund
1	1,500	130	-	130
2	1,370	130	-	260
3	1,240	130	-	390
4	1,110	130	-	520
5	980	130	-	650
6	850	130	-	780
7	720	130	300	1,210
8	290	130	160	1,500

From the first year of the loan cycle, the association builds up its own cereal fund. This money is banked with the project each year at the same time that project cereal fund loans are reimbursed. Although the sums are small for the first few years (rising however to over 500,000 CFA in year 4), they mount steadily, supplying collateral for outstanding revolving fund loans and an easy means to check each year on the financial success or difficulties of the association loan scheme.

The best use of this association money during the three or more months it is banked is under study; it might for example be used to fund bulk purchase of animal feed or veterinary inputs. More generally, it is intended that the funds handled at the level of Pastoral Centers, grouping several associations, should be managed in such a way as to encourage investment by richer pastoralists, farmers or townspeople, and thus increasingly to mobilise savings from within the pastoral zone itself as a source of development funding. Detailed proposals for this are currently being worked out.

Animal mortality

One important problem for the revolving fund is the risk of animal deaths. As associations build up their herds of reproductive females and bullocks for growing-out, there is an increasing probability that some association animals will die from normal causes. These annual mortality risks are estimated in table 7.1.6.

Table 7.1.6 Estimated risk of mortality in association herds

Species	Estimated annual mortality (%)
Cattle:	
- heifers and adult cows	2-5
- calves	25-35
- bullocks and steers in growing-out herd	5
Sheep:	
- adult rams from membership dues	10
Goats:	
- adult females	10
- kids	35
Camels:	
- adult females	2
- calves	35

These rates mean that an average association growing out herd of about 20 young bullocks will lose about one animal from normal mortality each year, and an association cow-calf herd of 5 adult cows and their calves will lose one adult cow every 4 to 10 years and approximately one calf in three.

Although such losses are high, they are a normal part of pastoral life. Since the animals concerned - the membership ram flock, the cow-calf herd and the growing-out herd - belong to the association and not to individual families, it is the association and not the families which carries the risk of loss, and account has been taken of these levels of risk in setting repayment levels for association credit programs. A careful check on all losses will be an essential association task, to be sure that losses are real, that they are kept at acceptable levels and that they do not compromise credit repayment schedules[1]. In fact, animal mortality rates in the association herds may be lower than the pastoral zone average and may decline, due to association animal health and nutrition programs.

A more difficult problem occurs in the case where losses are well above average, because of a disease epidemic, serious drought or other accident of pastoral life. If an associations losses go above a certain threshold, it would be unrealistic to expect the association to keep to its repayment schedule, or even in extreme cases to repay at all. These thresholds need to be defined by research during the early part of the ILP project, and an insurance system for associations will be developed as part of a wider insurance system being studied for major disasters. One important aspect of this is that while there is no incentive for individuals to attempt to defraud the association about individual association animals, a way needs to be found to discourage an association as a whole from defaulting fraudulently on its repayment obligations to the project or the loan administrator. One approach would be to extend the principle of collective responsibility to a high level,

---

1. A family could only benefit by a fraudulent declaration of loss if it secretly sold the animal. The small size of the associations and their strong links make this unlikely.

making credit funds the collective property of Pastoral Communities, with collective repayment obligations, and new disbursements dependent on prior repayment of outstanding community obligations.

Accounting

An accurate and timely accounting system is essential to the herders' association credit scheme and will be more difficult than in the agricultural zone because of the scattered geographic distribution and mobility of herders and diversity of their programs. A detailed accounting system is being worked out as the first associations are created and monitored and it is expected that this will evolve as experience of the problems is gained.

Herders' association assets consist of: (a) a flock of membership rams; (b) a growing-out herd of bullocks; (c) a cow-calf herd of females; (d) a millet stock; (e) a short-term credit fund; (f) the association's own progressively increasing cereal fund deposited for about 3 months each year with the project; (g) undisbursed sums on the other credit programs. The members of the association are jointly responsible for these assets. The accounting principle is that permanent written records of all transactions except the short-term credit are kept at association, pastoral center and project level, and that association physical assets, especially animals and millet stocks are inventoried twice a year by a project herders' association internal auditor. The accounts and animal records are then certified by the project director.

A number of problems arising from the nature of the pastoral economy and the credit scheme itself can be foreseen, and appropriate solutions need to be found. The main problem arises with the short-term credit program since there are no physical assets to be checked. In some associations, for example in half of the Twareg associations formed so far, there is an association member sufficiently literate in Arabic or Tifinagh to keep detailed records of loans and repayments, and the associations' literacy program will give priority to simple accounting procedures. For associations where there are no such skills, some other simplified system needs to be developed. It is envisaged that once a year, coinciding with one of the internal auditor's visits, all

short-term credit will be called in for verification. In addition, a condition of the short-term credit is that it can be called in at one month's notice at any moment, for audit and verification. In this case, if association members who have outstanding loans are not present (for example because of work migration), the remaining association members have to make up the sum since they are jointly responsible. Association assets, in particular the membership rams and the association's own progressively constituted cereal fund are held as collateral against this eventuality.

Most of the credit programs can be audited and verified without too great a problem. Stocked millet can be inventoried, and association animals, identified by their brands, can be counted. Even when association members go off on seasonal work migration, as some of them will continue to do for some time, their animals, including association-owned animals, are left in the care of another association member who stays behind. Undisbursed credit on all programs except the short-term credit scheme is kept at the Pastoral Center or project, and is only disbursed, in the presence of the buying commission described above, for actual purchase of animals.

FINANCIAL PERFORMANCE OF THE PILOT ASSOCIATIONS

The first associations were created in June 1982, so there was, at the end of 1982, only 6 months experience at best over which to evaluate their performance; for most of the associations the period was even less. It is clearly premature to attempt a full evaluation. However some account of progress so far can be given.

Revolving fund

The revolving fund is disbursed progressively to each association over the first year of its life, as the association's different activities are set in motion At the end of 1982, all 10 pilot associations were still in their first year, and their revolving funds had not yet been fully disbursed. Table 7.1.7 shows the status of the revolving fund of each association in November 1982.

Table 7.1.7 Status of revolving funds, November 1982

Association	Number of families	Months of life	Revolving fund entitlement (CFA)	Revolving fund disbursed (CFA)	Percent disbursed
Muumin	21	5	2,100,000	1,600,000	76
Almuriden	22	5	1,980,000	1,350,000	68
Doosewol	30	3	2,700,000	850,000	31
Abba	21	3	2,100,000	800,000	38
Ediindu	22	3	1,980,000	800,000	40
Yuguda	24	3	2,400,000	800,000	33
Inuttaban	30	2	2,700,000	350,000	13
Win Tahirit	21	2	1,890,000	350,000	19
Karadat	30	1	3,000,000	-	-
Idal-Husseyni	16	1	1,440,000	-	-
TOTAL	237		22,290,000	6,900,000	31

The revolving fund is divided among several activities, as decided by the association:

Growing-out herd

An association may spend up to 50 percent of its revolving fund on a herd of male animals (bullocks, camels, rams or goats) for growing-out and sale[1]. The first associations have begun to receive funds for this operation. Table 7.1.8 shows the situation at the end of 1982. More than 45 percent of the animals purchased under this program belonged to association members.

1. In the initial period, associations were encouraged not to allocate more than 30 percent of their revolving fund to any single activity. This proportion will probably rise to 50 percent during the association's second year.

Table 7.1.8 Status of growing-out herds, November 1982

Association	Sum allocated for growing-out herd (CFA)	Percent of revolving fund	Animals	
			Bullocks	Camels
Muumin	577,000	27	21	-
Almuriden	600,000	30	5	16
Doosewol	550,000	20	22	-
Abba	500,000	24	19	-
Ediindu	500,000	25	6	-
Yuguda	500,000	21	16	-
Inuttaban	200,000	7	-	5
Win Tahirit	200,000	11	-	-
Karadat	-	-	-	-
Idal-Husseyni	-	-	-	-
TOTAL	3,627,000		89	21

Cow-calf herd

An association may spend up to 30 percent of its revolving fund on a community herd of female animals (cows, camels, ewes or goats). This was the most recent activity organized by the project, and to date only two associations have benefited from it, as shown in table 7.1.9.

Table 7.1.9 Status of cow-calf herds, November 1982

Association	Sum allocated for cow-calf herd (CFA)	Percent of revolving fund	Animals		
			Cows	Camels	Goats
Muumin	623,000	30	1	1	74
Imuriden	400,000	20	4	1	-
TOTAL	1,023,000		5	2	74

Short-term credit

An association may spend part of its revolving fund on an internal credit system for association members. The loans are small (between 5,000 and 15,000 CFA per family) and must be repaid within a period established in advance by the association (3-4 weeks). After this time, members who have not repaid their loans are subject to sanctions, which vary among associations. Some associations impose an interest charge or tax (about 5 percent of the amount borrowed) on members who are late in repaying loans. It is envisaged that in the second year, interest will be charged on all short-term credit and that this will contribute to the repayment of the revolving fund. Table 7.1.10 shows the current situation of each association as regards short-term credit.

Table 7.1.10 Status of short-term credit funds, November 1982

Association	Sum allocated for short-term credit (CFA)	Percent of revolving fund
Muumin	400,000	19
Almuriden	350,000	18
Doosewol	300,000	11
Abba	300,000	14
Ediindu	300,000	15
Yuguda	300,000	13
Inuttaban	150,000	6
Win Tahirit	150,000	8
Karadet	-	-
Idal-Husseyni	-	-
TOTAL	2,250,000	

In summary, by November 1982, the first two associations had received a substantial part of their revolving funds. About 30 percent of the revolving fund had been allocated to the growing-out herd, and up to 20 percent to short-term credit[1]. The remainder, about 20 percent, had not yet been allocated, and its division among existing and potential new programs, such as craft activities or well construction, remains to be decided during the second year by each association jointly with the project. The other associations were at a much earlier stage of credit fund disbursements, and few general conclusions can yet be drawn.

1. In November 1982 it was decided to reduce the short-term credit allocation progressively to 10 percent of the revolving fund total.

Revolving fund repayments

A rough measure of the degree to which associations are already meeting their repayment schedules during their first year can be calculated. To do this it is assumed that the amount due in repayments by the end of an association's first year is a function of: (a) the total amount due for repayment at the end of the first year on the fully disbursed fund (from table 7.1.4) and (b) the proportion of the revolving fund actually disbursed. The level of repayment already made by January 1983, calculated as a percent of that due by the end of each association's first year, is shown in table 7.1.11. Repayment is likely to be concentrated at the end of the first year, and because of this the repayments recorded in table 7.1.11 do not include the main source of association cash for credit reimbursement, sales from the membership ram and growing-out herds. These will take place much closer to the end of each association's first year, and should permit a substantial cash repayment to bring the rates up to the target schedules.

Table 7.1.11 Revolving fund repayments, January 1983

Association	Months of life	Percent of revolving fund disbursed	Repaid by January 1983 (CFA)	Percent of repayment due at end of first year
Muumin	7	76	28,950	18
Almuriden	7	73	14,700	9
Doosewol	5	43	29,600	23
Abba	5	48	17,200	17
Ediindu	5	51	18,100	16
Yuguda	5	42	30,900	31
Inuttaban	4	31	7,800	8
Win Tahirit	4	45	3,150	3
Karadat	3	-	-	-
Idal-Husseyni	3	-	-	-

Cereal fund

Associations also have access to a second source of credit, the cereal fund, which is administered separately from the revolving fund, and is used only for bulk purchase of millet.

For the first experimentsl year, the project bought millet from OPVN in Tahoua. This wss sold on credit to the pilot associations in August 1982, at cost including transport and storage. By November 1982 the full value had been recovered as shown in table 7.1.12.

Table 7.1.12 Status of cereal funds, November 1982

Association	Millet purchased (tons)	Value (CFA)
Muumin	4.2	510,300
Almuriden	5.7	692,550
Doosewol	3.8	461,700
Abba	4.2	510,300
Ediindu	4.4	534,600
Yuguda	4.8	589,200
Inuttaban	2.6	315,900
Win Tahirit	-	-
Karadat	-	-
Idal-Husseyni	-	-
TOTAL	29.7	3,614,550

FUTURE PROBLEMS

Although the pilot herder association program has been successfully launched, it is possible already to identify a number of problems which will have to be resolved as the activities move from a pilot phase, during which NRL project staff were able to undertake a great deal of discussion with the new associations and a great deal of supervision of their activities, to an implementation phase on a larger scale, in which such close contact will not be possible. These problems are both institutional, concerning relations between the several government services involved in the association program, and technical, concerning specific programs or plans for association activities.

Several government services are concerned with herder association activities, but their respective mandates and responsibilites have not yet been clearly defined. UNCC has the major responsibility for creating, organizing and controlling all cooperative and precooperative groups in the country. Its experience had, however, been almost entirely in the agricultural south of the country, until it was recently instructed rapidly to create cooperatives throughout the pastoral zone. The Ministerial decree setting up the herder association program gave joint responsibility for the associations and pastoral communities (GMPs and GVCs) to UNCC and the donor-funded livestock projects, including NRL. But this was a provisional attribution of responsibilities for an experimental period, and no definitive attribution of mandates has since been made. UNCC has collaborated closely with the NRL project in the latter's approach, and has indicated a wish to adopt auch an approach itself; at some stage, a formal attribution of responsibilities for pastoral zone cooperative development will be needed in order to conserve the excellent existing working relationship between UNCC and the livestock projects.

The livestock projects are administrativeiv located within the Ministry of Rural Development, with particular links to the Livestock Service; most, although not all, project staff members are seconded from the Livestock Service, and may return there at any moment. However the mandate of the

livestock projects, and the particular orientation of the herder association program, is towards integrated rural development, touching on areas which are the responsibility of other government services, belonging in some cases to different Ministries. The tasks project staff members are called upon to perform include many that Livestock Service staff are not trained for, including socio-economic skills, "animation", accounting, human health and artisan work. Although it is easy to train people to do these things, questions of institutional responsibility are quickly raised. If there is to be a commitment to an integrated development program in the pastoral zone, which seems to be justified by the integrated nature of the problems there and the success of NRL's pilot integrated solutions, there has to be an institutional renewal within central and departmental government structures capable of handling such a program. The role of the Extension Service needs especially to be clarified.

The role of the traditional chiefs also needs clarification. As discussed above, the powers and responsibilities of tribal chiefs in the pastoral zone are severely circumscribed, but, in the absence of any more appropriate channel, the government has used them as an intermediary to communicate with herders in the bush. The policies of the Development Society were intended to replace this with a more participative form of democracy from below. However recent changes have tended to strengthen once again the power of traditional chiefs, who are not equipped to handle such responsibilities. It is likely that the success of a cooperative pastoral development strategy of the sort the government has decided upon, of which the herders' associations are the first building block, will pose a threat to the aspirations of some traditional chiefs, and that as a result they will resist such a policy. This will be especially true if the program attempts to implement, as the NRL program does, the government's commitment to self-managed development from the ground up. There is a danger that the pastoral cooperative structure could be captured by the traditional chiefs, particularly among the Twareg; the higher cooperative level of Pastoral Communities or GVC, is the most likely arena for this, since the associations or GMP are deliberately designed to be too small for this to happen easily. Special attention will be needed in the development of the herder association program to avoid this danger, but a clear government policy decision is also needed to clarify the future responsibilities and position of the traditional chiefs.

Technically, a number of problems are likely to be important in the next phase of the association program. A particular effort will be needed in the education and training field: training human and animal health auxiliaries, functional literacy, accounting and record keeping. This training, to be effective, will have to find ways of incorporating traditional knowledge and skills. Problems connected with training programs for women, as with association programs concerned with women generally, will be particularly acute. However, the association programs offer a particularly favorable opportunity for literacy and accounting training, since these programs can be based in the first place on association activities, providing both the motivation for learning and the subject matter for constant practice of new literacy and accounting skills.

Problems are also likely to arise in the relationship between association activities concerned with marketing of cereals and livestock, and the main existing market actors, the state and large private traders. Association programs are designed to increase the control of their members over key marketing processes, particularly the seasonal pattern of cereal purchases and storage, and the sale of grown-out male cattle. In this, the associations compete with other powerful market actors, who will no doubt resist the association programs. Under the pressure of events, especially the world recession and the relative failure of control of cereal marketing, the government is currently moving towards a liberalization of markets, which will probably work to the advantage of herders. However, association marketing policies and programs have to avoid the dangers either of setting up an economically inefficient semi-bureaucratic marketing organization, or alternatively of allowing their marketing operations to be captured by private trading interests. The associations must not be allowed to become mainly a channel for cheap credit for short-term livestock trading operations, although there is likely to be pressure from members of some associations in this direction.

Problems are also likely to arise in the general field of technical programs. To grow to their full potential, the associations must introduce new, technically improved, herding practices to the pastoral economy in order

to raise the productivity of herding. The associations provide an ideal institutional framework for such technical innovation, possibly for the first time under Sahelian conditions. However, now that the outline at least of a solution to the institutional problem of development of the pastoral economy is in place, there is a lack of technical packages, tested and known to be appropriate, to implement through the associations. The success of the credit funds, cereal stocks and auxiliary health and veterinary service programs has earned some credibility for the project and the government, but herders' associations must not be used as guinea pigs for untried ideas about range management, animal husbandry or anything else; the credibility gained so far would disppear very quickly. There is a particular responsibility on the technical disciplines concerned to provide the right technical solutions in the near future.

A last important problem concerns the nature and scale of project and government actions. NRL project activities in the herders' association program was the result both of a detailed research program, analysing the situation as it appeared to outsiders and also the perceptions and wishes of the herders themselves, and of an intensive input from a team which was able to deal individually with a small number of associations and their members. This type of contact was necessary at the start of a program, while its main directions, policies and procedures were being established. In the future, these relationships will have to be institutionalised and operate in a much more impersonal way if the program is to become widely implemented. The government's and the project's dealings will no longer be with a whole series of association members, well known to the Pastoral Center staff, but with one or two key people only. The degree of control, supervision and joint motivation will be much less, and there will be much more chance for inefficiency and dishonesty on both sides. The program faces obvious risks, on the one hand of becoming a powerless, resourceless bureaucracy, vainly competing with existing, better-established services for scarce funds, and on the other hand of being captured by important people in the pastoral zone and turned to serve their own limited interests. It will be important to expand the program slowly enough to identify and deal with the dangers, and to ensure at each step that the procedures are such that the genuine interests of the members of the associations, and of the majority of poor herders in the pastoral zone, are the main guiding force.

CONCLUSION

The first associations have existed for less than 7 months, so it is clearly too soon to make a definite judgement about their viability. However, there is considerable excitement among herders in the experimental area about this new program, and several groups of herders have agreed among themselves, without project intervention, to form associations as soon as the project will officially recognize them. There is thus already a waiting list.

The most important task for the immediate future is to monitor with great attention these pilot efforts. The two main themes will be how best to manage the programs and account for the funds, and how to best introduce technical innovations to raise the productivity of herding. Both of these aspects must operate efficiently on a large scale if the program is to provide an appropriate framework for development of the pastoral zone of Niger.

ANNEX TO CHAPTER 7.1

MANAGEMENT OF AN ASSOCIATION MEMBERSHIP RAM FLOCK

The assumptions used in table 7.1.13 are:

1. Each association member family contributes a ram worth about 10,000 CFA every two years.

2. Half the rams are sold after about 9 months at a price of 15,000 CFA, the rest after about 18 months at a price of 20,000 CFA, the full sales price being paid to the association.

