

BIBLIOGRAPHIC DATA SHEET1. CONTROL NUMBER
PN-AAH-7752. SUBJECT CLASSIFICATION (695)
AL00-0000-G190

3. TITLE AND SUBTITLE (240) A conceptual framework for the evaluation of livestock production development projects and programs in Sub-Saharan West Africa; with a selected bibliography of West African livestock development

4. PERSONAL AUTHORS (100)

Ferguson, D. S.; Sleeper, Jonathan

5. CORPORATE AUTHORS (101)

Mich. Univ. Ctr. for Research on Economic Development

6. DOCUMENT DATE (110)
19767. NUMBER OF PAGES (120)
203p.8. ARC NUMBER (170)
AFR636.208.F3529. REFERENCE ORGANIZATION (130)
Mich.

10. SUPPLEMENTARY NOTES (500)

(Bibliography: 49p.)

11. ABSTRACT (950)

12. DESCRIPTORS (920)

Livestock	Ranges
Cattle	Bibliographies
Cattle marketing	Sahel
Grazing land	Animal traction
West Africa	Development strategy

13. PROJECT NUMBER (150)
69809990014. CONTRACT NO.(140)
AID/REDSO/WA-77-105-T15. CONTRACT
TYPE (140)

16. TYPE OF DOCUMENT (160)

AFR
636.208
F352

PN-AAH-775

A CONCEPTUAL FRAMEWORK FOR THE
EVALUATION OF LIVESTOCK PRODUCTION
DEVELOPMENT PROJECTS AND PROGRAMS
IN SUB-SAHARAN WEST AFRICA

BY D.S. FERGUSON



CENTER FOR RESEARCH ON ECONOMIC DEVELOPMENT
The University of Michigan
Ann Arbor, Michigan 48109

A CONCEPTUAL FRAMEWORK FOR THE
EVALUATION OF LIVESTOCK PRODUCTION
DEVELOPMENT PROJECTS AND PROGRAMS
IN SUB-SAHARAN WEST AFRICA

BY D.S. FERGUSON

With

A SELECTED BIBLIOGRAPHY

OF

WEST AFRICAN LIVESTOCK DEVELOPMENT

Compiled by

Dr. Donald S. Ferguson and Mr. Jonathan Sleeper

Center for Research on Economic Development

P R E F A C E

This study was initiated by the author while a research scientist of the Center for Research on Economic Development of the University of Michigan. Portions of the report have been adopted from a feasibility study entitled "Feasibility of the Stratification of Livestock Production in Arid Regions (SOLAR)," United Nations Environmental Program (UN/EP), Nairobi, 1976, in which the author participated. Since November 1976, the author has been serving as Livestock Advisor in the African Bureau Agency for International Development, Washington, D.C. Errors in fact or interpretation remain those of the author.

Comments on this final draft are solicited.

Donald S. Ferguson
AFR/DR/ARD
Room 2941, NS
Agency for International Development (AID)
c/o Department of State
Washington, D.C. 20523
Phone (202)632-8716/8750

A CONCEPTUAL FRAMEWORK FOR EVALUATING LIVESTOCK PRODUCTION
DEVELOPMENT PROGRAMS AND PROJECTS IN SUB-SAHARAN WEST AFRICA

TABLE OF CONTENTS

	<u>Page</u>
I. <u>General Conclusions and Recommendations</u>	vii
<u>CHAPTER I:</u> A STRATEGY FOR MODERNIZING SUB-SAHARAN WEST AFRICAN LIVESTOCK PRODUCTION SYSTEMS	1
A. Terms of Reference and Geographic Focus	2
B. Development Priorities for the Sudano- Sahelian Region	3
C. Defining the Concept of Stratification in Livestock Production	8
<u>CHAPTER II:</u> WEST AFRICAN GRAZING AND AGRICULTURAL LAND USE SYSTEMS	10
A. Introduction	10
B. Sahelian Region - Nomadic and Affiliated Groups	15
C. Sudano-Guinean Region - Semi-Transhumant and Transhumant Pastoralist Groups	23
D. Crop-Dependent Production Units	27
E. A Note on Land Tenure in Relation to Forage Resources	28
<u>CHAPTER III:</u> REGIONAL STRATIFICATION BY LAND RESOURCE ZONE	32
A. Sudano-Sahelian Land Resource Zones	32
B. Development Potential and Constraints of Major Zones:	33
1. Zones Where Extensive Grazing is the Best Use of Land Resources	33
2. Agricultural Zones Parallel (Non-Inte- grated) Crop-Dependent and Livestock- Dependent Production Units	38
3. Zones Where Livestock Production Is A Minor Activity	41
4. Zones Where Use Potential Greatly Ex- ceeds Current Use Intensity	42

	<u>Page</u>
5. Limited and Multiple Land Use Zones	43
C. On Choosing Priority Land Use Management Sites and Project Models:	43
1. Criteria for Priority Site Selection	46
<u>CHAPTER IV:</u> SCHEMATIC VIEW OF STRATIFICATION BY STATE OF PRODUCTION	48
A. Introduction and Key Assumptions	48
B. Basic Outline of the Strategy	50
C. Framework for Evaluation Components of the Strategy	51
D. Marketing Sector Performance and Consumer Preference	54
E. The Structure of Live Animal Prices by Weight and Grade	60
<u>CHAPTER V:</u> FEASIBILITY OF LARGE SCALE (MODERN) INTERMEDIATE STATE PRODUCTION UNITS	67
A. Calf Saving Centers and Growing Out (Re-Elevage) Ranches - Sahelian Region	67
B. Medium to Long-Term Feeding Ranches	74
1. Doli Ranch - Sudanian Zone (Senegal)	76
2. SODEPRA Ranches - Guinean Zone (Cameroon)	76
3. Community Group Ranch (Upper Volta)	77
4. Ekrafane Ranch - Sahelian Zone (Niger)	80
C. Short-Term Fattening Ranches and Feedlots	81
1. Mokwa Ranch (Nigeria)	81
2. NUTRISENEGAL (Senegal)	82
<u>CHAPTER VI:</u> FEASIBILITY OF SMALL (PEASANT) INTERMEDIATE STAGE PRODUCTION UNITS	84
A. Animal Traction/Mixed Farming	84
B. Small Unit Feeding (Embouche Paysanne)	91
<u>CHAPTER VII:</u> FULL PACKAGE VERSUS PARTIAL PACKAGE DEVELOPMENT STRATEGY	94
A. The Experience with Phased Public Service and Sector Development Projects and Programs	94
B. Managed Land Use and Integrated Action Programs	97

	<u>Page</u>
1. Sudano-Guinean Region	98
2. Sudano-Sahelian Region	99
C. Animal Health Programs	103
D. Control of Range Fires	106
E. Toward a Strategy to Develop the Potential of the Range and Grasslands of Western Africa	108

ANNEXES

<u>APPENDIX I</u>	- Project (Activity) Checklist, Livestock Sector Programs in West Africa	111
<u>APPENDIX II</u>	- Appendix Tables	115
<u>ANNEX I</u>	- A Selected Bibliography of West African Livestock Development, by D.S. Ferguson and J. Sleeper	134

TABLES

<u>TABLE 1</u>	- Sahelian Countries: Estimated Percentage of Crop and Livestock Dependent Population, Mid-1975	14
<u>TABLE 2</u>	- Mauritania: Tenth Region (Guidiamaka), Estimated Cattle, Sheep and Goat Population by Ethnic Group, 1975	19
<u>TABLE 3</u>	- Upper Volta: Sahel ORD, Human and Livestock Population by Ethnic Group, 1974	20
<u>TABLE 4</u>	- West Africa: Hypothetical Weight and Value of Slaughter Stock by Age 1-6 Years, 1975	63
<u>TABLE 5</u>	- West and Central Africa: Percent Males in Sample Cattle Census Data and Percent Over 36 Months of Age	69

	<u>Page</u>
<u>TABLE 6</u> - Upper Volta and Niger: Gross Herd Composition and Productivity Estimates for Traditionally Managed Herds	41
<u>TABLE 7</u> - West and Central Africa: Estimated General Magnitude of Bovine Traction Animal Populations by Country, 1965-1974	87