3. Rams which die within 3 months of being given to the association are replaced by the member with another animal. Those that die after 3 months are an association loss; this risk is considered to be 10 percent per year (in the calculations, losses are rounded to the nearest integer).

4. In year 1, every family puts in one ram; half of these are sold at the end of that year; in subsequent years, half the association ram flock is sold each year.

Table 7.1.13 shows the detailed composition and income from the ram flock.

Table 7.1.13 Management of an association ram flock

	Years									
	1	2	3	4	5	6	7	8	9	10
Into flock:										
- Rams from previous year	0	10	0	10	0	10	0	10	0	10
- New subscription rams	20	0	20	0	20	0	20	0	20	0
- Total rams at start of year	20	10	20	10	20	10	20	10	20	10
Out of flock:										
- Mortality during year (10 percent)	2	1	2	1	2	1	2	1	2	1
- Sales by association	8	9	8	9	8	9	8	9	8	9
- Transfer to following year	10	0	10	0	10	0	10	0	10	0
Association income from sales (1000 CFA)	120	180	120	180	120	180	120	180	120	180

MANAGEMENT OF AN ASSOCIATION GROWING-OUT HERD

The management plan for the association growing-out herd, which can be changed by mutual consent of the association and the project, is as follows:

1. At the end of the dry season of year 1, the association buys 20 bullocks aged 2 to 3 years worth on average 32,500 CFA each.

2. These animals are kept for an average of about 18 months and are sold in the cold season for an estimated 60,000 CFA each. (These are conservative figures).

3. The total profit is reduced by 5 percent, due to death of one animal over this period. An insurance system to spread the risk carried by individual associations is under study.

4. The sales price is divided into 3 parts: (a) a first part is used to reconstitute the growing-out herd at the end of the following dry season; (b) a second part goes to make payments due on the revolving fund; (c) a third part is distributed in dividends to association members. This third part will be small during the early years while the association is repaying the original revolving fund loan and building up its own revolving fund, and much larger afterwards.

The details of management of the growing-out herd are specific to each association, and are decided by them jointly with the project.

7.2 RANGE MANAGEMENT AND ANIMAL PRODUCTION INTERVENTIONS

Achieving animal husbandry objectives in the pastoral zone through the course of the year depends mainly upon the forage and water present at any particular time in any given area. Because of the extreme variability in the amount and distribution of the annual rainfall which ultimately determines these resources, any management scheme must be flexible enough to allow proper adjustments to constantly changing conditions. In addition, management decisions made at any one point in the year carry long-term implications. Both the benefits and costs of these decisions must be considered in order to make optimal use of plant production while avoiding the risk of major production shortfalls or large-scale animal losses due to shortages of animal feed.

The results of project range research were described in 3.4. Their development implications for animal production and pasture management during the different moments of the year are considered here.

RAINY SEASON

The principle forage resource used by livestock for the entire year grows during the two to three month rainy season. As a result, plant production at this time will determine possible long term management actions as well as those actions which will permit maximum use of this short period of high pasture quantity and quality. It is only during this high production period that it is possible to maximize animal weight gain and at the same time manipulate the forage resource for later dry season use.

In the early rainy season, animal weight gain per day is maximized in pastures where the amount of vegetation present is below 300-500 kgs/ha and in the earlier phenological stages of development. These stages of plant growth have more palatable forage material and a high protein content. One important consideration at this moment is to allow the vegetation to become established before grazing begins. Otherwise plant production may be inhibited if the initial grazing is too intense. The grazing trial results

showed that a moderate intensity grazing pressure at this moment (stocking rate: Ibecetene 3.5 ha/TLU; Dakoro 1.6 ha/TLU) not only resulted in high individual weight gain but also considerably stimulated biomass production.

The other advantage of higher grazing intensities at this time is the creation of a soil moisture reserve. Increased soil moisture at the end of the rainy season affects the quality of the vegetation by decreasing percent dry matter, extending the "green feed" period, and increasing perennial regrowth, thus possibly allowing additional animal gains.

The consequence of continually seeking new pastures with the earlier phenological stages of plant development is the rapid vegetative growth that occurs after the grazing pressure is removed. This results in pastures where the grasses quickly reach maturity and thus go beyond the optimum stage for use by grazing animals.

Furthermore it is very unlikely that all the pastures in the open range will be efficiently used during the rainy season period of maximum quality. To ensure this would require a large increase in animal numbers, and a corresponding reduction in animal numbers at the end of the rainy season due to limited dry season forage.

By harvesting those underutilized pastures at the appropriate time for hay or silage, a two-fold benefit would result: (1) the pasture would be kept in a higher quality form, and (2) a dry season forage supplement would be created. The overall effect of cutting the grasses would be similar to those caused by higher intensities of grazing. Maturity would be delayed and many grass species would produce extensive tillering systems thereby increasing the proportion of higher quality leaves and decreasing the proportion of stems. As a result, a higher quality dry season pasture would be produced. Similar effects on soil moisture would be created by evapotranspiration and increasing subsequent early dry season forage quality.

The principal benefit to hay collection is in providing a forage supplement high in protein and energy for use during the dry season and the dry to rainy season transition period.

Managing forage production and quality by manipulating grazing pressure or hay collection would also allow animal weight gains to continue into the early dry season by using the higher quality regrowth. Traditional harvesting practices do exist but for the most part these involve the collection of dried grasses and litter after the rainy season and thus are of a lower quality. Cutting at the appropriate time, when the seed head is just developing inside the leaf sheath ("boot stage") is when protein content is at its highest.

DRY SEASON

In contrast to the rainy season, circumstances during the dry season dictate a change in priorities and objectives, and these themselves change during the course of the dry season.

In the early part of the dry season, the basic objective should be to maintain the improved animal condition and higher body weight acquired during the rainy season. In the later part of the dry season, when body weights will certainly decrease, the objective should be to hold weight losses to a minimum. The principal consideration in determining whether these goals are achieved is the efficent use of the limited forage available.

In the early part of the dry season, areas of plant growth atill available with a lower percentage of dry matter ("green feed") and a shorter, less stemmy growth form should be grazed by themselves or in conjunction with lower quality forage over a somewhat longer period of time. Grazing these areas at this time would ensure their use before they become completely dry, facilitating the gradual adaptation of the rumen microflora to the lower quality forage of the dry season.

The goal during the cold season should be to maintain improved animal condition and weight from the rainy season as long as possible into the dry season. The Ibecetene data indicated that gain per individual animal

started to decrease when approximately 350 kg/ha of residual standing herbage remained. Initial dry season grazing might concentrate on areas with shorter and less stemmy vegetation, leaving such areas when around 350 kg/ha of standing herbage remains. At this time areas locally abundant in wild melon (Citrullus lanatus) and Cyperus conglomerata would be beneficial in supplying "green feed". This would reduce the possibility of night blindness later in the season, supplying additional high quality feed and maintaining milk production.

During the transition period between the cold season and the hot season, there are likely to be losses in animal weight which seem related to climatic adjustment by the animals. A small amount of cottonseed or other feed supplement during this period might reduce animal weight losses by temporarily augmenting available protein.

Later, during the hot season (March-May), as forage stocks are reduced, areas that had been previously grazed, could again be returned to and grazed down to 200 kg/ha of residual standing herbage. This was found to be optimal grazing level for efficient use of forage considering both animal gain per hectare and animal gain per individual at Ibecetene. For more northern pastures represented by the Dakoro grazing trials, which are dominated by the taller, stemmier Cenchrus biflorus, this level was 350 kg/ha of residual standing herbage.

Leaving 200 to 350 kg/ha of standing herbage and a probable corresponding 200 to 300 kg/ha of litter would be a direct benefit not only to animal weights but also to the soil. Penning de Vries and Djitèye (1982) recommended leaving a minimum of 400 kg/ha of plant biomass to reduce losses due to wind erosion. This same report also noted that soil crust formation, which greatly reduces infiltration and site productivity, was caused by algal growth, high soil temperatures, wind and high velocity rains drops. From qualitative observations at the Ibecetene grazing trials, a higher percentage of crusty barren ground occurred in dry season pastures that had less than 57 kg/ha of standing herbage and 200 kg/ha of litter at the end of the dry season than in adjacent pastures with 150-250 kg/ha of standing herbage and 300-600 kg/ha of litter at the end of the season. This

indicates that relatively bare soil unprotected by standing herbage and litter in the early rainy season may be susceptible to soil crust formation, especially if the area receives little animal trampling during the rainy season.

If areas previously ungrazed and not too distant from water (i.e. grazing reserves) were made available during the mid-to-late hot season, animal weight gains could occur as was documented in the grazing trial deferred grazing system. This would put the animals in better condition to confront the difficult dry-to-rainy season transition period. In addition, areas abundant in good browse species would be desirable. Boscia senegalensis, Chrozophora brocciana, Maerua crassifolia, and Salvadora persica can supply green fodder at this time.

During the dry-to-rainy season transition period, animal weights are at their annual low. Litter, an important forage source at this time, is adversely affected by the first early rains. These combined effects make this period potentially the most critical. Hay reserves fed at this time would greatly reduce further deterioration of the animals' condition. Hay would not only supply badly needed high calorific feed but is also relatively high in protein. This would provide a good feed source until newly germinated grasses were established enough to withstand grazing.

Also during this time areas locally abundant in Cyperus conglomeratus would be advantageous as this perennial sedge responds quickly to the first rains and produces high quality feed. Early in the rainy season, cattle select this species rather than adjacent newly germinated grass.

Realization of range management interventions such as these depends on some form of grazing control. Possible methods of achieving this, at least partially, through herder association control of water are discussed in chapters 7.1 and 8 of this report.

7.3 VETERINARY AUXILIARIES

This chapter describes and evaluates a pilot veterinary auxiliary program started in the arrondissement of Tchin Tabaraden in April 1981. The program was the result of collaboration between the Livestock Service, the NRL project, and VETOPHAR, and had as its goal to set in motion an effective, self-help approach to the delivery of animal health care in the pastoral zone.

The program was launched before the formation of the first Herder Associations (which were created in June 1982). The proposals in this section should be considered accordingly. Henceforth the associations will provide an appropriate institutional framework through which problems of training, supervising and resupplying veterinary auxiliaries can be solved.

A PILOT PARAVET PROGRAM

Introduction

There are few veterinary posts in the pastoral zone. Distances between posts are considerable, ranging from 80 to 150 kms (see figure 8.3.1). Any rapid intervention in the bush by the Veterinary Service needs vehicles, which greatly increases the cost of animal health care delivery, especially since few animals are treated each time.

Herders often live in areas so remote that they are unable to take their animals to the nearest veterinary post. The situation is particularly severe in the dry season, when herders are most widely dispersed, and animals, weakened by malnutrition, cannot walk far. One solution to this problem is to develop a network of veterinary auxiliaries, or paraveterinarians, themselves herders living in the bush, who are trained and supplied with basic veterinary medicines. Such a program would make veterinary care available to herders living far from veterinary posts, without the need to send veterinary teams into the field. Such an approach has many advantages. It makes possible direct herder participation in the

Previous Page Blank

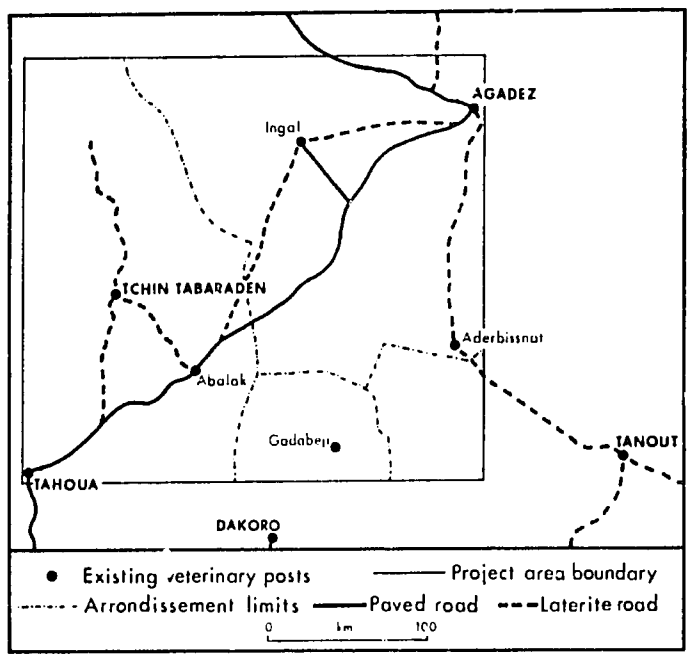


Figure 7.3.1 Veterinary posts in the project zone

activities of the Veterinary Service, and at the same time fosters a sense of involvement among herders regarding these activities. It opens a network of two-way communication between herders and the Veterinary Service, which can be used for outreach programs to introduce new techniques or products, and can provide information, for example, on the progress of an epidemic or the effectiveness of preventive measures. It is a good example of self-help as envisioned by Niger's Development Society program.

The project's experience of training twenty veterinary auxiliaries in Tchin Tabaraden illustrates some problems of this approach and provides leasons for future training programs.

The training program in Tchin Tabaraden

In late April 1981, twenty herders took part in a week-long training program held in Tchin Tabarden. The training followed a field trip by project personnel during which visits were paid to camps in the region in order to inform herders about the paravet training program and to identify trainees.

The 13 Twareg and 7 WoDaaBe herders who participated were chosen by the herder communities contacted, and were all located during the dry season within 60 km of the veterinary posts in Tchin Tabaraden and Abalak. They beonged to different administrative groupements (2, 3, 4, 5, 8 and 9) within the zone and, in the case of the WoDaaBe, to different lineages (Gojanko'en, Jijiiru, N'japto'en).

The following services participated in the paravet training program: the Sub-Prefecture, the Arrondissement Veterinary Service, the Animation and Literacy Services, VETOPHAR, and the NRL Project. Funding was provided by the Arrondissement Veterinary Service and the NRL Project.

Once the paravet has completed the training, he is expected to recognize the most frequent livestock diseases, common parasitic infectiona, appropriate treatments, proper doses of medicine, some nutrition and hygiene, and how to keep simple accounts and a record of activities. Each paravet is given a supply of medicines in an easy-to-carry leather bag as well as a note-book for recording all interventions. The medical kit includes anti-diarrheal sulpha drugs (Veto antidiar, Ganidan), an internal parasiticide (Exhelm 150 and 750), and an external parasiticide (Ectigal). These products are sold to herders with a 5 percent mark-up intended for the paravet himself. He also receives antiseptic solutions (mercurochrome, permanganate, methylene blue) and antibiotic ointments (3 percent Aureomycin, 1 percent ophthalmic Aureomycin), which are provided to users

free of charge and supplied by the project and Livestock Service. The products to be sold are obtained through VETOPHAR in Tahoua and distributed to the paravets upon reimbursement of previous sales.

By the end of their first year, the 20 trained paravets had already received supplies and supervision at the veterinary posts in Tchin Tabaraden and Abalak, directly from the project representative in Abalak, or during field trips by the Veterinary Service and project staff in May, June, and December 1981 and July 1982. A 5-day program of follow-up training took place in Abalak in late July 1982.

Evaluating the program was made difficult by a lack of coordination at the start among the people involved in supervising and supplying the paravets. Nonetheless, the supervisory field trip made in June 1981 gives useful information on the activities of the 16 paravets visited at that time.

- After one month, 3372 animals had been treated, including (in decreasing order of frequency) goats, sheep, followed by donkeys, cattle and camels, an average of 210 animals treated monthly by each paravet.

- The problems treated, in decreasing order of frequency, were sores, diarrhea, external parasites internal parasites, conjunctivitis, and buccal lesions.

- Of 431 herders who asked for treatment, 389 (or 90 percent) said that this was the first time their animals had had a curative treatment.

The results show that the paravets reach herders who do not visit veterinary posts. Thus they play a complementary role, acting as an extension of the veterinary service without competing with it.

LESSONS OF THE PILOT PROGRAM

The number of paravets trained in the Tchin Tabaraden pilot program was too small, and the experiment too recent, to draw any definitive conclusions. However, a number of important lessons were learned which should be applied in future paravet programs.

Definition of a veterinary auxiliary

Veterinary auxiliaries are a novelty in the pastoral zone of Niger and, unsurprisingly, there was some confusion in the minds of the herders, the Veterinary Service and the paravets themselves as to their exact status and role. A definition based on the first year's experience includes the following items:

The paravet is himself a herder, an unpaid volunteer chosen by his community. He does not live on the income from veterinary work; rather, he supports himself through herding. Thus he cannot devote more than a small portion of his time to the veterinary work, and should not be called upon to make frequent visits to distant camps. The paravet works mainly at his camp or at the well where he waters his animals.

The paravet is capable of treating simple livestock diseases. He has at his disposal a limited number of effective medicines. The diseases which the paravet is capable of treating should be chosen with the goal of reducing mortality among classes of animals particularly at risk: young animals and pregnant or lactating females. One of the basic objectives of training paravets is to increase livestock productivity by reducing animal mortality and morbidity.

The paravet promotes prophylactic health care. Examples include the systematic prevention of vitamin A deficiency by giving vitamin A boluses to all calves and pregnant or lactating cows, starting in January; and systematic parasite control at the end of the rainy season (as long as intestinal parasitism is confirmed as a real problem).

The paravet may participate in vaccination campaigns, but his role must be clearly defined. He may encourage other herders to have their animals vaccinated; he may educate them as to the usefulness of the vaccination; but in no case should he be called upon simply for his labor or to require other herders to have their animals vaccinated. The paravet can function as an outreach worker, able to promote new techniques and introduce new products.

The relationship of paravets to the Livestock Service on the one hand and to their own community on the other was inevitably unclear in this first experiment. It is important for the future of the program that this relationship be clarified, or the program will suffer. There was a tendency on the part of some Livestock Service and other arrondissement officials to see the paravets simply as unpaid government auxiliaries, available to help when needed. Herding communities tended to see the paravets as simple dispensers of government medicines. These different visions complicated the task of the paravets, and in particular led to confusion about their responsibilities: were they obliged to go to the arrondissement offices when summoned by an official, were they obliged to treat any herder who asked for help? To avoid this in future, it will be important to specify clearly to all parties that the paravet is a volunteer, responsible in his paravet work to a particular group of herders - his own herder association - and that he is not at the disposal of the Livestock Service, nor is he automatically available to other herders for unreasonable amounts of time. The creation of clearly-defined herder associations, in which several herders are doing equivalent jobs and where an elected president deals with most contacts with government services, will help clarify what can be legitimately asked of paravets.

Choosing the veterinary auxiliary

The choice of a paravet is not easy. In general, the choice properly belongs to the community in question, which best knows the character and skills of candidates. But conditions for choice vary, according to whether the community is largely an unstructured group, not yet clearly identified or precisely located, or rather an established herder association, which has already shown proof of group cohesion, strong motivation and which is used

to dealing with the technical services. The second situation is much the best, since the group is well-known and contact, technical supervision and resupply of the paravet is made easier. Wherever possible, paravets should be selected and trained within a herder association framework. Where this is not possible, and paravets have to be chosen outside herder associations, selection of candidates should be guided by two principles: first, each training cycle should be regionally based, focusing on a limited area around a veterinary post, market or major water point; second, candidates should be chosen from different tribes, lineages and major camps so as to reach a broad selection of the herder populations in the zone.

Outside the herder association framework, identifying and locating herder communities, lineages, and tribes in the zone is difficult. Only the camps of groupement chiefs are well-known and regularly visited by government services. To remedy this, at each veterinary post, a map showing surrounding lineages and tribes, as well as their seasonal movements, should be drawn up with the assistance of the Extension Service. In the interests of equity, precautions should be taken to avoid training paravets only in the camps of important chiefs.