FIGURES

<u>FIGURE 1</u> - Sudano-Sahelian and Sudano-Guinean Regions: Distribution of Agricultural Activities by Climatic Zone	13
<u>FIGURE 2</u> - Sudano-Sahelian Regions: Major Land Resource Zones and Sub-Zones	34
<u>FIGURE 3</u> - West Africa: Existing and Proposed Production and Marketing System Links, 1976	52
<u>FIGURE 4</u> - West Africa: Hypothetical Weight and Value Curves for Slaughter Stock by Age 1-6 Years, 1975	62
<u>FIGURE 5</u> - Upper Volta and Niger: Gross Herd Composition and Productivity Estimates for Traditionally Managed Herds	101

MAPS

<u>MAP 1</u> - West Africa Primary Cattle Production Regions	4
<u>MAP 2</u> - Sub-Saharan West and Central Africa: Natural Vegetation After Oxford Economic Atlas	11
<u>MAP 3</u> - Sub-Saharan Africa: Ecological Types and Breeds of Cattle	18
<u>MAP 4</u> - West Africa: Animal Traction Centers in Relation to Climatic Zones	85

Appendix Table

I	West and Central Africa: Area of Principal Climatic Zones	116
II	Sahelian Countries: Total Area and Estimated Arable Land, Land Used for Rain Fed Crops, Irrigation, Grazing, Forests and Waste Lands, 1972	117
III	West Africa: Estimated Crop and Livestock Dependent Population, mid-1975	118
IV	Sahelian Countries: Area and Population by Agro-Climatic Zone - 1970	119
V	Sahelian Countries: Estimated Population, Per Capita Income, Labor Force in Agriculture, and Population Growth Rate in Selected Countries, mid-1975	120
VI	West and Central Africa: Cattle, Sheep/Goat and Camel Population, Arid and Humid Countries, and Regions and Cattle Equivalent Per Capita, 1968	121
VII	Sahelian Countries: General Magnitude Estimate of Cattle Population by Type of Management System, 1970	122
VIII	Sahelian Countries: General Magnitude Estimates of Pre- and Post-Drought Cattle Population by Climatic Zone	123
IX	West Africa: FAO Production Yearbook Estimates of Sahelian Country and Cameroon Cattle Population, 1961-65 and 1972-74, and Drought Related Losses	124
X	Cameroon: Cattle Population by Age and Sex Category, Adamaoua Plateau, 1971	125
XI	Mali: Estimates of Age/Sex Composition Zebu Herds, Circa, 1965	126
XII	Chad: Post Drought Age/Sex Structure of Herds Mao (Tacher) Area, 1973	127
XIII	Niger and Upper Volta: Post Drought Age/Sex Structure of Herds - Sahelian Zone, September, 1973	
XIV	Sahelian Countries and Cameroon: Relationship Between Cattle, Sheep, and Goat Populations, 1961-65 and 1972-74	
XV	Senegal - Dahra Livestock Research Center: Calving and Implied Conception and Weaning Distribution by Month Unimproved Grazing Conditions	

	<u>Page</u>
XVI Upper Volta, Guinean Zone; Age/Sex Composition of Pre-Project Herd, Following Improved Veterinary Services and on Proposed Community Ranch, Constant 15,000 Hectares	131
XVII Upper Volta - Guinean Zone; Technical Coefficients and Estimated Sales by Age/Sex Category Pre-Project, Improved Veterinary Services, and Enclosed Community Ranch	132
XVIII French Speaking West Africa: Budget Estimates for Veterinary Services as Percent of National Budgets, 1970	133

GENERAL CONCLUSIONS AND RECOMMENDATIONS¹

CHAPTER 1

1. In comparison with other major agricultural commodities, the development of animal protein products has been neglected, for two reasons: (1) urban meat supplies were adequate and low-cost until the end of the drought period, and (2) the complex nature of constraints, which requires that progress be made simultaneously in many areas. Few livestock or managed grazing activities have attained project goals.
2. What may be termed the re-emergence of USAID's interest in the Sudano-Sahelian countries stems from (a) the 1968-1973 drought, which necessitated concessional grants of food to the affected countries; (b) the Foreign Assistance Act of 1973, which directs USAID to focus assistance on undertakings that directly improve the lives of the poor majority in developing countries; and (c) the increasing threat of "desertification" to the land and human resources of the region. It is generally agreed that overstocking and the lack of managed grazing patterns are important causes of environmental degradation. These causes are thought to be symptoms of more fundamental problems of population pressure and the lack of human resources to implement known land management and conservation technologies.
3. Most, if not all, of the many studies related to livestock development have endorsed in principle a livestock development strategy based upon "stratification" of livestock production. The term "stratification" has been used to connote two separate but related concepts:
 - a. stratification of the process of meat production into separate layers or stages - breeding cow/calf herds, growing out, fattening, processing - with each stage located geographically

¹The conclusions and recommendations, although drawn mainly from the text, also include items drawn from the literature review. Several are paraphrased from FAO/UNEP, "Report of an Expert's Consultation on the Formation of an International Program on the Ecological Management of the Arid and Semi-Arid Rangelands (EMASAR)," Rome, 1974. Others parallel closely those adapted by the UNEP-sponsored study, "Feasibility of the Stratification of Livestock Production in Arid Regions (SOLAR)," UNEP, Nairobi, 1977.

to take advantage of the comparative advantage of each eco-climatic zone.

- b. Stratification of land use and management systems or patterns - extensive grazing, extensive crop production, mixed farming, conservation and forestry - sited and planned to make the best use of all scarce resources, the land use potential of specific site locations, the existing infrastructure, population density, product demand, and other physical, social and economic factors.

The second, more inclusive definition was taken as the operational one for the purpose of this review.

CHAPTERS II AND III

4. Within the Sudano-Sahelian Region, geographic diversity is related to rainfall levels and distribution, soil productivity differences, population density, and a variety of social and economic factors. Specific ethnic groups have adopted different cropping and livestock husbandry patterns in order to take advantage of each of the land resources. Among the livestock-dependent family units, which comprise about one-fourth of the population of the Sahelian countries, semi-transhumant, transhumant, pastoralist, and nomadic pastoralist groups are identified. These are not rigid categories, but form a continuum from crop-dependent through entirely livestock-dependent households. Social and economic distinctions are being eroded by population pressure, drought, national policies, and the growth of monetized economies. Ancient antagonisms between ethnic groups remain an element in national policies toward livestock and Sahelian development. Because of the diversity of production systems and socio-economic groupings and their complex interactions, the area development approach (integrated rural development projects) is becoming more common.

5. Arid grazing zones normally support two-thirds of the cattle population of the Sahelian countries (Table VIII) and half the cattle population of West and Central Africa (Table III). Transhumant production patterns remain the optimum method for converting range vegetation into high value products.

These resources are being endangered by overstocking and uncontrolled grazing patterns. It must be an ultimate objective to confer on the users the responsibility for the conservation of these resources. This may require that new forms of land tenure and social organization be evolved.

6. In implementing policies of resource conservation, critical constraints are the lack of (a) a concept of individual or group responsibility for the conservation of land resources; and (b) mechanisms to ration access to and use of the commonly owned range resources in the absence of more formal systems of land tenure. It may be hypothesized that mechanisms which build upon existing social organizations are most likely to be accepted by target groups.

7. In the arid grazing zones, settlement and seasonal transhumance patterns are determined primarily by the availability of water for human and animal use and also by the availability of soils suitable for cultivation. The evidence shows that individual and group transhumance patterns are limited to well-defined zones of displacement within which a relatively fixed number of herds and dependent families live. These patterns may include both predominantly crop-dependent and livestock-dependent family units. Historically, group control of watering points and the monopolization of large animal ownership by livestock-dependent groups provided some control over grazing patterns and stocking densities. The democratization of livestock ownership and the construction of public wells have been factors in the acceleration of sedentarization and desertification. Wherever possible, development activities should encompass the entire displacement zone used by production units.