Even when communities are well known, they may remain difficult to locate: people move about, the bush is very large, and camps are widely dispersed. It is important to develop a method for finding and visiting herders at their camps. The project's experience in this respect is described below.

Within a single administratively-defined tribe there are groups of families who live together most of the year. These are the families which benefit most from a paravet, and are also the ones that encourage and motivate him in his work. It is not always easy to identifiy these families, because they may be spread out over an area of several kilometers around the paravet's camp, and not be present when an official makes a brief visit. Yet their role in supporting the paravet is crucial, and from the first contacts about a paravet program they must be invovled and made aware of their reaponsibilities.

Herder associations, which usually formalize the links between these groups of families, offer for this reason a framework which favors the development of a paravet network: in this case the paravet is integrated into a responsible and clearly defined community; and he is in contact with other paravets in neighbouring associations within the Pastoral Community, and with technical personnel at a Pastoral Center.

The training

Objectives

Since the training session is necessarily brief, it is important that objectives be precisely defined, priorities established, and instruction focused accordingly.

Currently the paravet training places too great an emphasis on individual curative care with little impact on animal mortality (such as care of the mouth, treatment of sores). The training curriculum needs to be revised, so that trainee paravets learn more preventive health care at the herd level with the goal of increasing productivity (such as supplements, vitamin A, vaccination). The paravet should also be better trained for the role of outreach worker and promoter of new techniques and products.

Location

Training should be conducted at the veterinary post that will supervise and resupply the paravets once they have started work. In the case of paravets from herder associations, training should be conducted at the Pastoral Center serving that association.

Timing.

Many training programs for primary health care workers in the agricultural zone are carried out in March and April; at this time there is little or no agricultural work for farmers. But for herders, this is the hardest time of year, and the time they are least available; everyone has to be in the camp to do the many jobs needed at that time. For this reason training sessions for herders should be after the rainy season, between November and January, which is a relatively quiet time. Although the

vaccination campaign is carried out then, training could be done just before the campaign, with the advantage of being able to communicate to the herders, through the paravets, the importance of vaccination.

Length of training

For the paravets, 10 days of training is too long. Herders cannot stay away from the camp for a long period because their animals need daily care and attention. The head of the family is the only person who can make important decisions: whether to break camp, whether pasture is sufficient, whether to sell an animal to buy cereals. On the other hand, a week or 10 days is thought by the Livestock Service too short a period to teach many useful skills. It will be necessary in the future to experiment with different forms of compromise. For example, an initial training period of one week might be followed by several two or three day follow-up sessions over the next month or two, timed to coincide with the weekly market at the Veterinary Post or Pastoral Center concerned. Annual back-up courses of a week or 10 days during which the paravet revises what he learned in previous courses and adds one or two new skills, would also help gradually build up knowledge and experience in a cumulative way.

Type of training

The simultaneous training for Twareg and WoDaaBe herders appears not to have posed any particular problems. In Tchin Tabaraden, the training was conducted in Tamasheq, because all the WoDaaBe involved spoke Tamasheq. The instructor was himself Twareg, and well acquainted with the life of herders in the bush, their proverbs, and their language; thus he was able to present material in an appropriate way. In cases where the instructor speaks neither Tamasheq nor Fulfulde, it is essential that he be provided with interpreters fluent in both languages, because Hawsa is not well enough understood by many herders.

A tape recorder would be a useful teaching aid. One possibility would be to record comments from the paravets during evening discussions, or to give the tape recorder to each trainee paravet in turn and ask him to record his impressions or his knowledge of a given subject; the tape could then be played back to the entire group and discussed. An important part of the

training should consist of demonstrations and practical exercises using animals at the veterinary post or, better, herds in the bush.

Some paravets learn the new material more slowly than others. It is important to repeat lessons, and in some cases to ask those who have understood to teach the others.

Instructors

One person should be put in overall charge of training the paravets, to act as coordinator if several instructors are involved in the training (from Animation, Literacy, Training, VETOPHAR). The person in charge should be relieved of all other tasks during the course in order to devote all his time to teaching and coordination.

The technical agent of the veterinary post or Pastoral Center where the paravets will be supervised and resupplied should participate in the training in order to establish direct contact with the paravets. At the moment the instructors have no training in teaching methods. This additional training will become increasingly important as the paravet system becomes more widespread. Future project activities should include training programs for instructors focusing on extension techniques, teaching methods, supply management, the introduction of new methods of animal production, and understanding traditional approaches to herding.

Drugs and equipment.

In order to be effective, the paravet must be provided with adequate drugs and equipment. The choice of drugs issued to paravets needs further thought. Currently the great majority of effective veterinary products (such as antibiotics and vitamins) are in injectable form, but the paravets are not trained to make injections. The best products for use by the paravets would be in tablet form. It will also be important to re-examine to what degree paravets should be trained to inject certain products themselves. Technically this presents few problems.

Simple new techniques, such as oral rehydration of animals suffering from diarrhea by means of sweetened, salted water, can be introduced through the paravets. On the other hand, the usefulness of permanganate and methylene blue, both currently issued to paravets, needs to be evaluated.

Finally, products should be chosen according to their cost-effectiveness. Herders have no pharmacological knowledge and should not have to choose products themselves. Those responsible for selecting products should resist the temptation to promote a new drug which is twice as effective but four times more expensive.

Some simple adaptations are needed to make the paravets' equipment better adapted: the wooden case provided in some training sessions should be replaced with a practical leather bag (one designed and used by the project is shown in figure 7.3.2). Glass bottles should be replaced with plastic flasks, and the quantities and types of medicine carried should be adapted to seasonal needs.

Motivating and supporting the veterinary auxiliary

The motivation of a paravet is different depending on whether he belongs to an unstructured group or a herder association. In the first case, the paravet does the work out of interest and material advantages, as long as these compensate for the extra work and inconvenience. In the second case, the paravet is one of a group of herders who are already motivated and, through the various activities of the association, engaged in a variety of development activities, of which veterinary self-help is but one aspect.

During the Tchin Tabaraden session, it was clear that the paravets were interested in what they were learning and eager to demonstrate their new knowledge. In order to maintain this level of interest, training must continue, for example, during supervision visits. Unfortunately, additional

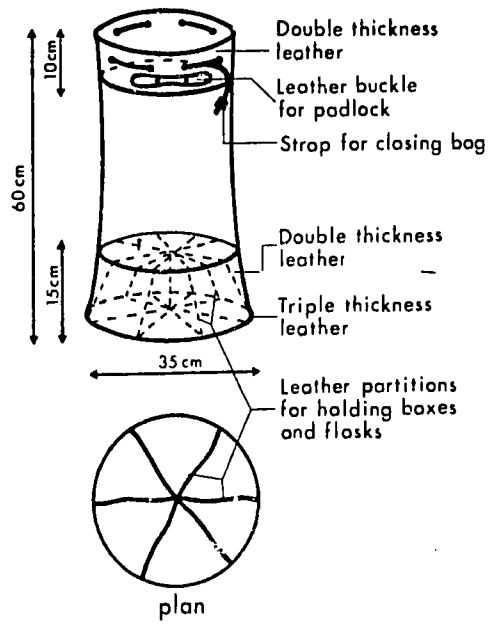


Figure 7.3.2 Leather bag for paravets

training is often not given, and there is likely to be a decline in interest in their work by the paravets. The paravet must feel that he is receiving training and support from his supervisor, as well as a regular resupply with drugs, and easy access to the Livestock Service agent when he visits the veterinary post.

The paravet is likely to incur some expenses (for example travel, lodging) in the course of his work, and if he is not compensated for this he may abandon the work. Probably the small mark-up received on the sale of some medicines barely covers these expenses. The paravets do not expect a salary, but rather recognition of the value of their work and a gesture from the government services as a compensation for their efforts. Better access to OFVN millet would be an appropriate solution in the case of paravets who

do not belong to a herder association, although there is a danger that this encourages the idea that the paravets are a sort of very junior civil servant. In the case of paravets within the herder association framework, the problem does not arise with such urgency, as long as any actual expenses are reimbursed, since several other association members are performing similar tasks, and the association is already benefitting from millet stocks, credit and other programs.

During discussions with paravets in the bush, it was clear that herders benefitting from their work do not reward them, do not give their voluntary work adequate recognition, and view them quite simply as distributors of government-provided medicines. This attitude reveals a lack of participation and sharing responsibilities in the communities to which the paravets belong. In future training programs greater emphasis should be placed on identifying communities genuinely interested in having a paravet, and on actively involving them in the program. This problem can best be solved by training paravets mainly with herder associations, as the program is part of a much broader set of development actions in which all member households are involved, and to which they contribute.

Supervision and resupply

Supervision

The success of the paravet program depends above all on the regularity and quality of supervision and resupply. This is perhaps the most important part of the program. Given the dispersal and mobility of herders and the size of the region, visiting paravets in their camps necessarily entails developing a method of supervision that allows the supervisor to locate and reach the paravets quickly. The fuel and time available for field trips are limited, and it is important to avoid wasting hours searching for the right camp.

There could be two different methods of supervision, one used in the case of unstructured groups of herders, and the other adapted to paravets working in the context of herder associations. The first type depends on establishing contact at the market place. On market day, the supervisor,

who will normally be the veterinary technical agent at the nearest veterinary post or Pastoral Center, gathers news of each paravet by talking to herders from the same groupement, the same lineage, or the same camp. Once he has established the approximate location of the paravets he decides which one he will visit first. He then looks for a herder who lives in the same camp, or nearby, who can serve as a guide. The paravet is warned of the supervisor's visit by herders returning to the camp that same evening.

The following day, the superviaor begins his field trip, accompanied by the guide, starting out early, if possible, in order to reach the camp before the paravet gets out to go to the well, or to pasture his animals. This type of supervision, based on lengthy field trips, is expensive, time-consuming, and exhausting; experience shows that when the supervisor reaches the camp he often does not have the energy to discuss the paravet's problems or to provide additional training. All his time is spent in adding up the treatments recorded in the paravet's notebook and restocking him with medicines.

The second type of supervision is simpler, because it relies on the herder association structure and the many different contacts which the Pastoral Center maintains with each association. The paravet's visits to the Center, and the visits to the paravet by the Center's Livestock Service agent, are easier and more regular. It would be desirable for the paravets from a single Pastoral Community within the same Center to be supervised as a group, rather than individually; this should be very easy to arrange, since geographical proximity is an important criterion for organizing a Pastoral Community.

Monthly supervisory trips are expensive and time-consuming, and it would be better to reduce the frequency to once every three months. To maintain continuity of contact between field trips, a system of supervision at the veterinary post or Pastoral Center needs to be developed. This is not difficult in the project zone. Most herders go to market at least once a month for supplies; paravets are no exception. A paravet could visit the veterinary post when he goes to market, bringing his bag of medicines and his notebook, and be resupplied on the spot. In this way he is not required

to make a special trip, and regular contact between him and his supervisor is maintained. Supervisors need to be taught that when paravets call on them for this purpose, they must be well received and all the time necessary devoted to them. On market day, paravet supervision should be a clearly-understood priority for veterinary agents responsible for the veterinary auxiliary system.

Paravets' movements relative to veterinary posts

Because they are nomadic, paravets are not always close to the same veterinary post. For example, in February a paravet might be closest to Tchin Tabaraden, in May to Abalak, and in September, during the Salt Cure, close to Ingal. But to a certain degree his movements are predictable. The supervision and resupply of the paravets should be organized accordingly. The identification card carried by the paravets is particularly important in this respect when they visit a new veterinary post to be resupplied. Contact among the veterinary agents at different posts is also important for a smoothly functioning supply system.

Occasionally paravets change arrondissement or department, for example in moving from Tchin Tabaraden to Ingal during the rainy season. In such a case it would be useful to alert the veterinary post or Pastoral Center. It is important to have coordination among departmental livestock directorates and among posts located in different arrondissements and departments, as well as to standardize the paravet identification card and the system for supplying medicines.

Resupply

At present the drugs used by the paravets come from three sources: VETOPHAR, the Livestock Service, and ONPPC (National Office for Pharmaceutical and Chemical Products). This variety of sources creates a confusing situation, with no one person in charge of centralizing orders and distribution. It is important to decide who in VETOPHAR, the Livestock Service, or the project will assume this responsibility.

The project could become the sole distributor of products used by paravets within the project zone, as follows. A central stock is delivered to project headquarters in Tahoua through VETOPHAR. A smaller stock of supplies is delivered monthly to each veterinary post responsible for resupplying paravets and to each Pastoral Center. The products delivered by the project are intended solely for paravets. The supplies are managed by the local technical agent (a Livestock Service employee), who is responsible for supervising the paravets, and it is his responsibility to resupply them as well. He keeps separate accounts and enters all medicines received and distributed in a register furnished by the project. Independently, the paravets record in their notebooks all medicines received and distributed, as well as payments for medicines sold to herders. The two separate records allow for regular monitoring and for evaluating the activities of the paravets. An overall record is kept at project headquarters in Tahoua.

Extending the paravet system

Developing veterinary coverage for the entire project zone by means of the paravet network requires infrastructure as well as an organizational strategy for coordinating the activities of the technical services in the program.

Infrastructure

The paravet system must be backed up by an adequate infrastructure. Experience elsewhere shows that the cost-effectiveness of services delivered from fixed points (veterinary posts) is far greater than for services depending entirely on a mobile system. The expansion of an effective paravet system thus means constructing new veterinary posts at Tassara, Tchin Taborak and Amataltal, so that each of the proposed Pastoral Centers will have one. The zone will then have a relatively uniform network of fixed supervision and supply points for the paravets.

Organizational structure

The training program for paravets should gradually extend from post to post or from Pastoral Community to Pastoral Community, until the entire project zone is covered. While each post should initially focus on training herders in its immediate area, it could subsequently train herders who are resupplied at neighboring markets or at major water points. In the case of Abalak, for example, subsequent training could focus on Tofamenir, Chadawanka, or Aburaya as secondary centers, as shown in figure 8.3.3. Once or twice a month the agent from Abalak would visit the marketplace in Tofamenir, for instance, to resupply paravets from the region. Thus the zone will include permanent supply centers, at the veterinary posts, and secondary centers visited regularly by the agent. In cases where the paravets belong to herder associations, the Pastoral Centers constitute the principal supply points.

In the field, the technical agent responsible for the paravets has a crucial role. He is an employee of the arrondissement veterinary service who should receive three months special training, organized by the project and covering the following areas: applied epidemiology; traditional animal husbandry practices; principles and techniques of outreach work; basic accounting and pharmaceutical stock management.

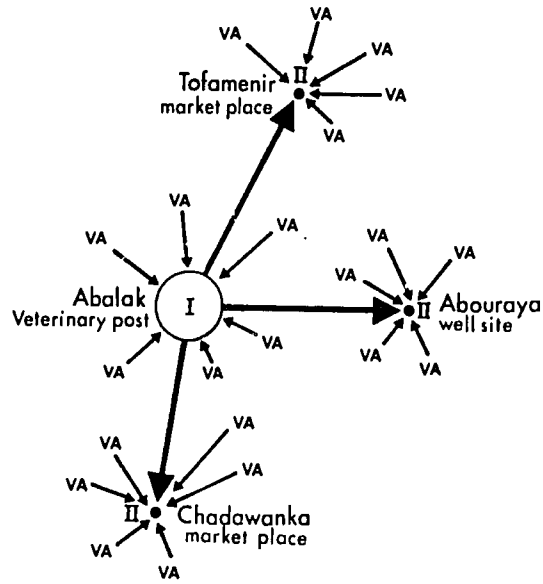


Figure 7.3.3 Relationship of main and secondary supply points for paravets

The agent is based at a veterinary post or Pastoral Center and is responsible for the following activities: coordination between the arrondissement veterinary service and the project in training paravets; supervision and resupply of the paravets assigned to him (between 20 and 40); ensuring proper management and delivery of medicines intended for the paravets. The agent's activities should be supervised by the arrondissement veterinary service in collaboration with the project.

The responsibilities of the services

For the paravet program to function well, it is important to define clearly the responsibilities of the three participating services. These could be outlined as follows:

Livestock Service

1. Trains and employs veterinary post agents.
2. In collaboration with the project and VETOPHAR, trains paravets.
3. Supervises paravets.
4. Resupplies paravets at the veterinary posts and markets.

VETOPHAR

1. Furnishes medicines to project.
2. Participates in training paravets and extension activities to diffuse new techniques and products.

Livestock project

Technical support

1. Responsible for special additional training of veterinary post agents.
2. Tests and develops appropriate methods of instruction, follow-up training, and supervision of paravets.
3. Prepares paravet training manual.
4. Makes annual evaluation of paravet program.
5. Coordinates livestock service and VETOPHAR efforts.

Financial support

6. Constructs new veterinary posts at pastoral centers.
7. Finances training and refresher courses for paravets.
8. Provides vehicles and motorcycles for supervision.

7.4 HUMAN HEALTH

Previous chapters have described herders' health and nutrition and the difficulties in delivering health care to a mobile pastoral population This chapter looks at ways of tackling these problems, mainly by a program of health auxiliariea or paramedics operating through the herders' associations

PRIORITIES IN PRIMARY HEALTH CARE

The conclusions of the project's human health research, described in chapters 4.2 and 6 can be briefly stated:

Herders in the zone have many health needs, but the limited capacity of existing and potential services makes it necessary to establish priorities The general level of health cover is low at preaent in the pastoral zone, so first priority should be given to reducing the prevalence of diseases known to endanger children's lives, diseases affecting the working capacity of adults, and those diseases considered to be important by the herders themselves The priority health problems of children are fever (presumed to be mainly malaria) diarrheas pulmonary diseasea conjunctivitiea and vitamin A deficiency with the addition of gonorrhea for adults. In addition there is a need for simple first aid and for ways of increasing contact between the government health services and the herders in order to facilitate immunization campaigns and the referral and treatment of more serious illnesses.

The mobility and dispersal of herders greatly limits their access to existing medical centers and dispensaries which are all located in towns and villages. However a fully mobile approach to health care delivery to herders - although useful in some cases, such as immunization - is much too costly to develop as the main way of meeting herders' priority health needs. One cost effective way of improving health care at the most basic level is likely to be through a system of health auxiliaries or paramedics, that is, herder

Previous Page Blank

volunteers trained to diagnose and treat the commonest, most important diseases with effective and simply administered medicines.[1] A paramedic system, especially if integrated with existing health care facilities and programs, could substantially improve herders' access to health care.

In Niger's southern farming area, a system of volunteer health auxiliaries and midwives is fairly well developed, and the health service has for some time been eager to extend this approach to the pastoral zone. However, there clearly have to be changes to the program to make it suit the herders' way of life and their health needs. With this in view, pilot paramedic training programs have recently been undertaken at Bermou, Ingal and Tchin Tabaraden to test the viability of auxiliaries in the pastoral zone and to determine what adaptations need to be made. The Tchin Tabaraden experiment is described here, since the NRL project participated in all phases of it; information on the other two programs is available in Loutan (1982d: 44-46).

One modification in the primary health care program which is clearly necessary in the pastoral zone concerns childbirth and infant care. In the farming zone, traditional midwives are given training by dispensary nurses on such subjects as detecting and monitoring pregnancy, and identifying and referring high-risk pregnancies to a clinic; they also advise on hygiene, nutrition, family planning and infertility, and promote health education. In the pastoral zone, however, there are no traditional midwives who can be trained in this way to improve mother and child care, and indeed the midwife system does not seem to be well-suited to the needs of a dispersed and mobile population. A different approach is necessary; proposals for an appropriate pastoral zone childbirth and infant care program are made below.