8. The zone of intermixing between pastoral nomadism and sedentary agriculture is generally conceded to be the zone with the most severe environmental degradation problems, the lowest incomes, and the greatest number of "at risk" persons. At the present time, there are no proven soil building crop rotations for the zone, and village perimeters are often marked by a ring of nearly barren soils as the result of shifting cultivation, deforestation, and overgrazing by village flocks and herds. As there are few other cash income-generating activities, each family seeks to accumulate

livestock as a possible investment and as a hedge against crop failure. Furthermore, as the cash export crop-oriented research stations and development societies have focused attention on higher rainfall zones, there is little new production-related research in progress. As there are few extension agents, project implementation is particularly difficult. In this zone, destocking to permit a more optimum stocking density assumes either an expansion of food crop production or the out-migration of a portion of the human population.

9. In the Sudano-Guinean Region (more than 600 mm. of rainfall) the proportion of the livestock-dependent households becomes less as the opportunities for cash crop production and more secure food crop production increases. In these zones, grazing patterns are strongly influenced by crop production and harvesting patterns. Herds are moved out of more densely settled zones during the cultivation season, returning after harvest to exploit fallow land and to feed upon sorghum and millet stover. Those family units with larger herds are able to seek out better wet season grazing than those that must remain near home villages to cultivate and harvest food crops. Rainy season campsites are rarely more than a few tens of kilometers from home villages, although late dry season ones may be at considerable distances and located either on seasonally flooded lands or within the Guinean Zone. In some localities, it may be possible to link wet and/or late dry season grazing sites in a local or regional grazing reserve system.

10. With the exception of the zones with less than 400 mm. of rainfall, a majority of rural households depends upon crop production for a major share of family income. However, it is the exceptional household that does not own at least a few poultry, goats, sheep, and, in some localities, pigs and donkeys. More prosperous farmers and those with salaried incomes may also own cattle as an investment. Small stock are usually scavengers, but cattle are frequently managed by paid herdsmen. Scavenger sheep and goats are important factors contributing to village perimeter desertification and crop damage. Modalities should be sought to include small stock in land use management programs.

11. Localities with very low income or where desertification is occurring are not limited to the arid zones, nor is overgrazing the only cause of environmental deterioration. Even on the best arable soils of the Sudano-Sahelian Zone, nearly continuous cultivation occurs without the use of adequate organic or mineral fertilizers to maintain soil productivity. It is possible that the combination of animal traction or feeding enterprises and the introduction of crop rotation could provide a package which would make both organic farming and cattle feeding profitable on a larger number of production units. Although there are often active development societies or authorities in the Sudano-Guinean Region, the practice, by these crop promotion societies and associated research stations, of focusing on single crop technology and maximum yield packages has resulted in little scientific research being done, and not much experience has been gained as to the best crop rotations and production packages for a majority of rural family production units. Research stations should be encouraged to expand farming-systems research appropriate to each of the major land resource zones.
12. While there is a strong presumption that desertification is occurring throughout the Sudano-Sahelian Region, there is little hard documentary evidence to support this presumption. That is not to say it is not occurring, but that data and the conceptual framework are inadequate to assess trends and severity of damage. The statistical services and survey units in the region should be assisted in collecting the necessary baseline studies and in developing the necessary analytical framework to monitor and assess trends in crop yields, herd productivity, and soil and range conditions over time.
13. In the regional context, there are some land resource zones which are underpopulated and underdeveloped in relation to land use potential. These include potentially irrigable lands and some onchocerciasis and trypanosomiasis zones. In others, there are known technological methods which, if adapted, could rapidly expand output. Given the necessity of expanding agricultural output, most nations would continue to focus development activities on those areas of the country with the best land resource and usually either the highest rural incomes or potential incomes. That is, they would concentrate on zones with the best land resources and therefore the highest

extant or potential rural incomes in order to expand food production and increase export earnings as rapidly as possible. Few West African governments have the financial ability or trained staff necessary to provide the continuing local cost component and supervision for projects selected on the basis of ecological or rural income criteria. Unless the international community is willing to provide guarantees in advance of long-term financial and management support, these otherwise high-risk and non-self-financing development and resource conservation activities cannot take place.