---

1. The terms paramedic and health auxiliary are used interchangeably in this section.

THE NRL PILOT PARAMEDIC PROGRAM

The NRL training program

At the end of February 1981, 9 health auxiliaries were trained at Tchin Tabaraden by the head of the Medical Center there and the dispensary nurse from Abalak with assistance from NRL. Three of the students were sedentary Twareg agropastoralists living in the bush; the other six, three Twareg and three WoDaaBe, were nomadic herders. The Twareg students spoke Tamasheq and Hawsa; the WoDaaBe spoke these two languages and Fulfulde.[1] Of the nine, only one had been to school and could read and write French. Four of the Twareg were literate in Tifinagh, the Tamasheq script, and the remaining five could neither read nor write. (This low literacy rate was taken into account, and the training, teaching and system for recording consultations were adapted accordingly.) All the trainees were 30 years old or more. They had families and children of working age and were themselves herders. The amount of time they could devote to health care was therefore limited.

Training was carried out at the Medical Center at Tchin Tabaraden and lasted 9 days. The program covered the following main subjects: principlea of nutrition and hygiene; disease transmission; recognition and treatment of common complaints (fever, diarrhoea, cough, conjuntivitis, trauma, wounds); drug dosages; identification of tuberculosis and epidemic diseaaes (measles, whooping cough, meningitis); and the recording of consultations.

Lectures on these subjects were held in the morning, and practical exercises (such as dressing wounds, making splints and bandages) were conducted in the afternoon. Evenings were devoted to discussing and reviewing what had been taught during the day, over traditional tea.

---

1. In this region, Tamasheq is the common language. Hawsa is understood by most herders but is correctly spoken by only a few.

At the end of the course, the Head of the Medical Center organized a visit to the government offices in Tchin Tabaraden (Livestock Service, OPVN, OFEDES, Functional Literacy) and the auxiliaries were introduced to those in charge. Each auxiliary received a card with his name, photo and the name of the dispensary to which he would be attached. They also received a wooden box of drugs in appropriate quantities, and a leather satchel in which they could carry smaller quantities of drugs on trips to wells on visits to more distant camps.

Supervision

Supervision of the paramedics, when they returned to their camps, was carried out by the head of the Tchin Tabaraden Medical Center, a State Nurse. It was clearly necessary to develop a system by which the auxiliaries could be rapidly located and contacted. Both petrol and time for making rounds in the bush are limited and hours cannot be spent searching for the auxiliaries' camps. A plan of supervision based on markets was adopted. On market day, the Head of the Medical Center gets news of the paramedics from herders from the same group of tribes, the same lineage or the same camp. Once each auxiliary has been located, the supervisor decides in which order to visit them and finds a guide (a herder living in the same camp as the auxiliary or nearby) to lead him there. The auxiliary is warned about the visit by herders returning from market the same evening.

The day after market the nurse begins his tour, accompanied by the guide. They leave early in the morning, so as to arrive at the camp before the auxiliary has left to go to the wells or to pasture. At Tchin Tabaraden market day is Sunday, while at Kao it is Tuesday. It is therefore possible for the nurse to visit the paramedics around Tchin Tabaraden on Monday, then go to the market in Kao on Tuesday and finish the round of visits on Wednesday.

Some supervision trips have been carried out differently. Instead of visiting all 9 health auxiliaries in 2 to 3 days of intensive activity, several outings were made over a period of one or two weeks.

Both supervision plans depend on information obtained in the villages, mainly on market day from merchants and visiting herders. It is essential for the nurse to establish a network of informants who can tell him where the auxiliaries are.

On its first tour, the supervision team covered 360 km to visit 9 auxiliaries (or 40 km per auxiliary) and 90 litres of petrol were used. Of the 25 hours spent in the bush, two thirds were spent travelling; only a third of the time was passed with auxiliaries (or one hour per auxiliary).

The second tour, consisting of 5 successive trips during which 8 of the auxiliaries were seen, was made during the rainy season; a total of 520 km were covered (or 65 km per auxiliary) and 130 litres of petrol were used. More than 32 hours were spent in the bush, three-quarters of which was spent travelling. The most "costly" visit took 6.5 hours, including two hours spent digging the vehicle out of the mud. When the team at last reached the camp, the auxiliary had left to find his camel.

These figures give an idea of the time, money and effort involved in visiting the paramedics in their camps. This type of supervision is so exhausting that when the team arrives in the camp no one has the energy to discuss the auxiliary's problems or to give him further training. The hour is spent in counting the consultations recorded in his note-book and in giving him more drugs.

Considering the time and money needed for these monthly tours of supervision, it was decided at a seminar on primary health care in the pastoral zone, organised at Tchin Tabaraden in June 1981 by the Health Service in conjunction with the NRL project, to reduce the frequency of the visits to once every three months. In order to maintain continuity with the auxiliaries between visits to them in the bush, a system of supervision at the dispensary was developed.

In general herders go to market once a month to get supplies, and the health auxiliaries are no exception. If their wooden drug chest is replaced by a convenient leather satchel, the auxiliary, when he goes to market, can

also go to the dispensary with his satchel and notebook and get the drugs he needs. In this way, no extra travel is required and there is regular contact between him and the nurse. This means, of course, that the nurse must be welcoming and set aside time for the auxiliary, who has often travelled 30 or 40 km by camel to see him. At Tchin Tabaraden this system has worked well due to the personal qualities of the nurse.

As the paramedic program expands the problem of transport for nurses making supervision trips in the bush will arise more acutely. It is not realistic to envisage supervision trips in the bush by camel or horse; they are too slow and would be unacceptable to most of the nurses who have no experience of them. Supervision of paramedics needs a vehicle. At present, 5 of the 10 dispensaries in the project area have a Land Rover, with a petrol allocation of 1,000 litres every three months; the allocation of a Medical Center is 1,650 litres. The vehicle is used to fetch supplies for the dispensary, evacuate patients and supervise the health auxiliaries. A disproportionate part of these petrol allocations is spent on evacuating individual patients, which is of limited public health utility.

If public health care is to be developed in the pastoral zone, priorities will have to be established for the use of vehicles, together with stricter control of the petrol allocation. Each dispensary should have a vehicle at its disposal, permanently or periodically for quarterly supervison tours. Motorcyles or light vehicles like the Suzuki jeep might be suitable for this and would be worth trying.

The paramedics at work

The health auxiliaries say that most of their consultations are given early in the morning in their camps. The people come to see the auxiliary as they would the marabout.[1]

---

1. A traditional Muslim practitioner who gives treatment by reciting verses from the Koran and by making charms.

The auxiliary rarely visits patients in their homes. Although he has a satchel, he rarely gives treatment at a well and only in unusual circumstances will he go to a patient's camp (for example for one of his relatives or an important person). The camps may be far from one another and a visit to a patient's home might entail a long journey. As the auxiliary has no transport and no compensation for the time spent, an expansion of his activity in this respect cannot be expected.

The method used in auxiliaries' note books is very simple, each consultation being recorded by a mark in the column below the symbol of the drug given. However this system was obviously difficult for the auxiliaries, given the little training they had received. Recorded consultations between two supervision visits averaged 73 per consultant per day in March and 45 per day in June. Clearly, this is exaggerated. In order to get a better idea, each health auxiliary was asked the number of patients he had seen in the 3 days before the nurse's visit. At the end of March, one month after the training course, each health auxiliary was seeing on average 9 patients a day and at the end of June, 5 a day. Seven auxiliaries recorded in the three preceeding days (i.e. a total of 21 auxiliary-days) that their patients were 26 men, 34 women and 34 children. The origin of the patients was not detailed but the auxiliaries say that they are consulted by herders from a variety of tribes and lineages.

Because of the irregular intervals at which fresh supplies are obtained from dispensaries, the exact rate of use of each drug by the auxiliaries, and in particular seasonal changes in this use, are not known. It would be desirable to develop an accounting system to centralise the data and make it possible for the Head of the Medical Center to forecast accurately each season's needs.

The number of patients referred to the dispensary by the auxiliaries has not been recorded, but it is probably small; herders dislike going to the dispensary and this part of the health auxiliary's work was not given prominance during the first training course.

After more than one year of activity, all nine paramedics were still practising.

PROBLEMS AND PROPOSALS FOR THE FUTURE

The experience at Tchin Tabaraden, as well as the other programs for health auxiliaries shows that the national primary health care program is a feasible enterprise in the pastoral zone. It offers a unique possibility of access to some primary health care at reasonable cost for herders far from villages and towns. However these training programs show the limits of a type of primary health care originally designed for villages, when it is applied to the pastoral zone. These problems are discussed in this section.

Identifying and locating target communities

At present, government social and development services have difficulty identifying the different lineages and tribes of herders living in their region. Only the camps of a few main chiefs are well known and regularly visited. This lack of familiarity with the zone and its inhabitants leads the nurse to choose candidates for training as health auxiliaries only from the camps of important chiefs, or to propose training to the first herder they meet when they go to the bush, or to give up trying to train herders and choose farmers instead.

Even when the herding communities are known, they remain difficult to locate. People move and their camps are scattered in a huge area. A method needs to be developed for finding and visiting herders in their own camps.

These problems become much less important when health auxiliaries are chosen and trained within the context of a herders' association. As described earlier in this chapter, associations are composed of small, closely-knit groups of herding families bound by ties of kinship, geographical proximity and the increasing experience of cooperation in development activities. The association is in regular contact with the main government services, and is well enough known by them for an informed choice of candidate for auxiliary training to be made. In fact, the herders' association framework makes it

possible for the group of people who will mainly benefit from the auxiliary's skill to choose their own candidate; this may be expected greatly to increase community support for the auxiliary once trained. It seems likely on the basis of experience so far that a combination of selecting health auxiliaries mainly through the association framework, and the methods of supervision involving contacts and information gathered at markets outlined earlier in this section, will largely solve the problems of identifying and locating target communities for health auxiliary training.

Receptivity of the herders

On the whole the herders are very receptive to the idea of having a health auxiliary in their community. However, this interest is accompanied by some mistrust, caused perhaps by fear of being drawn into a system alien to their way of life and which escapes their control, fear of working with a government service, or simply fear of the unknown. Often the herders do not make any clear difference between one government service and another, and all are seen as being involved in some way in the collection of taxes especially on animals.[1] The reticence of some people to be trained as auxiliaries may arise from a fear of being different and of being considered by the rest of the community to belong to a government service. Many do not see how they could do the work of a health auxiliary in addition to their herding activities. This is especially true of heads of families whose children are not yet old enough to help them.

Two very devout communities refused to have a health auxiliary, although the members of these tribes frequently use the local dispensary. This suggests that they do not object to modern drugs, but that the presence of a health auxiliary is perhaps perceived as a form of undesirable dependence on a government service; alternatively that the auxiliary is seen as a competitor with the traditional healing practices of the marabout. It will be interesting to see if, having observed the work of other health auxiliaries, these communities will eventually want an auxiliary of their own.

---

1. The animal tax has been abolished since the drought of 1973.

Some herders however realise immediately the potential value of being a health auxiliary, or of having one in their group. Being an auxiliary may be an opportunity for social advancement or of consolidating an existing position. This is reflected in the high proportion of auxiliaries at the Tchin Tabaraden training session who were related to tribal chiefs (4 out of 9 trainees).

It has proved impossible so far to train women as health auxiliaries, given the subordinated position of women in the herding societies concerned. A possible course of action worth trying in the future in some groups (WoDaaBe and some Twareg) would be to train husband and wife couples as paramedics, since occssionally wives seem to stand in for their paramedic husbands when the latter are absent.

At present no financial or other kind of participation is asked of the communities as a sign of their interest in health care. The community might in the future be asked to pay for the satchel used by the auxiliary.

Objectives of the training program

In the agricultural zone (Niger 1980), health auxiliaries are trained to:

- Treat common diseases and everyday accidents,
- Improve hygiene,
- Advise on nutrition, well maintenance, and the treatment and conservation of water,
- Teach people about health,
- Liaise between village and health service, and
- Manage a stock of drugs and other products.

This programme is ambitious and the students cannot adequately cover it in a week, especially since the nurse has not been trained in teaching methods. In the pastoral zone it would be wise to limit the scope of the training program to more attainable objectives.

When the herders are asked what they expect from a health auxiliary, they reply: treatment when we are ill. This is understandable, for they are far from dispensaries and have little access to drugs.

This demand should be met by training the paramedics to deal mainly with the following priority health problems:

- fever (presumed to be malaria)
- diarrheas
- respiratory problems
- rheumatic pains
- conjunctivitis
- Vitamin A deficiency
- wounds and sores
- gonorrhea

Respiratory problems are one of the most important causes of work incapacity, especially in the cold season. At present the paramedic has no drugs against these diseases and no training on preventive measures especially for children. A simple treatment plan could allow the health auxiliary to distinguish between an ordinary dry cough needing treatment of symptoms, and a cough with fever, yellow expectoration and intercostal pain, requiring the oral administration of an antibiotic (penicillin or ampicillin). The same applies to gonorrhea which is considered a priority health problem by the WoDaaBe and which may lead to serious complications when inadequately treated, as is often the case in the pastoral zone. The health auxiliaries should be taught to treat both partners with a strong oral dose of chloramphenicol or ampicillin.

In developing primary health care in the pastoral zone, it is important to give the health auxiliary as much autonomy as possible, for in view of the

distances involved, he cannot continually consult the nurse and get fresh supplies from him. The dispersal of the pastoral population also makes it important to supply the auxiliary with enough drugs to treat a range of illnesses without having to refer the patient to the dispensary, which is often too far for the patient to visit. Herders are however willing to travel quite far to see the health auxiliary if they know that he has effective drugs. The large seasonal changes in disease incidence also make it important to adapt the paramedic's drugs and guide his activities towards the diseases most important in each season, such as coughs in the cold season, and fever during the rains.

The task of the auxiliary consists mainly in curative treatment and health education. To bring about major changes in herders' habits in hygiene and nutrition is beyond the ability and competence of an auxiliary, particularly since no realistic alternatives to present practices may exist. But the paramedic should also be a health educator who teaches other herders first aid, how to use common drugs, who encourages them to get vaccinated and to visit the dispensary for problems he himself cannot handle.

Training

Training courses in the farming zone are normally held at a Medical Center. However, in the pastoral zone Medical Centers can be far from the dispensary to which the health auxiliaries are attached: in the project area the average distance between dispensaries and their Medical Center is 105 km. For this reason it would be better for pastoral auxiliary training courses to be held at the dispensary to which the auxiliaries will be attached, as was the case of the Ingal training program.

Most sedentary zone training courses are held in March or April, when farmers have little agricultural work. For herders, however, this is the busiest time of year, and few people can easily leave their camp then. It would be better to hold the pastoral zone training courses after the rainy season, between November and January.

For the student auxiliaries, 10-day training sessions are too long. Herders, whose animals need daily care, cannot easily leave their camp for such long periods. Herders also do not like to stay for long in villages, where they feel strangers, and the prospect of spending 10 days in a village causes some apprehension. Sometimes the need for training is not understood by the auxiliary's family and friends and they try to discourage him.[1]

For the dispensary nurse, however, a 10-day training session is too short. If the quality of training is to improve and if the auxiliaries are to manage drugs such as antibiotics, the course should be lengthened to two weeks; each year there should also be a week of refresher courses and learning new skills.

One possible way to resolve these conflicting demands would be to hold a 14 or 15 day couse, not all at once, but rather in several periods of two or three days, spread over a month or more, and coinciding perhaps with the weekly market at the dispensary village.

In the training programs so far undertaken, the simultaneous training of Twareg and WoDaaBe herders did not seem to create any special problems. At Tchin Tabaraden, the language used was Tamasheq. The nurse in charge of the training was a Twareg familiar with the life of the herders in the bush and with their proverbs; he could therefore teach in a way that the herders readily understood.

However this will often not be the case in the future. Many Twareg herders speak some Hawsa, and some speak it well enough for training to take place in that language. But in most cases this is not so. Wherever possible training should be carried out in Tamasheq for Twareg paramedics, and where this is impossible through a Hawsa-Tamasheq interpreter who is completely

---

1. During the Tchin Tabaraden course the wife of one of the auxiliaries returned to her parents' camp, signifying that she had abandoned her husband, because she was sure that he had left her.

fluent in both languages. For the WoDaaBe there is little chance of finding nurses fluent in Fulfulde; the decision on the language of training courses for WoDaaBe will have to be taken on local criteria: in Tamasheq or Hawsa where the WoDaaBe student paramedics speak these languages well enough, and through a Hawsa-Fulfulde or Tamasheq-Fulfulde interpreter where they do not. One important task of the next few years will be to find and train a small group of excellent interpreters into Fulfulde for paramedic and other training programs within the herders' associations.

Teaching should be kept simple. In the bush, news is transmitted orally and not by pictures or texts. Teaching should be based mainly on discussion, not on pictures, posters or other visual aids. No special teaching materials are required, although tape recorders can be helpful, by recording group discussions among the students and later reviewing important points.

Evening sessions spent going over the day's lessons while drinking tea are an ideal setting for discussing and completing the teaching; herders often spend their evenings in this way, and are more at ease in such a setting than in a classroom.

Teachers

The head of the Medical Center is in charge of paramedic training. This is in addition to his normal duties of administering the dispensaries in his district and of providing health care at the Medical Center. At the Tchin Tabaraden paramedic training couse, the head of the Medical Center was helped by a Twareg nurse, who was freed of all other tasks during the course and was able to devote himself entirely to the students. This was a great advantage. In further courses, the nurse responsible for training should have no other duties during that period, and should be with the students at all times, including especially the evening.

Nurses have no teacher training and could profit from a knowledge of some elementary teaching techniques. Before the paramedic training, each year, the nurses themselves should follow a course on teaching methods, particularly adapted to bridging the gap between the nurses' own experience and the life of the pastoral zone.

Movements of the paramedics

One of the main advantages of nomadic paramedics is that they move with their own camps and kin groups, and are thus always available. But this also causes problems for supervision and the supply of drugs. To illustrate this, figure 7.4.1 shows the movements of the 9 health auxiliaries trained at Tchin Tabaraden between March and September 1981, that is, at the end of the dry season and during the main part of the rains.

In February and March the paramedics moved relatively little, but between March and June, their positions changed substantially as a result of movements at the end of the dry season and the start of the rains when many wells are dry and pasture scarcity is relieved by scattered storms. During the rainy season they moved more often and farther. However, the map is not representative of the usual movements of three of the Twareg paramedics (D,F,I) who normally go to Ingal during the rainy season. In 1981 rains and pasture were scarce at Ingal so the herders remained around Tchin Tabaraden.

These maps also show that the dispensary closest to the health auxiliary may change. For example, the auxiliary E who had depended on Tchin Tabaraden in March, moved closer to Kao in June and therefore used the Kao dispensary. By September, A, D and E had moved back north and were using Tchin Tabaraden. The movements can to a certain extent be predicted, and supervision and supply of the auxiliaries should be adjusted accordingly. The paramedic's card is important for identification when he visits a new dispensary for supplies. Contacts between nurses at different dispensaries are also useful to ensure a smooth supply system. Sometimes paramedics change arrondissement or departments, going for example from Tchin Tabaraden to Ingal during the rainy season. Such movements emphasise the importance of coordination between the departmental health directors and their subordinates, of issuing an identification card to all paramedics and of standardising the drug supply system.

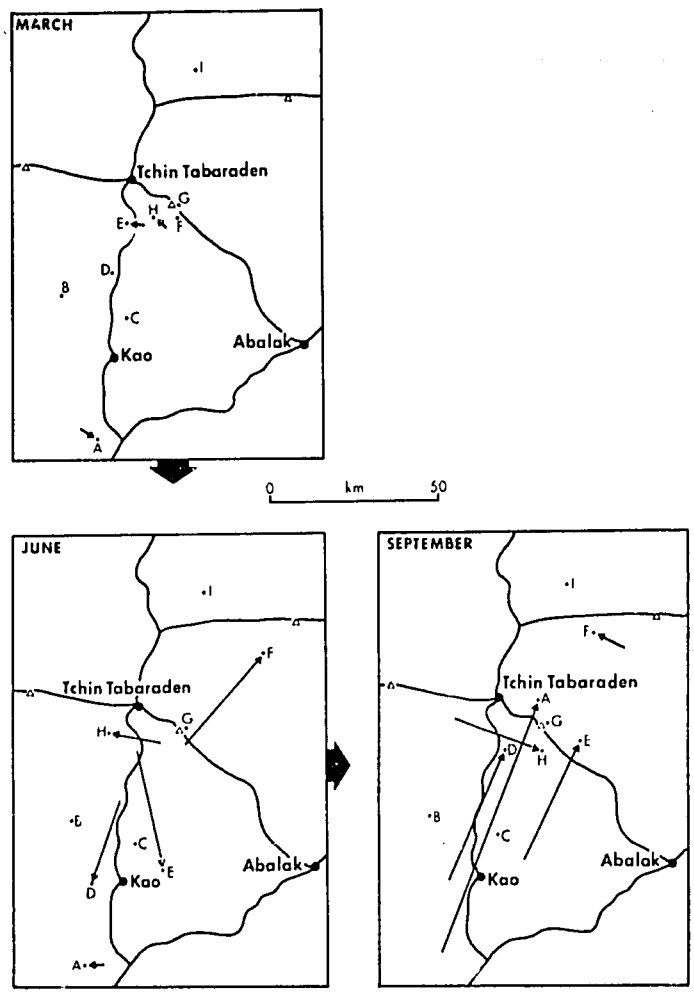


Figure 7.4.1 Movements of nine herder paramedics, Tchin Tabaraden area, late dry and rainy seasons 1981.

Arrows show movements of their camps since the previous supervision visit to them. There is little movement during the dry season, dispersed movement in several directions at the start of the rains in June, depending where early storms occur, and a concentration and more concerted movement to the north east during the rains.

Drug supplies

Dispensaries are supplied with drugs twice a year. At the arrondissement level the head of the Medical Center lists the needs of his dispensaries and sends to the departmental health director (DDS) an order for drugs for the next six months. The DDS countersigns the order and forwards it to the Ministry of Health in Niamey, which groups the orders from all the departments and sends them to the ONPPC.[1] The drugs are sent out to the different departmental health services which distribute them to the Medical Centers. This process seems to work well. In the pastoral zone, dispensaries are regularly supplied with drugs and are rarely out of stock, although quantities are limited and have to be carefully managed by the nurse. The dispensaries do not pay for the drugs delivered to them.

In the villages, health auxiliaries get their drugs either from the dispensary or from a "People's Pharmacy" which are located in the larger towns. They buy the drugs with the money received from their previous drug sales.

In the pastoral zone, drugs are distributed free of charge to the health auxiliary by the dispensary, where a stock is specially reserved for auxiliaries by the nurse. This is kept separate from the main dispensary.

Drug provisioning is made more complicated in the pastoral zone by the movements of the paramedics, and a paramedic who goes to a new dispensary may sometimes find that there are no drugs available for him. At each dispensary there should be a reserve stock set aside for unplanned visits by auxiliaries; alternately a reserve could be kept at the Medical Center for dispensaries whose stocks run low because of unexpected demands by visiting nomad paramedics. The organisation of such reserve stocks is particularly important at Ingal where herders from all over the zone converge during the rainy season for the salt cure.

---

1. ONPPC: Office national des Produits pharmaceutiques et chimiques (National Office of Pharmaceutical and Chemical Products.

As paramedics may get drugs from different dispensaries or directly from the nurse when he visits them in the bush, a central accounting system should be set up at Medical Center level to control and measure the use of different drugs by auxiliaries. Each dispensary should record both in its account book and in the auxiliary's notebook the type and quantity distributed. This double entry would limit embezzlement and make it possible to estimate the needs of each auxiliary in each season.

Health auxiliaries in the agricultural zone sell drugs at cost plus a small mark-up but in the pastoral zone herders do not pay for the drugs they get from the auxiliaries. This encourages extravagant and irresponsible use of drugs. Drugs should be sold by the paramedics at a moderate price, as in villages. This change would have to be accompanied by the same policy at the dispensaries, which now give out free drugs. If drugs are free at the dispensary but have to be bought from the paramedic, the latter is at a disadvantage. Such a situation would penalise people living far from dispensaries: not only is it hard for them to get to the dispensary but they would also have to buy their drugs from the health auxiliary. A policy decision to make all drugs payable at cost would encourage the development of self-management in health and would reduce recurrrent costs in the primary health care program.

Motivation and recognition of paramedics

Health auxiliaries are volunteers who receive no salary for their work, which is additional to their normal employment as herders or farmers. Their motivation is important since it will in the long run determine whether or not auxiliaries continue to work once the first excitement has worn off.

During training, the auxiliaries take great interest in what they are learning, and they are clearly enthusiastic about practising their skills when they return to their camps. But the position of a paramedic makes demands on a person's time which can become substantial, and there may be other problems: for example, people who come from far away to consult them may expect the hospitality due under traditional rules to a guest, or the authorities may expect the paramedic to help at short notice in a government activity. The

volunteer auxiliary may soon find his interest in his work dwindling as the demands on his time increase.

There are two types of incentive - material and non-material - which can reduce the danger of this. Paramedics could be given material incentives, such as a small mark-up on all drugs sold, as in the case of the farming zone, or, as happened with the herder auxiliaries trained at Ingal, they could be given privileged access to OPVN millet stores as if they were civil servants.[1] But these courses of action create problems of their own. Auxiliaries who benefit from a mark-up may overprescribe drugs or embezzle cash. More subtly, treating auxiliaries as junior civil servants, will reinforce the impression that paramedic training is indeed a stepping stone to the lowest ranks of the civil service itself. This second danger is part of a wider problem, arising with auxiliaries of all kinds, of defining the position of auxiliaries in relation both to government services and to the herders, and is dealt with in greater detail in the chapter of this report evaluating herders' associations.

Non-material incentives include measures that increase the paramedics' feeling that they have acquired useful skills valued by their community, and that those skills are being continually improved and exercised. Revision and upgrading courses, and supervision which includes teaching new skills, play key roles in this, putting a very great responsibility on the trainers and supervisors. The paramedic must feel that he has the support and guidance of the nurse, that the nurse is available whenever he visits the dispensary and that his contribution is valued by the health authorities. Minor irritants must be eliminated: drugs must be regularly delivered, the paramedics' kit must be designed with convenience and durability in mind, and seasonal supplies of drugs must be arranged so that auxiliaries do not have to carry large stocks around with them at a time when they are of no use. Figure 8.3.2 (in the previous chapter) showed the leather satchel designed and manufactured by the project for the paravets, which proved to be convenient and popular, and could equally be used by the paramedics.

---

1. On the administrative fiction that they were dispensary staff.

The professional reward-systems in other societies include many non-material rewards such as diplomas or medals, travel in order to discuss common problems with other people in the same profession, and the chance to meet decision-makers at occasions which give the professional a chance to influence policy in their field. There seems no reason why some of these rewards should not work in the case of the paramedics. Clearly some experimentation is needed.

However, potentially the most important way of keeping up the paramedics' enthusiasm, as well as solving the difficult problem of their relationship with government on one hand and herders on the other, is to ensure a close integration of the paramedics and other auxiliaries into the herders' association structure. In this case the paramedic is one person among several in the association doing a job; he can no longer feel that he is carrying an unfair burden in comparison with other members, or that he is simply on the lowest step of a government service hierarchy hoping for promotion to a paid job in due course. Other association members then also see him not as a simple distributor of drugs he has received from the government, but as a working member, like any other, of a joint enterprise to which all are contributing.

Relations between paramedics and traditional practitioners

When a herder falls ill he treats himself with plants whose beneficial effects he knows. Each herder is familiar with an extensive pharmacopoeia, and some are very knowledgeable in a particular field: for example, one person may specialise in cures for eye diseases, another in atomach illnesses. Herders can consult a practitioner specialised in their illness.

Only when plants have failed do herders go to the dispensary or to a marabout. The marabout is generally consulted for diseases where a supernatural cause is suspected, for chronic diseases where all other treatments have failed, or for illnesses whose context suggests that someone wishes you evil. When a herder consults a marabout, he expects him to act on the forces at the root of his illness.

Dispensaries and modern drugs have no magic power. Herders seek treatment at the dispensary for ordinary illness or where the nurse is known to have an effective cure such as an injection of penicillin for urethritis or an aspirin for headaches. For herders, the health auxiliary belongs to this same category of healers. He does not compete with the marabout since he is consulted for different reasons. It is also probable that the marabouts will not want to become health auxiliaries because they would then occupy a junior position in a hierarchical system over which they would have no control. The marabouts are greatly esteemed in the bush and are obviously keen to keep their priviledged status.

On the other hand traditional specialists in plant medicines may be good candidates for paramedic training. It would in any case be a good idea to suggest to herders' associations the possibility of selecting traditional practitioners or marabouts when students for paramedic training are being chosen, both so as to show respect for their skills, and also so as not to set them against public health; even if they do not want to become paramedics it may be possible to obtain their support for the program.

CHILDBIRTH AND INFANT CARE

A second component of the national primary health care program concerns improvements in childbirth and infant care. The NRL made no experiments in this, but some guidelines emerge from the general experience of health activities in the pastoral zone.

As mentioned above, many women in the pastoral zone go to market only rarely, and thus are even less likely than men to go to the dispensary.[1] Childbirth and infant care are priority health questions, but there are no traditional midwives in Twareg or WoDaaBe society. At her first pregnancy a woman leaves her husband's camp and returns to her family, where she gives birth, assisted by her mother or sisters. Later pregnancies generally take place in the husband's camp, although the woman often returns to her mother. In some large Twareg camps, experienced women help with deliveries, but as a general rule there are no birth attendants. In fact, after one or two deliveries, at which they are helped by their mothers, women in the pastoral

1. This is less true of WoDaaBe than of Twareg.

zone quite often give birth without any assistance at all. This independence is understandable in societies where camps rarely contain more than a few families, so that it would be ill-advised to be dependent on the knowledge of a handful of women experts who are unlikely to be present at the moment of birth. There is also considerable resistance in many of the herding societies in the zone, in which women occupy a clearly subordinate position, to singling out particular women for training as auxiliaries, with the absences from the camp and the responsibilities this would entail. For these reasons, it seems preferable that a pastoral zone childbirth and infant care program should aim to diffuse knowledge and skills to the female population in general, rather than working through auxiliaries.

Objectives and scope

A childbirth and infant care component of a pastoral primary health care program should have the following priorities: to improve hygiene at childbirth; to improve infant health care; to reduce nutritional stress on children at the end of the dry season and during the transition between dry season and rains; and selected other topics judged important by the women concerned.

Teaching should take place, at least at first, at discussion meetings attended by all the adult women of an association, and should be organised and led by a woman nurse or teacher with special training. Such meetings should concentrate on a single topic identified by the women concerned as of major importance, such as hygiene during childbirth. The various aspects of childbirth would be discussed, including personal hygiene, the importance of breathing, pushing to synchronise with contractions, cutting and disinfecting the umbilical cord, the cleanliness of the place where the mother gives birth, use of a clean mat, observing the placenta after delivery of the child, and washing the mother and infant. The approach should always be based on traditional practices, reinforcing positive things and suggesting alternatives to those which are unsuitable. The key to success in a program of this kind

is winning the confidence of the women, and this is achieved by recognising the rationality of many current practices.

For example, the diet of the pregnant woman is considered very important in Twareg society. The greater part of what is traditionally recommended has some justification and can serve as the basis for discussions aimed at a better understanding of the nutritive value of various foods and for promoting alternative balanced foods, for instance when the supply of milk runs out.

Women in the zone have their own views about priority health issues and where possible these should be addressed. A good example is infertility, a serious problem in some pastoral societies. Fertility in these societies appears to be lower than that in sedentary populations, but the causes of this are not understood. It may be that social factors, such as prolonged post-natal abstinence, play an important role, although some diseases (gonorrhoea, syphilis, tuberculosis, rickettsiosis, toxoplasmosis) may also cause secondary sterility or miscarriages. Childlessness is seen as a great misfortune, and is often a cause of divorce. Women therefore put this problem high on their list of priorities. It would be useful during the training sessions to describe some of the potential causes of infertility, and encourage women whose husbands suffer from urethritis to be treated at the nearest dispensary.

Training and support

Ideally a women's health program of this kind should be administered by female nurses who speak the language concerned fluently. But there are very few such people. At the beginning therefore, the (probably male) nurse in charge of paramedics at each dispensary should be made responsible for the program. Since women interpreters are not normally available either, the nurse should be assisted by a male interpreter, and, if possible, by a woman instructor ("animatrice") from the health education service. The lack of women able to speak local languages is clearly a major problem. It is important that the few nurses who speak Tamasheq or Fulfulde are assigned to the pastoral zone, and that intermediaries or "relay-women", able to speak both a local language and Hawsa, are identified early in the program and

trained to provide an acceptable channel of communication between nurses and herders.

Training should take place in a season when women have time to spare, for instance in the period between the rainy and cold seasons. The training should take the form of meetings of all the women of one association, and be repeated at intervals of one or two weeks over a long enough period to ensure that the chosen theme has been completely mastered. It is not advisable to teach Twareg and WoDaaBe women together at the outset.

The women should have some medicines, such as chloroquine for new-born infants and pregnant women during the rainy season, mercurochrome to disinfect the umbilical cord, ferrous sulphate if anaemia is found to be common in women with several children. These can be distributed by the health auxiliary, or better, at the time of the women's training meetings directly from the nurse to the women concerned.

CHAPTER 8 PASTORAL DEVELOPMENT STRATEGY OBJECTIVES

This chapter summarizes the major objectives of the proposed pastoral zone development strategy. Two categories of objectives are distinguished: primary objectives, which are those arising from the principle that development serves human needs and must therefore be defined in terms of human objectives; and intermediary objectives, which include the main technical sector goals, such as sound range management or improved animal health, by which the primary objectives can be attained.

These primary and intermediary objectives are listed in an approximate hierarchy of importance: where two objectives compete or are mutually contradictory, the one higher in the hierarchy has precedence. In this chapter attention is focused mainly on the primary objectives of the proposed pastoral zone development strategy, on the grounds that an unequivocal statement of aims must guide development policies and actions if they are to be effective. Intermediary objectives are discussed more briefly; they are considered in greater detail in the appropriate technical chapters of the report.

These objectives have been constructed from several main sources, principally the Five Year Plan, and related national policy and planning documents, from extensive discussions with national, departmental, arrondissement and poste level officials, from the conclusions of project research, and from a systematic effort by the project to consult herders about their own objectives and needs. This discussion of objectives seeks to put into concrete planning terms, appropriate to the pastoral zone, the major national policies that already guide rural development.

These objectives may be summarised as follows:

Primary Objectives

1. Improve self-reliance in the pastoral economy
   - 1.1 Improve pastoral zone food production and distribution
   - 1.2 Assure food security in case of drought
   - 1.3 Make possible increased, better distributed incomes.

2. Improve self-management by pastoral zone inhabitants
   2.1 Improve herders' ability to organise to take in hand their own development
   2.2 Improve human health
   2.3 Improve education and training
   2.4 Improve herders' ability to manage natural resources
   2.5 Improve the ability of the rural economy to finance its own development.

3. Increase the contribution of the pastoral sector to the national economy
   3.1 Improve the supply of animals from the pastoral zone for fattening, traction, export and urban consumption
   3.2 Increase government revenues from the livestock sector.

Intermediary Objectives

4. Raise the productivity of herding
   4.1 Improve animal health
   4.2 Improve animal management and nutrition.

5. Manage the range.

6. Manage water.

PRIMARY OBJECTIVES

Primary objectives are defined in terms of three priority objectives specified in the Five Year Plan: self-reliance, the participatory "self-management" structures of the Development Society, and economic independence (Plan quinquennal 1980: 82).

Improve self-reliance in the pastoral economy

Improve pastoral zone food production and distribution

Staple food production in Niger is variable and food security precarious. Despite considerable efforts, Niger is not exempt from general African trends of declining per capita and per hectare agricultural production, declining overall food production, and an increasing danger of dependence on international trade and aid for basic foods. The relatively small farm cereal surplus is channelled in priority to urban consumers. Pastoralists rely on exchange of animals and animal products for their essential food grains, and are thus especially susceptible to cereal price variations. Project research has shown important seasonal shortages in the food supply of poor pastoral households, resulting in impaired nutritional status of adults and children.

The ability of the pastoral economy to meet the minimum food requirements of its members depends on the size and distribution between households of herds and flocks, on their productivity, and on the relative prices at which pastoralists exchange their products for the major consumption goods they need, especially cereals, cloth and manufactured inputs to herding. The data suggest that a significant number of pastoral households do not own a viable minimum herd, that productivity in the pastoral economy is low and variable as a result of animal disease and seasonally variable nutritional status resulting from feed shortages, and that although the general trend in prices is not unfavourable to pastoralists, terms of trade vary widely, causing hardship to pastoral producers.

A pastoral development strategy must act on these three main determinants of pastoral food production and distribution, by guaranteeing the minimum herd capital necessary for production, by improving herd productivity, and by improving or at least reducing as far as possible the uncertainties of terms of trade variability for pastoral producers.

Assure food security in case of drought

Because of their dependence on market or barter exchange for a significant part of their basic food supply (cereals obtained through exchange account for probably between half and three quarters of pastoralists' food intake in the zone), herders are particularly vulnerable to disruptions in the exchange mechanism, whether this is caused by shortages in cereal or animal supply or by changes in relative prices. In years of exceptional hardship, caused most often by drought but potentially resulting from any major disruption of rural production or distribution, the terms of trade between the products of the pastoral economy and those things pastoralists need to buy from other economic sectors may change dramatically enough to threaten pastoral livelihoods and lives. When this happens, as it did in 1973 and will do again in the future, pastoralists face different problems from farmers: because of their lack of cereal stocks in household granaries, pastoralists face food shortages earlier and more seriously than farmers; in years of bad harvests the price of animals falls sharply, diminishing herders' purchasing power; the scattered distribution of pastoralists and communications problems in the pastoral zone make information about the situation, and administration and transport of emergency aid, harder: and pastoralists who have lost or been forced to sell their animals are without the capital necessary for rapid economic recovery afterwards. As a result, food security and anti-drought measures must be specifically adapted to the pastoral zone.

A pastoral zone development strategy should provide a food supply monitoring mechanism able to give warning to government and to herders of an impending food crisis sufficiently early for action to be taken; should organise in advance of such events cereal security stocks in appropriate locations in order to maintain minimum food supplies through an emergency period; should put in place infrastructure and policies which encourage orderly destocking at reasonable prices when the pasture resources of the zone become massively insufficient; should provide an effective mechanism for timely monitoring of the situation, especially as regards human nutrition, emergency actions to be taken, identifying target areas and populations for special action, and evaluating the success of interventions; and should facilitate and guide the timely and orderly reconstruction of pastoral herds after the end of the emergency.