CHAPTER IV

14. Most previous analysis of the appropriate strategy for livestock development has endorsed, in principle, a concept of the stratification of the production process into three distinct states: primary producers with cow/calf herds, intermediate stage producers growing out immature stock to larger sizes and weights, and fattening units for final finishing before marketing. Some models assume the progressive industrialization of cattle slaughter and meat processing within the cattle surplus zones. Examples of most of the key proposed private and public intermediate stage production units are already in place and may be objectively evaluated. It may be hypothesized that only those units which would increase the value per kilogram of immature and range-grown animals would significantly contribute to a solution of income and environmental degradation problems.

15. The analysis of market performance and price structure, which must be considered provisional, supports the following conclusions:

- a. Public or corporate marketing agencies are rarely able to compete in price with the private marketing trade. Given the rapidly escalating costs of upper level management, fuel and other sources of energy, capital equipment, and interest rates, the cost advantage is likely to remain with the movement of live animals over shipment of carcass meat on most trade routes in West Africa for the indefinite future. However, public and donor support for activities which improve the efficiency of the private trade should be continued.

- b. The preliminary analysis supports the conclusion that the price per kilogram of immature stock (18 months or less) would need to double before it would be economically advantageous for primary producers to sell immatures as opposed to semi-mature and range mature categories. Should this occur, the flow of immatures might not increase greatly because the retention of males to range-mature sizes and weights is an effective hedge against drought periods.
- c. The potential to reduce stocking densities by encouraging primary producers to market less-mature males is small. Males are retained to heavier weights in zones with least demographic pressure, where herds are larger and where ox cultivation is important. Conversely, the percentage of males is lowest (and sales occur at precocious weights) where there is greatest demographic pressure, where herds are smaller and little ox cultivation occurs. In localities where a reduction in the number of animal units using the range resources is necessary or would be desirable, a reduction in the number of animals in all age/sex categories could be required.

CHAPTER V

16. The analysis of the proposed or in-place public or corporate intermediate stage production and fattening units supports the following conclusions:
- a. The projected performance of calf-saving centers to reduce the dry season mortality of weaned calves is not an encouraging one. Operating costs are expected to be high, as would mortality and feeding costs. They would not be expected to be financially feasible.
 - b. The projected performance of growing-out ranches for weaned calves in the Sahelian region is not encouraging. It is difficult to find sites which do not have permanent crop-growing settlements. Leveling out the dry season growth curve would require production of irrigated fodder at non-economic cost levels, development and management costs are expected to be high, and there

- are few persons with the experience required to operate a complex ranch operation.
- c. The conclusion is that primary producers should be encouraged to retain young stock to semi-mature and range mature categories - weights and ages more suited to animal traction and other feeding-out activities.
 - d. There are several examples of medium- to long-term feeding-out ranches, which feed animals on managed rangelands for 6-18 month periods - sometimes supplemented with cultivated fodder or concentrate feeds in the dry season. The evidence is that those located in the Guinean Zone that have shorter dry seasons and are closer to final markets are more likely to be financially viable. Of particular interest is a "community ranch" in process of development in Upper Volta, which is seeking to bring together livestock-dependent and crop-dependent families in managed land use units. Portions of each unit would be used as a feeding ranch for ranch-produced and purchased semi-mature cattle.
 - e. The sole example of the commercial feedlot in the region is no longer functional because of financial difficulties resulting from the high cost of feeds. Given the very high export value of concentrate feeds produced in the region - cottonseed and groundnut oil cakes - and the low feeding value and high handling costs of most alternative by-product feeds, industrial scale feedlots are not likely to become financially viable in the foreseeable future.

CHAPTER VI

17. Bovine traction (ox cultivation) combined with small unit fattening have long been viewed as the logical approach to breaking both the labor/energy constraint to expanding crop production and the soil structure/fertility constraints to maintaining or improving crop yields. In most situations, the value of oxen in support of the crop production enterprise

is not sufficient to assure financial viability, but when combined with the feeding-out of the animal to heavier weights and per kilogram values, it becomes economically feasible in many localities. As opposed to public or corporate ranches, which now feed out something less than 40,000 head per year, there are estimated to be an even 400,000 head used in animal traction with an annual turnover of 125-155,000 per year. Although the adoption of animal traction tends to be localized (less than one family in 40 has an ox team), there would appear to be a substantial potential to expand bovine traction units. However, because of the advantages of drawing oxen from local herds, a general expansion of ox cultivation would have comparatively little impact on the demand for steers produced in the Sahelian Region.

18. There are two categories of small unit feeding and fattening enterprises not associated with ox cultivation. The first occurs in the groundnut production zones and near several locations where flood retreat hay can be harvested in the dry season. Cattle are either penned or staked out, and feed is brought to them. Value is added in the farm business through the increase in value of the animal and by the use of manure/compost on farm gardens. The second category occurs locally in mountain enclaves where one or more animals may be fattened on crop residues for slaughter on festive occasions. Unlike cattle used in traction, stall-fed cattle cannot be walked to market, limiting this type of production unit to localities near major consumption and transportation centers. Where the practice of using compost on farm gardens has developed, it may be possible to encourage the stall feeding of sheep and goats as a point of departure.

CHAPTER VII

19. The reduction in the livestock population in the Sudano-Sahelian Region caused by the drought provides a temporary opportunity for regulating the restocking of the rangelands, which may prove easier than attempting the "destocking" of already overpopulated areas. In the past, range management technology has too often been applied in a piecemeal fashion, contributing to the failure of many livestock-focused development

projects. Some of the reasons big projects have failed to achieve targeted goals and objectives are summarized.

20. The sole West African examples of functioning managed grazing use areas in the Sudano-Guinean Region in 1974 were two of the eight Nigerian grazing reserves developed initially with USAID's assistance. In the socio-economic conditions characteristic of the reserves, Fulani pastoralists have accepted the loss of independence which is part of scheme participation in exchange for the greater security and presumably higher incomes. Data on before and after productivity is lacking for a more objective evaluation of scheme financial viability. Extreme care should be exercised in generalizing the limited grazing reserve experience on a broader scale to arid rangelands and higher population density zones.
21. One possible development model for the Sudano-Sahelian Region, as yet untried in West Africa, would be the creation of very large "pastoral grazing units" in arid and extensive grazing zones which include all range units used by one or several ethnic groups for seasonal crop production (if present) and grazing activities. By including the entire agro-pastoral zone, the opportunity exists to make the best use of each complementary soils unit. Experience has adequately proven that the development of unplanned water supplies invites sedentarization, overgrazing, and a deterioration in range resources. To provide the forage production technology necessary to retain breeding herds on smaller units of land would appear to be prohibitively expensive as a general development model, but limited feeding of lactating cows, weaned calves, and oxen may be practical in some localities.
22. Annual vaccination campaigns are used to control the several highly communicable animal diseases found in the region. The vaccines are inexpensive and effective. It would be the height of folly to curtail communicable disease control as a method of stock limitation because of the high mortality which would occur among all age and sex categories. On the other hand, a go-slow approach to more comprehensive disease control programs, which require comparatively expensive and imported drugs or pesticides, is indicated. The safe rule of thumb would appear to be to finance the initial phases of these programs only where stock owners are financially

able to pay a large share of costs. This, in turn, would reduce the financial burden of veterinary health services on limited government resources.

23. A partial solution to the unfavorable budget problems of target countries may be to concentrate on activities which require a minimum of direct contribution by host governments. These would include support for the international research network and the local outreach centers of these institutes. A second type of project would be planning task forces, synthesis studies of both physical resources and economic studies designed to create the necessary data base for effective training, development planning, and project implementation. However, without specific follow-up implementation projects, which implement programs for change, the basic developmental problems will remain.