Make possible increased, better distributed incomes

The pastoral zone provides a livelihood for a significant number of people: Niger's nomadic population, dependent exclusively on livestock, was estimated in 1977 at 740,000, or 15 per cent of the national population, and an unknown but considerably larger population of agropastoralists also live and work in the zone. With the recent fall in uranium demand and prices, which is likely to continue at least in the medium term, the rapidly approaching saturation of a small agricultural zone in the south of the country, and discouraging prospects in the industrial and service sectors, livestock provides an increasingly important economic activity and a source of employment which must be maintained and developed if greater national unemployment is not to result. Declining employment, increasing polarisation of incomes and increasing poverty in the pastoral aector will exacerbate problems in other economic sectors.

Changes in the structure of resource distribution and ownership in the pastoral zone, intensified especially since the drought of the early 1970s, are increasingly jeopardising the number of viable jobs in the pastoral sector, and are leading to increasingly unequal distribution of wealth and incomes there. The capacity of the pastoral zone to support at least a portion of the increased population growth there in the medium term, and to fulfil its essential role in the national economy are being undermined.

A pastoral zone development strategy should reverse these trends by providing the necessary conditions for secure jobs, and increased and better distributed income, in the pastoral economy. The essential elements are: a herd reconstitution program focused on the poorest households and acting eventually as a permanent insurance mechanism ensuring that households which lose productive capital are able to regain the status of autonomous productive units; a pastoral credit program enabling households to make productive investments both in inputs such as collectively-owned wells, and in working capital such as steers for growing out; the creation of new possibilities for productive employment, such as artisan work or haymaking; the possibility of short-term credits to allow households to avoid distress sales of animal capital, which reduce the long-term viability of the

production unit. Particular attention should be paid in implementing such policies to the situation of poorer households or of special groups such as women or former servile groups, whose situation may be more adversely affected than the average by the changes now under way.

Improve self-management by pastoral zone inhabitants

Niger's development policies give an important place to the increased participation of rural, including pastoral zone, inhabitants in national life and decision-making, including the increased availability of basic services paid for and managed by rural people, and increased security of tenure over the main productive resources. National policy recognises that the leading role hitherto played by the state in all service and development sectors will have to be reduced, and encourages rural populations to organise themselves to take increasing responsibilities in this respect. The problems of implementing this in the pastoral zone are different but no less great than in the agricultural zone.

Improve herder's ability to organise to take in hand their own development

The traditional social, economic and political structures of pastoral zone societies have long ago lost the power to regulate or organise pastoral life in a meaningful or development-oriented way, and the state has substituted for some of their previous functions. However, the small amount of resources at its disposal and the lack of experience from elsewhere of how to administer pastoral development, means that the state machinery is unable to operate as efficiently as it would like. It is unrealistic in a time of falling state revenues to expect the government to be able to define and administer a pastoral development strategy with the detail and flexibility made necessary by the specific conditions of the pastoral zone.

To be successful, the pastoral development strategy outlined here should be implemented through an administrative structure in which the state progressively devolves some of its powers to local herders' organisations. The principle underlying such organisations is that of the maximum feasible participation by all categories of land-users in the decisions and plans

which affect their well-being; the justification is that herders have as much right as other people to participate in the decisions that affect their livelihood, and also that actions decided upon and administered in this way will be more efficient in the long term since the people concerned will put their whole weight behind the things they have themselves decided and are responsible for implementing.

National policy, as expressed in the concept of the Development Society, fully recognises the importance of these issues, and in particular the need for new institutional structures in the pastoral zone. These will have to undertake two tasks; on the one hand to provide an appropriate organisational vehicle through which national technical services can interact with clearly defined and responsible herding populations; on the other hand to provide a representative organisation which can improve herders' ability to define their own interests, and defend them in the national planning process. An organisation which meets these two tasks will provide a new and appropriate development administration at the lowest level, capable of carrying out more efficiently the tasks of resource management and service provision.[1] Through such a structure, herders can participate more actively in making and implementing decisions about development, will increasingly manage their own development programmes and services, and will also be able to evaluate the impact of such actions with a view to changing priorities, methods and directions if necessary.

A pastoral development strategy should meet these requirements by setting up, at the lowest level, associations of herders small enough to have real cohesion and unity of purpose and action. Such associations should be made progressively responsible, after appropriate training and in liaison with government services, for starting and managing the main development and service programmes undertaken as part of the pastoral development strategy. Such associations should meet the criteria, and pursue the objectives, outlined earlier in this section.

---

1. Plan quinquennal 1980: 94

Herders' associations should be small enough to be relatively homogenous in terms of ethnic composition, wealth, social position and production strategies. At a higher level, groups of associations should combine into larger scale Pastoral Communities which reflect the regional diversity of herder populations and economic systems. These Pastoral Communities should in the medium-term have a coordinating, not a decision-making role, with a view to evolving in the long term into the main forum through which resource use and management, service programmes, choice of development priorities and herders' participation in development planning are mediated.

This two-tier organisation of herders' association and pastoral community should become the partner with which government services deal, and to which they progressively devolve an increasing share of their activities.

Improve human health

Human health is considered an essential right of all citizens, and health care is supposed to be a constituent of all development projects.[1] The pastoral zone shares some health problems with the agricultural zone, while others are unique.

The major epidemic diseases affect herders, and immunization is difficult because they are scattered and mobile. There are seasonal variations in important diseases: malaria is especially important in the rains, respiratory infection in the cold season, and diarrheas, skin diseases and conjunctivitis in the hot season. Diseases resulting from close contact with animals, such as brucellosis, tuberculosis and several others, are a particular danger. In general, there are no traditional midwives among pastoral zone populations and women are reticent about taking on such a role; as a result there are problems with childbirth and infant care.

---

1. Plan quinquennal 1980: 91

Niger has a pioneering primary health care system in the agricultural zone. But scattered distribution, small settlement size, low population density and nomadic movement make primary health care much more difficult in the pastoral zone. A system based only on fixed facilities, or only on mobile teams, is unlikely to reach many people or to be cost-effective.

A pastoral zone development strategy should encourage an epidemiological and cost-effective approach to health care, with the following priorities: (a) sufficient immunization cover for major infectious diseases, such as measles, meningitis (if a low cost vaccine can be developed) and perhaps tetanus, whooping cough and diptheria; (b) major health problems including serious infant and child diseases, illnesses which reduce ability to work, and diseases considered important by the herders themselves (priorities are: malaria, diarrhea, respiratory infections, conjunctivitis, vitamin A deficiency, gonorrhoea); (c) problems of childbirth, postnatal care, and dry season and weaning infant nutrition; (d) diagnosis and treatment of simple diseases, first aid and elementary emergency treatment; (e) referral facilities; (f) health and nutrition education.

Such a programme should be articulated around three types of structure: fixed installations, especially rural dispensaries, mobile medical teams responsible for intensive annual or bi-annual vaccination campaigns, and health auxiliaries selected by and working within pastoral camps organised into herders' associations. A special approach to births and mother-child health is necessary: the most likely solutions lies in periodic seminars giving all the women in a camp or herders' association notions of basic childbirth and infant care.

The objectives should be to shift most routine primary health care activities to trained health auxiliaries, with adequate supervision, resupply and referral to fixed dispensaries located at the Pastoral Centers serving several Pastoral Communities. Immunization should be carried out during one or two intensive annual campaigns by mobile teams based at the same dispensaries, with assistance from the auxiliaries. The possiblity of collaboration between human and animal vaccination efforts should be

explored, with a view either to undertaking simultaneous campaigns, or to sharing a common stock of vehicles, cold chains and vaccinators for campaigns at different times of year. The entire programme should be closely linked to and work through herders' associations, which should exercise a coordinating and supervisory role for their own auxiliaries, and a two-way liaison and information channel for other interventions.

Traditional medical knowledge and practice and particularly people's basic concepts of health, disease and appropriate cures, have an important role to play in such a system; further research is needed to tap this resource fully, and to indicate where modern medical treatment may not be readily accepted.

Improve education and training

Education and training present special difficulties in the pastoral zone. Scattered, low density and mobile populations make schooling difficult and potentially extremely expensive. Many children work with their families at pastoral tasks and their absence at school would necessitate substantial changes in adult work loads and schedules. Herders are reticent about sending their children to school from well-founded fears that it will alienate them from pastoral life, and the children themselves are frightened of school; as a result the authorities have sometimes had to take drastic measures to get at least a small number of children into school. Schools have to have boarding facilities to lodge the children, further cutting them off from a pastoral life. Few return there after a year or two at school, but drift to towns or out of the country to earn a living as they can. Few girls of pastoral origin enter the school system. Even functional literary or technical training programmes are hampered by the difficulties of maintaining contact with mobile camps. As a result of these influences, the general education level in the pastoral zone is falling behind that of the rest of the country, further marginalising the zone's inhabitants, and reducing the efficiency of development programmes which require at least some education, literacy or technical training.

A pastoral zone development strategy should reverse these trends, and put in place appropriate education and training programmes. The questions

of what form schooling should take, and what should be taught, both have to be solved. A first step should consist of adult education in the skills necessary to manage herders' association technical programmes: the simple numeracy required for accounting, and basic literacy needed by association technical advisers, section heads and veterinary and human health auxiliaries to keep records. A second objective is the introduction of technical training in animal health, production and range management, including the best traditional knowledge and skills in these subjects. Successful development of short courses in these subjects will lead to a simple functional literacy programme, using the same format, again designed to provide in the first place skills appropriate to the management of association programmes, thus ensuring the continued use of the literacy skills once acquired. An aim of such teaching should be, by concentrating in the first place on adult education, to reduce parents' fears that education will alienate their children from pastoral life. By doing this, the programme should prepare for a more successful educational programme for children to be introduced in the long term.

Improve herders' ability to manage natural resources

Pasture and water management systems which once existed within pastoral zone societies no longer operate. The state has taken over ownership of pasture land, and by constructing public wells and boreholes has diminished the ability of individual or collective ownership of water to restrain pasture use.

Some direct or indirect natural resource management is carried out by the state. Some areas of pasture have been taken into direct management as state ranches; the forest service in theory manages some areas as forest reserves, and attempts to control use of trees in general, especially by banning cutting; and there is a theoretical northern limit to cultivation, expressed through legislation which refuses compensation for animal damage to crops planted north of the designated line. The state, through its local administrative and technical services, also decides the opening dates for boreholes, effectively influencing pastoral use in their area of influence. However, although these measures taken together do amount to a considerable potential intervention power in natural resource management, they are not

currently used as part of an integrated resource management strategy, and do not in fact contain adequate powers for this. In some areas, a few individuals have been able in practice to appropriate public resources such as boreholes or favoured pastures. The sale of private water points to non-herders is increasing, and the digging of new public water points is not fully coordinated with existing water and pasture potential.

The lack of secure land tenure for herders in the pastoral zone exacerbates some of these problems. Herders cannot invest in land (for example by creating pasture reserves or simple water spreading devices) because the increased value can be taken by anyone. Worse, since cultivation of a field under traditional legal principle confers rights while pastoral use does not, herders and others are encouraged to cultivate land increasingly marginal to farming. Although this is economically rational for individuals, it is not so when wider social costs, especially environmental degradation and reduced pasture availability, are taken into account. Thus the imbalance in land tenure biases land use away from an ecological and economic optimum towards unsound uses. As a result, each year new pastures are put into cultivation.

By these processes, the ability of the actual pasture and water users - the herders themselves - to conserve, protect, use wisely or invest in natural resources is progressively reduced, and their security of tenure threatened. Resources are used in an economically and ecologically inefficient way, and the environmental stability needed for future development is reduced.

Access to natural resources and the ability to manage them is essential to the correct functioning of the pastoral economy and to raising the productivity of herding. A pastoral development strategy should improve herders' ability to manage natural resources in an economically and ecologically sound way, and to ensure that the benefits of this are equitably distributed. At the level of actual resource use, the basic units should be herders' association and pastoral communities, to which pasture and water management powers should be progressively devolved.

The main elements of a medium-term strategy to this end are a new approach to management of water, including (a) planning the operation of existing boreholes in the context of subregional pasture management, including the possibility of rotational opening; (b) integrated planning of all new public and private water point construction in consultation with users, especially herders' associations and pastoral communities, and in the light of pasture management objectives; (c) the possibility of converting some existing high capacity boreholes equipped with pumps into borehole-wells with a manual or animal-drawn water lift mechanism to reduce grazing pressure; (d) the possibility of charging water user fees as a way of balancing private and social costs and benefits of pasture use; (e) the allocation through herders' associations and pastoral communities of reimbursable well credits allowing them to construct, with appropriate technical advice, low capacity water points under their own control in areas where new water can achieve a better seasonal or geographic distribution of grazing pressure, or can optimise use of presently underused pastures; (f) the provision of technical advice to herders' associations and pastoral communities on repairing, maintaining or improving existing water points.

A pastoral development strategy should seek to reduce conflicts for land between herding and farming by a more sustained application of existing legislation concerning the northern limit of the agricultural zone, and should provide for an adequate network of properly equipped livestock trails through farmed land to the south of the pastoral zone for trekking marketed animals. It should also seek to reduce the economic incentives for herders and others to cultivate marginal agricultural areas within the pastoral zone, by reducing the cost and the risk to herders of acquiring staple food grains at fair and predictable terms of trade with animals and their products, and by guaranteeing households the minimum conditions for independent pastoral production.

The strategy should also encourage in the medium term a progressive extension of herders' association and pastoral community pasture management powers, using the traditional legal principle that investment in a natural resource creates ownership rights. The objective should be for herders' associations to undertake specific pasture management activities in their

dry season areas, for example protecting or replanting forage treea or shrubs for the dry season, direct reseeding by hand of especially valuable grass species, controlled burning or heavy rotational grazing, or measures to facilitate the grass recolonisation of denuded areas. Such activities should be accompanied by legal backing, conferring exclusive user rights to the herders' association member concerned, and giving associations and pastoral communities the initial enforcement role.

In the long term the objective should be to move slowly towards an appropriate legal framework of pastoral land tenure, which gives sufficient guarantee of tenure and management control to users organised into herders' associations and pastoral communities for them to make physical investments, and to manage the range in such a way as to optimise productivity.

Improve the ability of the rural economy to finance its own development

In the present economic situation, Niger cannot afford a pastoral development strategy based on free or heavily subsidised government provision of inputs and services. Expected continued low uranium revenues, leading to cutbacks in public expenditures, as well as a more general need for greater economic efficiency in the allocation of inputs and service, require new approaches to the financing of pastoral development.

The pastoral economy needs productive development capital and credit. At present animals are widely used as a means of savings and investment by non-herders, who place them with herders, but this does not result in an optimal allocation of resources from a development point of view because of the lower productivity of the animals herded in this way. Nor does it allow the herders themselves to build up in an efficient manner their own productive capital to the minimum needed for independent production. There is thus a need for new financial structures in the pastoral zone that meet two objectives: (a) cover an increasing proportion of recurrent costs from users; (b) mobilise rural and other savings for the most economically efficient investments in raising pastoral productivity.

The main principles of a pastoral zone development strategy needed to achieve these objectives on recurrent costs are: (a) that the recurrent costs of actions concerned with major social goods, where failure in one place jeopardises success elsewhere (such as the control of contagious human and animal diseases) should be at least partially paid by the government from general revenue; (b) that most inputs to herding and all commodities should be priced at their economic cost; the only exceptions should be when new inputs to herding or new drugs are being introduced, where subsidies can be used to encourage people to try them; (c) the recurrent costs of some infrastructure developments, such as markets or new water points, should increasingly be recovered by direct user fees; (d) in the long term, an objective should be to shift an increasing proportion of some recurrent service costs to users. This requires as a precondition for success a parallel liberalisation, with appropriate government controls and safety mechanisms, of the service professions concerned, especially veterinary and medical science, so that herders' associations or pastoral communities can negotiate service contracts with the professionals of their choice; in this way they can reward competent work, and increasingly manage and control the type and quality of service they receive.

A general condition for the successful implementation of such a recurrent cost policy is that herders should benefit sufficiently from value added to their animals by improved inputs and services to be able to pay for them and also to increase their income. To do this they should be able to obtain inputs at the lowest economic cost and sell their animals at the highest economic price; this implies a freeing of imports of livestock-related inputs and of livestock exports. To be effective, the implementation of a policy of recurrent cost recovery must be closely linked to increases in productivity as a result of the improved inputs and services.

A pastoral zone development strategy should also encourage the creation of viable rural financial institutions which mobilise rural and other savings for development purposes, including especially the provision of credit for inputs and production capital, and insurance against risk. Such institutions should create an alternative to the use of animals as a store of wealth, thus encouraging long run destocking.

The aim should be to create a financial framework which will channel rich herders' savings and the money currently invested in animals by non-herders, towards a more formal credit system which makes productive investments available to needy herders, with appropriate benefits to both parties: to herders who get credit to build up their own productive capital to the minimum needed for self-sustaining production, and to investors including rich pastoralists who get a secure return on their investment without the risk, supervision costs and low productivity of the present system. The production system as a whole benefits from a reduction of the number of animals held as savings and from the maximization of productivity that results from herders managing an adequately sized herd of their own animals to best advantage; with their own animals, herders will be more inclined to buy inputs, ensure proper veterinary care including purchase of drugs, and to work harder, than with other people's animals where few of the benefits from such additional inputs would accrue to the herder.

By reducing herders' dependence on entrusted animals, such a credit system will raise the cost to non-herders of using animals as a store of wealth, and will increase the competitiveness of other forms of investment, especially capital investments in agriculture or investment in on-farm fattening programmes.

In order to introduce the discipline and mobilisation of herders' own savings often lacking in official credit programmes, credit disbursement should be linked to a progressive increase in savings made by herder families. Herders' associations and pastoral communities will provide an appropriate institutional mechanism for handling credit, and will permit a group approach to credit disbursement-reimbursement which will improve repayment rates by bringing pressure on defaulters by those next in line for loans.

In an area as risky as the pastoral zone, an important objective of an new financial structure should be to provide an insurance system which spreads the risk to individuals of loss of productive herd capital from disease, drought or accident. Although an insurance system capable of

handling losses on the scale of a major drought is unlikely to be feasible in the medium-term, a realistic target is to spread the risk of disaster in any one area or any one year to a wider area or over several years. Insurance premiums paid by herders could become an important source of loan capital within the framework of herders' association credit programmes.

Increase the contribution of the pastoral sector to the national economy

As a principally Sahelian country with a small farming zone, Niger has always relied on livestock for an important part of Gross Domestic Product and of export earnings; in the 1960s livestock production was probably around one quarter of GDP, with livestock trading contributing another important share. These shares fell considerably with the drought of the early 1970s, and the rapid expansion of uranium revenues. The situation is now changing again, and livestock is destined to play a renewed role in national economic activity. An important task of the proposed pastoral zone development strategy is to contribute to the third of the priority objectives specified in the Five Year Plan, namely that of economic independence.[1]

Increase the supply of animals from the pastoral zone for fattening, traction, export, and urban consumption

National policy envisages a stratification of livestock production with cow-calf and growing out operations in the pastoral and transition (or southern pastoral) zone and fattening in the agricultural zone to the south. Increased demand from traction animals (both for ploughs and carts) in southern Niger and northern Nigeria, and sustained high demand for slaughter stock in Nigeria, coupled with improved roads, are likely to keep global demand for livestock high. Official livestock exports are now the source of about 25 per cent of foreign exchange earnings, and it is estimated that unofficial exports are considerably higher.

1. Plan quinquennal 1980: 82

Herders have always sold males and old females to the agricultural zone and for export, in order to provide cash needed to buy cereals and other consumption goods. The objective of a planned stratification programme should not be to supplant this process but to facilitate an economically and ecologically efficient and orderly supply of animals. To do this a successful stratification policy requires economically appropriate and sufficiently attractive price differentials at each stage of the marketing chain to secure a regular supply of animals through the system, combined with an equitable distribution of value added to producers at each stage of the chain. Transaction costs must be kept as low as possible, and the links in the chain reduced to a minimum.

To meet these objectives, a pastoral zone development strategy should promote policies designed to reinforce cow-calf operations in the pastoral zone (through credit for reproductive females, and an improvement in cow-calf health, management and nutrition, aimed at reducing calf mortality and increasing cow fertility), and should promote preliminary growing out through pastoral cooperatives or herders' associations, assisted by credit, technical advice and inputs for association growing out herds. The animals would complete their rapid growth of the first three to four years in the pastoral and transition zones which are better adapted ecologically to this than the agricultural zone, and would be castrated (and perhaps trained for traction) there. Credit and technical input programmes in the agricultural zone would be geared to buying animals through the market or through pastoral-agricultural intercooperative agreements at four or five years for fattening or traction, with the possibility of finishing at intensive feedlots near major consumption centres.

Such a strategy should make it possible that growing out operations are organised through herders' associations with appropriate credit and technical inputs in order that producers, having carried the high mortality risk and relatively high labour costs of the first year, are rewarded by the rapid growth at low labour cost of the subsequent two or three years. There are several advantages to this: the number of links in the marketing chain, with a need for high price differentials as an incentive at each stage, are reduced; benefits are equitably distributed; because the supply

of young males is increasingly in the hands of herders' associations, which have to sell to meet basic consumption requirements, rather than as at present in the hands of investors who are more interested in livestock as a store of wealth, destocking of the pastoral zone is encouraged and there is a more regular and orderly supply of animal of the right age for fattening programmes.

The main strategy measures likely to increase revenue and foreign exchange earnings from livestock exports are to free such exports from legal restrictions other than the need for export licences and vaccination certificates, and to reduce trucking costs by improving the road network in the south of the pastoral zone.

Increase government revenues from the livestock sector

A development strategy which successfully raises the level and value of economic activity in the pastoral zone needs to tap part of such productivity increases, both to pay its own costs and also to generate general revenue for the state.

The measures outlined in earlier sections of this chapter, especially concerning recurrent costs, will reduce the costs to the state of several component programs by shifting them directly to users as a tax on the increased productivity resulting. Additional state revenues can be generated by a variety of means that require more detailed study, but potentially include user fees at state-owned water points, and eventually on pastures (although the latter would be expensive to gather), increased market and slaughter fees, and increased licence fees on livestock exports once they are freed. A renewed direct head tax on animals would be unpopular, but if considered necessary should be made progressive, starting only on a herd beyond the minimum needed for subsistence, and increasing with the size of the herd. However such taxes are expensive to collect efficiently.

INTERMEDIARY OBJECTIVES

Raise the productivity of herding

Improve animal health

The scarce resources of the livestock service are principally spent on the annual vaccination of cattle against rinderpest and CBP; the resulting control of these diseases is largely satisfactory, although the effort cannot be relaxed since these diseases have not yet been eliminated from the region. The remaining animal health efforts of the livestock service are concentrated principally on urban veterinary clinics and visits to the bush to treat specific urgent problems that arise. These activities are of doubtful cost-effectiveness and reach few truly pastoral zone herds. Because of the lack of means, important animal diseases such as anthrax, blackquarter, small ruminant pest, foot and mouth, brucellosis and internal and external parasites are not adequately treated at a herd level. Diseases of sheep, goats, camels and donkeys are scarcely treated at all, even though the animals concerned are an essential part of the production system of many herders in the zone.

The underlying principle of animal health interventions in the pastoral zone should be an epidemiological one: animal disease treatments should be based on an implicit or explicit calculation of the costs and benefits of intervention. A pastoral zone development strategy should reinforce the capability of the Livestock Service to deal effectively with major infectious diseases, with particular new emphasis on diseases and species not currently treated, selected according to their economic incidence on animal production in the pastoral zone. A combination of static and mobile facilities based on the present model remains appropriate for these purposes.

Responsibility for routine animal health care should increasingly be shifted to herders themselves, in the first place through veterinary auxiliaries or herders trained in simple animal health measures under the technical supervision of the Livestock Service and operating through herders' associations. The number of veterinary auxiliaries and their

skills should be progressively increased until the majority of routine animal health measures are carried out by them. The supply of veterinary pharmaceutical products used by the auxiliaries should be channelled through Vetophar as an increased private sector activity. As the veterinary profession is liberalised, herders' associations and pastoral communities should be encouraged to contract directly with private practice veterinarians to ensure health coverage of their herds, eventually in combination with a veterinary insurance scheme.

Improve animal management and nutrition

Animal production in the pastoral zone is at present characterised by low and uncertain fertility, high juvenile mortality and serious seasonal nutritional shortfalls. Highly seasonal plant production necessarily affects animals, leading to a short production season followed by a long period of low or no milk production and slowing of growth and then weight loss. There is little prospect of achieving substantial changes in the total vegetation production, since this is determined mainly by rainfall and soil fertility, but the management of the existing stock of vegetation can be improved.

The objectives of a pastoral development strategy in animal management and nutrition should be to raise fertility and reduce juvenile mortality, and to achieve a better seasonal distribution of animal production and vegetation use, thus optimising the balance between production gains and losses.

The main potential areas of intervention to achieve these objectives are: (a) target feeding of nutritional and mineral supplements to selected classes of animals in the dry season and the transition season between the dry season and the rains, with a view to maintaining nutritional status and creating the conditions necessary for high fertility; (b) increase herders' control over the reproductive cycles of their animals, with the particular objectives of improving overall cattle herd fertility by increasing the number of cows conceiving in the favourable rainy season and reducing conceptions which lead to unfavourable early dry season births; (c) promote (by means of improved veterinary health and management, and herders'

association loans of reproductive females) species which present counter-seasonal advantages, especially camels and goats which, because of their browsing ability, prolong animal production and range use into the dry season; (d) schedule pastoral growing out programmes to sell grown out male stock each year during the cold season, thus removing a substantial number of animals from the range after they have benefitted from the abundant rainy season pastures and before the pasture shortages of the dry season; (e) manage the vegetation so as to prolong the growing season by a faster start at the beginning of the rains and a continuation into the cold season; (f) water development and management to contribute to better seasonal distribution of pasture use.

It is increasingly recognised that the best herders have a variety of traditional animal management skills which can make an important contribution to animal production. A pastoral development strategy should encourage research on such skills, and, where they are found to be appropriate, should seek to extend them together with modern skills to herders in general.

Manage the range

Recent Sahelian range research indicates that although ecological problems are growing, the main priority at the moment is not large scale desertification so much as serious seasonal shortages in animal feed of sufficient quality, leading to production losses.

In this light, the objectives of a pastoral development strategy in the field of range management are threefold: to avoid the future possibility of permanent enviromental damage which might result from overgrazing, to optimize use of an existing annual stock of vegetation according to management objectives defined jointly by herders and technicians, and to manage the range so as to increase the total quantity and quality of vegetation, or to change its species composition or seasonal distribution.

In the medium term there is no prospect of grazing control in the pastoral zone other than through private individual or collective water

rights. Attribution of exclusive grazing rights to individuals or groups, fencing, or enforcement of discipline on open ranges are not economically or politically viable, and would in any case threaten the mobility essential to herders' survival and their efficient ecological use of the range. For this reason, some range management options, such as large scale pasture reserves, are not open in the medium term. However this does not exclude some types of range management innovation, using as the chief means partial and limited control over water, burning and temporary heavier-than-usual grazing. The progressive creation of herders' associations in the pastoral zone provides an organisational framework which makes such initiatives possible. What is needed, is a range management program designed to be accomplished without complete de jure range control.

In the longer term, as herders' associations evolve into more complex resource-managing organizations, rangeland control will become increasingly possible, and grazing practices based on more general principles of optimal range use will become feasible. Research needs to continue to define these principles in the specific context of the pastoral zone.

Medium term range management objectives of a pastoral development strategy include two main elements:

(a) to use an existing vegetation stock each year to achieve more efficiently a set of production targets which optimize for herders the total annual production and seasonal distribution of milk, meat and herd growth, and minimise the risk of major production shortfalls or of large scale animal deaths due to shortages of animal feed;

(b) to manage the range so as to optimize production, by increasing the vegetation stock, changing its distribution within the year, improving species composition, or making available currently underused pastures.

The main potential means now available to achieve these objectives are the creation of a temporary soil moisture reserve to stimulate early dry season pasture regrowth; use by herders' associations with exclusive dry season water of a deferred grazing scheme which protects pastures closest to

water for mid and late dry season use, and grazes those furthest from water at the start of the dry season; and haymaking.

Herders' traditional range management skills are often highly developed and play an important role especially in maximizing animal production gains in the rainy season. Range training programs should include teaching the best of such skills to herders generally.

Manage water

Uncontrolled development of high capacity water points can lead to rapid overuse of surrounding vegetation. But appropriate development and management of water is a powerful tool for better pasture management.

A pastoral development strategy should seek to develop and manage pastoral water sources with the aim of optimizing grazing pressure geographically and seasonally. The aim should be in particular: (a) where possible to reinforce the control of identifiable groups of herders, especially herders' associations, over water sources, including a programme of well-construction credits to such associations, or construction by means of herders' associations' own cash or labour investment; (b) to construct new water sources under herders' association control in areas of suboptimal pasture use, including especially new or improved surface catchments to continue grazing currently under-used areas late into the dry season; (c) to reduce grazing pressure around existing boreholes by manipulating opening and closing dates, or by transforming them into borehole-wells, according to plans worked out jointly by herders and technicians from the livestock and water services; (d) in the creation of new water sources, to prefer small capacity (such as wells and borehole-wells) to large capacity water points (such as boreholes), and to site such points in joint consultation with herders and livestock and water service technicians on the basis of surveys of range underuse; (e) to assist herders, through herders' association training programmes, to repair, maintain and improve their wells; (f) to consider the feasibility and economic and social costs and benefits of charging user fees at some public water points as a way of manipulating grazing pressure and meeting operating costs.

REFERENCES

1. NIGER RANGE AND LIVESTOCK PROJECT REPORTS[1]

Aranson, D R. 1982. Toward Development for Pastoralists in Central Niger; A Synthesis Report of the Work of the Niger Range and Livestock project. Niamey: NRL. 121 pp. (F).

Glazier D. 1983. Herding Dynamics Study: Profile of a WoDaaBe Herding Unit of the North Dakoro Region, Niger. Tahoua: NRL.

Louis, S.L. 1982. Technical Report on Animal Production in the Pastoral Zone of Niger; Recommendations for Improvement. Tahoua: NRL. 139 pp. (F).

Louis, S.L., Dankintafo, A., Boukary, B., Goumeye, N. 1983. Seasonal Influence on the Nutritive Value of the Rangeland in Pastoral Zone. Tahoua: NRL. 44 pp. (F).

Loutan, L. 1982a. Health and Nutrition in a Group of WoDaaBe (Bororo) Herders in Central Niger. Discussion Paper. Tahoua: NRL. 139 pp. (F).

Loutan, L 1982b. Santé et Nutrition en Zone Pastorale: Propositions d'Interventions. Tahoua: NRL. 94 pp.

Loutan, L. 1982c. Auto-Encadrement Vétérinaire en Zone Pastorale. Tahoua: NRL. 20 pp. (F).

Loutan, L. 1982d. Primary Health Care in the Pastoral Zone. Tahoua: NRL. 38 pp. (F).

Loutan, L. 1982e. Les Soins de la Mère et de l'Enfant en Zone Pastorale: Propositions. Tahoua: NRL. 25 pp.

---

1. (F) denotes French language version available.

Makinen, M., Ariza-Nino, E. 1982. The Market for Livestock from the Pastoral Zone of Central Niger. Discussion Paper. Tahoua: NRL. (F).

Maliki, A.B. 1981. Ngaynaaka: Herding According to the WoDaaBe. Discussion Paper. Tahoua: NRL. 154 pp. (F).

Maliki, A B. 1981a. Etude Socio-Démographique sur la Population WoDaaBe et FulBe de la Région de Projet NRL. Unpublished report. Tahoua: NRL.

Maliki, A.B. 1982. Introduction à l'Histoire des WoDaaBe du Niger. Discussion Paper. Tahoua: NRL. 52 pp.

Milligan, K. 1982a. Aerial Survey of Human, Livestock and Environmental Conditions in a Central Region of the Pastoral Zone of Niger. Final Report. Addis Ababa: International Livestock Centre for Africa (Aerial Survey Unit) for NRL. 105 pp. (F).

Milligan, K. 1982b. Wet Season Aerial Survey of the Human and Livestock Populations and Environmental Condition in a Central Region of the Pastoral Zone of Niger. Final Report. Addis Ababa: International Livestock Centre for Africa (Aerial Survey Unit) for NRL. 55 pp. (F).

Milligan, K. 1982c. Dry and Wet Season Aerial Surveys of the Numbers and Distribution of the Pastoral and Livestock Populations and Ecological Conditions in a Pilot Intervention Area near Tchin Tabaraden, Niger. Final Report. Addis Ababa: International Livestock Centre for Africa (Aerial Survey Unit) for NRL. 56 pp. (F).

Sollod, A.E. 1981. Animal Disease Patterns in the Niger Range and Livestock Project Area of Niger's Pastoral Zone. Discussion Paper. Tahoua: NRL. 31 pp. (F).

Sutter, J. 1978. Pastoral Herding in the Arrondissement of Tanout. Niamey: NRL. 55 pp.

Sutter, J. 1982. Commercial Strategies of the WoDaaBe Nomads of Tanout Arrondissement, Niger. Discussion Paper. Tahoua: NRL. 86 pp.

Swift, J.J., Campbell, W., Wass, K., Newman, A. 1984. Pastoral Atlas of Central Niger. Niamey: Institut de Recherches en Sciences Humaines and NRL project. (F).

Swift, J.J., Maliki, A B. 1982. Preliminary Evaluation of a Pilot Program to Create Herders' Associations in the Pastoral Zone of Central Niger. Discussion Paper. Tahoua: NRL. 119 pp. (F).

Thomson, J.T. 1981. Nigerien Herder Associations: Institutional Analysis and Design. Discussion Paper. Tahoua: NRL. 269 pp. (F).

Wilson, R.T., Wagenaar, K. 1982. An Introductory Survey of the Livestock Population Demography and Reproductive Performance in the Area of the Niger Range and Livestock Project. Bamako and Addis Ababa: International Livestock Centre for Africa for NRL. (F).

Wylie, B , Senock, R., Snyder, L., Roettgen, B., Porter, B. 1983. Range Research and Results. Tahoua: NRL. 151 pp.

2. PUBLISHED REFERENCES

Addo, P.B., Eid, F.I.A. 1978. "Caseous Lymphadenitis of sheep and goats in Nigeria." Bull. An. Hlth. Prod. Afr. 1: 37-41.

Ambwani, V R., Jatkar, P.R. 1973. "Salmonella infections of camels in Bikaner." Indian Vet. J. 50: 100-102.

Arnal, J.P., Garcia, M. 1973. Evaluation des Pertes sur le Bétail dues à la Secheresse: Rapport Provisoire de la Mission Effectuée au Niger du 5/11/73 au 5/12/73. Communauté Economique du Bétail et de la Viande. mimeo.

Asagba, M.O., Nawathe, D.R. 1981. "Evidence of sheep pox in Nigeria." Trop. Anim. Hlth. Prod. 13: 61.

Baier, S. 1980. An Economic History of Central Niger. Oxford: Clarendon Press.

Bartha, R. 1970. Plantes Fourragères de la Zone Sahélienne d'Afrique. Munich: Weltforum. 306 pp.

Bartha, R. 1971. Studien in Fragen des Zebu-Rinderzucht in den Tropen. Afrika Studien 59. Munich: Weltforum.

Baxter, P.T.W. 1975. "Some consequences of sedentarization for social relationships." In T. Monod ed. Pastoralism in Tropical Africa London: Oxford University Press. pp 206-228.

Beauvilain, A. 1977. Les Peul du Dallol Bosso. Etudes Nigériennes 42. Niamey: Institut de Recherche en Sciences Humaines. 274 pp.

Bénéfice, E., Chevassus-Agnes, S., Marie, B., Ndiaye, A.M. 1981. "Surveys on nutritional status in semi-arid tropical areas (Sahel 1976-1979): methods and results." In Nutritional Status of the Rural Populations of the Sahel. Ottawa, Canada: International Development Research Centre. pp 33-50.

Bernus, E. 1974. Les Illabakan (Niger): Une Tribu Touarègue Sahelienne et son Aire de Nomadisation. Atlas des Structures Agraries au Sud du Sahara 10. Paris: ORSTOM, Mouton. 116 pp.

Bernus, E. 1981. Touaregs Nigériens: Unité Culturelle et Diversité Régionale d'un Peuple Pasteur. Mémoires ORSTOM 94. Paris: ORSTOM. 507 pp.

Blood, D.L., Henderson, J.A., Radostits, O.M. 1979. Veterinary Medicine. (5th ed.). Philadelphia: Lea, Febiger. pp. 759-764, 751-753.

Bonte, P. 1970. Production et Echange chez les Touaregs Kel Gress Du Niger. Université de Paris 5. Thèse de 3e cycle.

Bonte, P. 1975. "L'organisation économique des Touareg Kel Gress." In R. Cresswell ed. Elements d'Ethnologie. Paris: Colin. pp 166-215.

Bonte, P. 1976. "Structure de classe et structures sociales chez les Kel Gress." Rev. Occ. Musuluman et de la Med. 21: 141-162.

Breman, H., de Wit, C.T. 1983. "Rangeland productivity and exploitation in the Sahel." Science 30 September, 221 (4618): 1341-1347.

Bremaud, O. 1969. Notes sur l'Elevage Camelin dans les Districts du Nord de la République du Kenya. Maisons Alfort: IEMVT.

Britt, D.P. 1979. "Salmonella in some captive Nigerian animals." Bull. An. Hlth. Prod. Afr. 27: 289-290.

Brun, T., Bleiberg, F., Goiham, S. 1981. "Energy expenditure of male farmers in dry and rainy season in Upper Volta." British Journal of Nutrition 45: 67.

Burgemeister, R.E. 1975. Elevage de Chameaux en Afrique du Nord. Eschborn, FRG: GTZ.

Capponi, M. et al. 1970. "Premier isolement d'une souche de Rickettsia coxiella burneti de tiques (Hyalomma truncatum) de Sénégal." Bull. Soc. Path. Exotique 63: 530-534.

Carmichael, I.H. 1972. "The pathological physiology of helminth infestations. II. Oesophagostomum columbianum." Trop. Anim. Hlth. Prod. 4: 175-181.

Charnot, Y. 1963. "Synchronisation de la croissance du voile du palais et des testicules pendant le cycle sexuel chez le dromediare." Bull. Soc. Sci. Nat. Phys., Maroc 43: 49-54.

Cleave, J.H. 1974. African Farmers: Labor Use in the Development of Smallholder Agriculture. New York: Praeger.

Coulomb, J. 1971. Zone de Modernisation Pastorale du Niger: Economie du Troupeau. Maisons Alfort: IEMVT.

Coulomb, J. 1972. Projet de Développement de l'Elevage dans la Région de Mopti: Etude de Troupeau. Maisons Alfort: IEMVT.

Dahl, G. 1981. "Production in pastoral societies." pp. 200-208 in J.G. Galaty, D.Aranson, P.C. Salzman and A. Chouinard eds. The Future of Pastoral Peoples. Ottawa: International Development Research Centre. 396 pp.

Dahl, G., Hjort, A. 1976. Having Herds: Pastoral Herd Growth and Household Economy. Studies in Social Anthropology 2. Stockholm: University of Stockholm. 335 pp.

Dahl, G., Hjort, A. 1979. Pastoral Change and the Role of Drought. Stockholm: Swedish Agency for Research Cooperation with Developing countries. 50 pp.

de Ville de Goyet, C. et al. 1977. "Anthropometric measurements in a relief program in Niger: a tool for decision making at the community level." Disasters 1 (3): 223-229.

Diallo, A., Wagenaar, K. 1981. "Livestock productivity and nutrition in the pastoral system associated with the flood plains." In R.T. Wilson, P.N de Leeuw, C.de Haan eds. Systems Research in the Arid zones of Mali: Preliminary Results. Research Report 5. Addis Ababa: ILCA.

Doutre, M.P., Toure, B.A. 1978. "A propos d'un nouveau cas de botulisme hydrique de type D survenu au Sénégal. Considerations etiopathogeniques." Rev. Elev. Med. Vet. Pays Tropicaux 31: 411-415.

Dumas, R. 1980. "Contribution à l'étude des petits ruminants du Tchad." Rev. Elev. Med. Vet. Pays Trop. 33: 215-233.

Dupire, M. 1962. Peuls Nomades: Etude Descriptive des WoDaaBe du Sahel Nigérien. Travaux et Memoires 64. Paris: Institut d'Ethnologie. 336 pp.

Dupire, M. 1962a. "Trade and markets in the economy of the nomadic Fulani of Niger (Bororo)." In P. bohannan, G. Dalton eds. Markets in Africa. Evanston: Northwestern University Press. pp. 335-362.

Dupire, M. 1962b (Reprinted 1972). "Les facteurs humains de l'économie pastorale." Etudes Nigériennes 6. Niamey: Institut de Recherches en Sciences Humaines.

Dupire, M. 1971. "The position of women in a pastoral society." In D. Paulme ed. Women of Tropical Africa. Berkeley: University of California Press. 308 pp. pp 47-92.

Dupire, M. 1975. "Exploitation du sol, communautés residentielles et organisation lignagère des pasteurs WoDaaBe (Niger)." In T. Monod ed. Pastoralism in Tropical Africa. London: Oxford University Press.

Echard, N. 1975. L'Experience du Passé: Histoire de la Société Paysanne Haussa de l'Ader. Etudes Nigériennes 36. Niamey: Institut de Recherches en Sciences Humaines.

Eddy, E. 1979. Labor and Land Use on Mixed Farms in the Pastoral Zone of Niger. Ann Arbor, Michigan: Center for Research on Economic Development.

Edelsten, R.M., Pegram, R.G. 1974. "Contagious skin necrosis of Somali camels associated with Streptococcus agalactiae." Trop. Anim. Hlth. Prod. 6: 255-256.

Eicher, C.K., Baker, D.C. 1982. Research on Agricultural Development in Sub-Saharan Africa: A Critical Survey. East Lansing, Michigan: Michigan State University.

Fox, R.H. 1953. A Study of Energy Expenditure of Africans Engaged in Various Rural Activities. University of London: Ph. D. thesis.

Gerbaldi, P. 1978. Divers Rapports sur les Petits Ruminants du Niger. Maisons Alfort: IEMVT.

Gidel, R. et al. 1974. "La brucellose en Afrique occidentale et son incidence sur la santé publique: résultats de dix enquêtes épidémiologiques éffectuées en Côte d'Ivoire, Haute volta et Niger, de 1970 à 1973." Rev. Elev. Med. Vet. Pays Tropicaux 27: 403-418.

Goni, M, Onoviran, O. 1973. "Contagious caprine pleuropneumonia: a reassessment of the disease situation in Nigeria." Trop. Anim. Hlth. Prod. 5: 114-118.

Greene, M.H. 1974. "Impact of the Sahelian drought in Mauritania, West Africa." Lancet 1: 1093-1097.

Greigert, J. 1968. Les Eaux Souterraines de la République du Niger. Niamey: Direction des Mines et de la Géologie. 2 vols.

Greigert, J., Sauvel, C. 1970. Modernisation de la Zone Pastorale Nigérienne: Etude Hydro-Géologique, Atlas. Paris and Niamey: BRGM, Direction de l'Elevage.

Hare, F.K. 1983. Climate and Desertification: A Revised Analysis. World Climate Programme 44. Geneva: World Meteorological Organization. 149 pp.

Haumesser, J.B. 1975. Modalités et Résultats des Enquêtes sur les Petits Ruminants au Niger. Maisons Alfort: IEMVT.

Haumesser, J.B., Pontrel, B. 1973. "Contribution à l'étude des rickettsioses au Niger: enquê réalisée dans la region de Maradi." Rev. Elev. Med. Pays Tropicaux 26: 293-298.

Hawking, F. 1953. "Milk diet, p-aminobenzoic acid and malaria (P. berghei)." British Medical Journal 2: 1201-2.

Haywood, M. 1980. Changes in Land Use and Vegetation in the ILCA/Mali Sudano-Sahelian Project Zone. Working Document 3. Addis Ababa: International Livestock Centre for Africa. 187 pp.

Hill, A.G., Randall, S.C., Sullivan, O. 1982. The Mortality and Fertility of Farmers and Pastoralists in Central Mali 1950-1981. London: Centre for Population Studies, London School of Hygiene and Tropical Medicine. 54 pp.

Hunter, J.M. 1967. "Seasonal hunger in a part of the West African savanna: a survey of body weights in Nangodi, north east Ghana." Transactions and Papers 41, Institute of British Geographers.

IEMVT. 1970. Paturages Naturels Saheliens du Sud-Tamesna. Etude Agrostologique 28. Maisons Alfort. IEMVT.

IEMVT. 1978. Etude de la Factibilité Technique du Concept d'Unités Pastorales au Niger (Arrondissements de Tanout et Goure). Maisons Alfort: IEMVT for IBRD.

INSEE/SEDES. 1966. Etude Démographique et Economique en Milieu Nomade: Démographie, Budgets et Consommation. Paris: Ministère de la Cooperation/ INSEE/Société d'Etudes pour le Développement Economique et Sociale. 201 pp.

Ipatenko, N.G. 1973. "Infectious enterotoxemia of camels." In F.M. Orlov, Little-known Contagious Diseases of Animals (2nd ed.). USSR: Izdatel' stvo kolos. pp. 248-255.

Issa, A., Labatut, R. 1974. Sagesse des Peuls Nomades. Yaoundé: Clé. 67 pp.

Koth, T.I. et al. 1976. "Sahel nutrition survey, 1974." American Journal of Epidemiology 103 (4): 383-390.

Leeflang, P., Ilemobade, A.A. 1977. "Tick-borne diseases of domestic animals in northern Nigeria. II Research summary 1966 to 1976." Trop. Anim. Hlth. Prod. 9: 211-218.

Leese, A.S. 1927. A Treatise on the One-Humped Camel in Health and Disease. Stamford: Haynes.

Longhurst, R., Payne, P. 1979. Seasonal Aspects of Nutrition: Review of Evidence and Policy Implications. Discussion Paper. University of Sussex: Institute of Development Studies.

Macadam, I., Zwart, D. 1967. "Enterotoxemia in sheep in Nigeria." Bull. Epi. Dis. Afr. 15: 243-244.

Musa, B.E., Abusineina, M.E. 1976. "Some observations on reproduction in the female camel." Acta Vet. 26: 63-67.

Nduaka, O., Ihemalandu, E.C. 1973. "Observations sur le complexe pneumo-enterite chez des chèvres naines des états de l'Est du Nigeria." Bull. Epi. Dis. Afr. 21: 87-95.

Nicholson, S.E. 1982. A Note on Sub-Saharan Rainfall in the Years 1976-1980. Worcester, Massachussets: Clark University. Unpub. ms. cited in Hare 1983.

Nicolaisen, J. 1963. Ecology and Culture of the Pastoral Tuareg. Copenhagen: National Museum. 548 pp.

Nicoletti, P. 1980. "The epidemiology of bovine burcellosis." Adv. Vet. Sci. Comp. Med. 24: 69-95.

Niger 1980. Auto-Encadrement Sanitaire; Méthodes de Formation des Agents de Santé de Village. Niamey: Ministère de la Santé.

Niger Centre-Est. 1981. Résultats Enquêtes Zootechniques 1980-1981. Projet Niger Centre-Est: Cellule Suivi et Evaluation.

Norman, D.W. 1973. Economic Analysis of Agricultural Production and Labor Untilization among the Hausa in the North of Nigeria. African Rural Employment Paper 4. East Lansing, Michigan: Michigan State University, Department of Agricultural Economics.

Norman, D.W., Newman, D., Ouedrago, L. 1981. Farm and Village Production Systems in the Semi-Arid Tropics of West Africa: An Interpretive View of Research. Andhra Pradesh, India: ICRISAT.

Norman, D., Pryor, D., Gibbs, C. 1979. Technical Change and the Small Farmer in Hausaland, Northern Nigeria. African Rural Economy Paper 21. East Lansing, Michigan: Michigan State University, Department of Agricultural Economics.

Norman, D.W., Simmons, E.B., Hays, H.H. 1982. Farming Systems in the Nigerian Savanna: Research and Strategies for Development. Boulder, Colorado: Westview.

Obi, T.U. 1978. "Survey of the incidence of anaplasmosis among Nigerian trade cattle." Trop. Anim. Hlth. Prod. 10: 87-90.

Obi, T.U., Gibbs, E.P.J. 1978. "Orf in sheep and goats in Nigeria." Trop. Anim. Hlth. Prod. 10: 233-235.

Office of Nutrition. 1978. United Republic of Cameroon, National Nutrition Survey. Washington, DC: USAID.

Okoh, A.E.J. 1979. "A survey of brucellosis in camels in Kano, Nigeria." Trop.Anim. Hlth. Prod. 11: 213-214.

Okoh, A.E.J., Kaldas, M.Y. 1980. "Contagious caprine pleuropneumonia in goats in Gumel, Nigeria." Bull. Anim. Hlth. Prod. Afr. 28: 97-102.

Ola Ojo, M. 1976. "Caprine pneumonia in Nigeria. I Epidemiology and bacterial flora of normal and diseased respiratory tracts." Trop. Anim. Hlth. Prod. 8: 85-89.

OMBEVI. 1978. Enquête sur les Effets de la Secheresse au Mali. Bamako: OMBEVI.

Osman, A.M., el-Azab, E.A. 1974. "Gonadal and epididymal reserves in the camel Camelus dromedarius." J. Reprod. Fert. 38: 425-430.

Oxby, C. 1978. Sexual Division and Slavery in a Twareg community: A Study of Dependence. London University: School of Oriental and African Studies. Ph. D. thesis.

Pegram, R.G. 1973. "An unusual form of lymphadenitis in sheep and goats in the Somali Democratic Republic." Trop. Anim. Hlth. Prod. 5: 35-39.

Pegram, R.G. 1979. "Serological types of Pasteurella haemolytica isolates from sheep and goats in the Somali Democratic Republic." Trop. Anim. Hlth. Prod. 11: 29-30.

Penning de Vries, F.W.T., Djitèye, M.A. 1982. La Productivité des Paturages Saheliens: Une Etude des Sols, des Végétations et de l'Exploitation de cette Ressource Naturelle. Wageningen: Centre for Agricultural Publishing and Documentation. 525 pp.

Perreau, P. 1973. Maladies Tropicales du Bétail. Paris: Presses Universitaires de France.

Peyre de Fabrègues, B. 1973. Synthèse des Etudes de la Zone de Modernisation Pastorale du Niger; Amélioration de l'Exploitation Pastorale. Maisons-Alfort: IEMVT. 50 pp.

Peyre de Fabrègues, B. 1979. Lexique des Plantes du Niger. Maisons Alfort and Niamey: IEMVT, INRAN. 156 pp.

Plan quinquennal 1980. Plan Quinquennal de Développement Economique et Social 1979-1983. Niamey: Ministère du Plan.

Provost, A., Haas, P., Dembelle, M. 1975. "Premiers cas au Tchad de botulisme animal (type C): intoxication de dromadaires par l'eau d'un puit." Rev. Elev. Med. Vet. Pays Tropicaux 28: 9-11.

Raynaut, C. 1976. "Transformation du système de production et inégalité économique: le cas d'un village Haoussa (Niger)." Canadian Journal of African Studies 10 (2): 279-306

Raynaut, C. 1977. "Circulation monétaire et évolution des structures socio-économiques chez les Haoussas du Niger." Africa 47 (2): 160-171.

Raynaut, C. 1980. Recherches Multidisciplinaires sur la Région de Maradi: Rapport de Synthèse. Bordeaux: Université de Bordeaux II.

Rippstein, J., Peyre de Fabrègues, B. 1972. Modernisation de la Zone Pastorale du Niger. Etude Agrostologique 33. Maisons-Alfort: IEMVT. 306 pp.

Robertson, A. ed. 1976. Handbook on Animals Diseases in the Tropics. (3rd ed.). London: Brit. Vet. Assoc.

Sandford, D. 1981. Pastoralists as Animal Health Workers: the Range Development Project in Ethiopia. Pastoral Network Paper 12c. London: Overseas Development Institute.

Seaman, J., Holt, J., Rivers, J., Murlis, J. 1973. "An enquiry into the drought situation in Upper Volta." Lancet 2: 774-778.

SEDES. 1975. Approvisionnement en Viande de l'Afrique de L'Ouest. Tome 1-4. Paris: SEDES.

SEDES. 1978. Projet de Modernisation de la Zone Pastorale; Dossier Général. Paris: Société d'Etudes pour le Développement Economique et Sociale. 158 pp.

Shalash, M.R., Nawito, M.F. 1964. "Some reproductive aspects in the female camel." Ve Cong. Rep. Anim. I. A., Trento 2: 263-273.

Sharma, V.D., Bhargava, K.K., Singh, M. 1963. "Secondary sex ratio of normal births in Bikaneri camels." Indian Vet. J. 40: 561-563

Spencer, P. 1973. Nomads in Alliance: Symbiosis and Growth Among the Rendille and Samburu of Kenya. Oxford: Oxford University Press.

Stenning, D.J. 1971. "Household viability among the pastoral Fulani." In J. Goody ed. The Development Cycle in Domestic Groups. Cambridge Papers in Social Anthropology 1. Cambridge University Press. pp 92-119.

Sterne, M. 1981. "Clostridial infections." Brit. Vet J. 137: 443-454.

Sutter, J. 1979a. "Social analysis of the rural producer." In Niger Agricultural Sector Assessment. Niamey: USAID. Vol. 2, annex D.

Sutter, J. 1979b. Commerical Strategies, Drought, and Monetary Pressures: Wo'Daa'Be Nomads of Tanout Arrondissment, Niger. Cornell University. unpublished ms. 52 pp.

Swaroop, S. 1968. Méthodes Statiatiques Utilisables dans les Campagnes d'Eradication du Paludisme. Geneva: Organisation Mondiale de la Santé.

Swift, J.J. 1977. "Sahelian pastoralists: underdevelopment, desertification, and famine." Annual Review of Anthropology 6: 457-478.

Swift, J.J. 1979. The Economics of Traditional Nomadic Pastoralism; the Twareg of the Adrar n Iforas (Mali). Brighton: Sussex University. D. Phil. thesis. 394 pp.

Swift, J.J. 1982. "The future of African hunter-gatherer and pastoral peoples". Development and Change 13 (2): 159-181.

Tager-Kagan, P. 1978. "Bovine fascioloasis." Rev. Elev. Med. Vet. Pays Tropicaux 31: 437-442.

Tamboura, T.A. 1981. Performance de Bovins Croisés "Racea Locales et Races Européenes" au CNRZ de Sotuba. Toulouse: INP. thesis.

UNCC. 1981. Compte-Rendu de la Tournée des Membres de la Commission de Reflexion sur la Strategie du Developpement du Mouvement Cooperatif; I - Nord des Departements de Tahoua, Agadez, Zinder et Diffa. Niamey: UNCC.

UNESCO 1983. Update of the Case Study on Desertification in Niger and Strengthening of the National Strategy to Combat Desertification. UNSO/DES/NER/82/003. UN Educational, Scientific and Cultural Organization (UNESCO) and UN Sudano-Sahelian Office (UNSO). Final Report, preliminary version. 73 pp.

USAID. 1981. Enquête sur la Nutrition (Juin-Aout 1980). Gouvernement du Niger/USAID, Projet de développement du Département de Niamey.

Waterlow, J.C. 1973. "Note on the assessment and classification of protein-energy malnutrition in children." Lancet 2: 87.

Watts, M.J. 1979. A Silent Revolution: The Nature of Famine and the Changing Character of Food Production in Nigeria. University of Michigan: unpublished Ph. D. thesis.

Williamson, G., Payne, W.J.A. 1978. An Introduction to Animal Husbandry in the Tropics. London: Longmans.

Wilson, R.T. 1975. "Comparative data on two populations of sheep and goats in Sudan and Ethiopia." Sudan J. Vet. Sci. Anim. Husb. 16: 1-11.

Wilson, R.T. 1976a. "Studies on the livestock of Southern Darfur, Sudan. III Production traits in sheep." Trop. Anim. Hlth. Prod. 8: 103-114.

Wilson, R.T. 1976b. "Studies on the livestock of Southern Darfur, Sudan. IV Production traits in goats." Trop. Anim. Hlth. Prod. 8: 221-223.

Wilson, R.T. 1978a. "Studies on the livestock of Southern Darfur, Sudan. V Notes on camels." Trop. Anim. Hlth. Prod. 10: 19-25.

Wilson, R.T. 1978b. "Studies on the livestock of Southern Darfur, Sudan. VI Notes on equines." Trop. Anim. Hlth. Prod. 10: 183-189.

Wilson, R.T. 1978c. "Livestock production on Masai Group Ranches. 1. A preliminary survey of the goat and sheep populations at Elangata Wuas." E. Afric. Agric. For. J. 43: 193-199.

Wilson, R.T. 1980. Livestock Production in Central Mali: Structure of the Herds and Flocks and some Related Demographic Parameters. Bamako: International Livestock Centre for Africa.

Wilson, R.T. 1981. Livestock Production in the Agropastoral System of Central Mali. Bamako: International Livestock Centre for Africa.

Wilson, R.T. 1983. "Livestock production in central Mali: the Macina wool sheep of the Niger inundation zone." Trop. Anim. Hlth. Prod. in press.

Wilson, R.T., Clarke, S.E. 1975. "Studies on the livestock of Southern Darfur, Sudan. II Production traits in cattle." Trop. Anim. Hlth. Prod. 8: 47-57.

Wilson, R.T., Peacock, C., Sayers, R. 1983. "Livestock production on Masai Group Ranches. 3. Aspects of reproduction in goats and sheep at Elangata Wuas." Anim. Prod. in press.