24. The drought-induced crisis in the Sahelian Region of West Africa and parts of Eastern Africa - with modest losses of life among people, heavy livestock losses, destruction of vegetation, and widespread soil erosion - was due to the buildup over the years before the drought of excessively high human and livestock populations in the Sahelian region. The lesson brought home by the drought period is that the land resources of the region are limited, and that the livestock population cannot be expected to expand beyond the levels of the mid-1960's. If the levels of income of the residents of the arid zone are to be maintained or improved, the productivity of the land and animal resources must be improved.

CHAPTER 1

A STRATEGY FOR MODERNIZING SUB-SAHARAN WEST AFRICAN LIVESTOCK PRODUCTION SYSTEMS

In comparison with the other major export commodities of the Sudano-Sahelian Regions of West Africa, the development of animal protein production has been comparatively neglected. There are a number of identifiable reasons for this comparative neglect. First, red meat prices in West Africa have been, until the last three years, at levels one-third to one-half of those prevailing in European markets. Through the mid-sixties, supplies of cattle and meat in urban centers increased regularly. Although substantial "deficits" of meat were projected to develop by 1980, it was assumed that cattle populations could continue to increase and that productivity and off-take could be increased principally through the development of marketing infrastructure (SEDES, 1971). As late as 1971, little urgency was perceived for undertaking major projects to expand the productivity of small family subsistence production units (AID/Afr. 1976a).

Second, few major "livestock" development projects have been objectively evaluated as having successfully attained project goals. Contributing to the low "success" rate were the low cattle and meat prices and the general lack of knowledge of the physical resources and the social and economic factors that constrain development. The complex nature of the constraints usually requires that investments and progress be made simultaneously on many fronts, including animal health, herd management, marketing infrastructure, and effective limitation of stocking rates to the long-term carrying capacity of the individual range units. In addition, they are generally investments which require 5 to 25 years to reach goals -- periods of time to which few donors are willing to commit project support.

Because of the high risk factor and the low rate of return from sector projects, there has been a tendency for pre- and post-independence governments and donor agencies to invest scarce development resources --

manpower, research capability and capital -- in the cash export crop sector, which was believed to result in quicker payoffs.

Terms of Reference and Geographic Focus

The terms of reference for this review are, in general terms:

- a. to identify and describe the principal production systems for livestock and livestock products in the Sudano-Sahelian Region of West and Central Africa and their relationship to agricultural (crop) production systems;
- b. to identify the constraints to improving the efficiency of livestock production in the Region and, more generally, to the expansion of production;
- c. to assess that group of development activities normally lumped under stratification of livestock production by production zone and function to determine those that appear to be technically, economically, and socially feasible and those that would contribute most to arresting the process of desertification.

The geographic focus of the survey is generally the Sudanian and Sahelian vegetative zones of Sub-Saharan West Africa, within which the great majority of red meat production occurs (see Chapter II).¹ On the other hand, the markets where the highest prices for meat occur are the coastal cities -- Dakar, Abidjan, Accra, Lome, Cotonou, Ibadan/Lagos, and Yaounde/Douala. Over the decades, a sizable trade in cattle and meat has developed from "surplus" interior production zones to the cattle and meat "deficit" coastal zones. The volume and value of the trade are described in other segments of the CRED Entente Livestock

¹In this review, Sudano-Sahelian Region is used to define the Savanna through sub-desertic eco-climatic zones of West and Central Africa within which most livestock production occurs. Sahelian Region is used in referring to that portion of the Sudano-Sahelian Region with less than 600 mm rainfall and Sudano-Guinean Region that with more than 800 mm and less than 1,200 mm. The term zone is used in referring to specific climatic, vegetation, or land resource "zones".

Research Project.

At the request of the Africa Bureau of USAID, which has provided the funding for the study, somewhat greater emphasis has been given to the Entente States -- Ivory Coast, Togo, Dahomey, Upper Volta and Niger (see Map 1), but examples and data are drawn from throughout West and Central Africa. In preparing the survey, the analysis, and the accompanying partially annotated bibliography, USAID program concentration guidelines have been used to provide the conceptual framework. The survey examines the correspondence (or lack of correspondence) between what would appear to be optimum development strategy for the sector with AID program guidelines and the development priorities of the host countries.

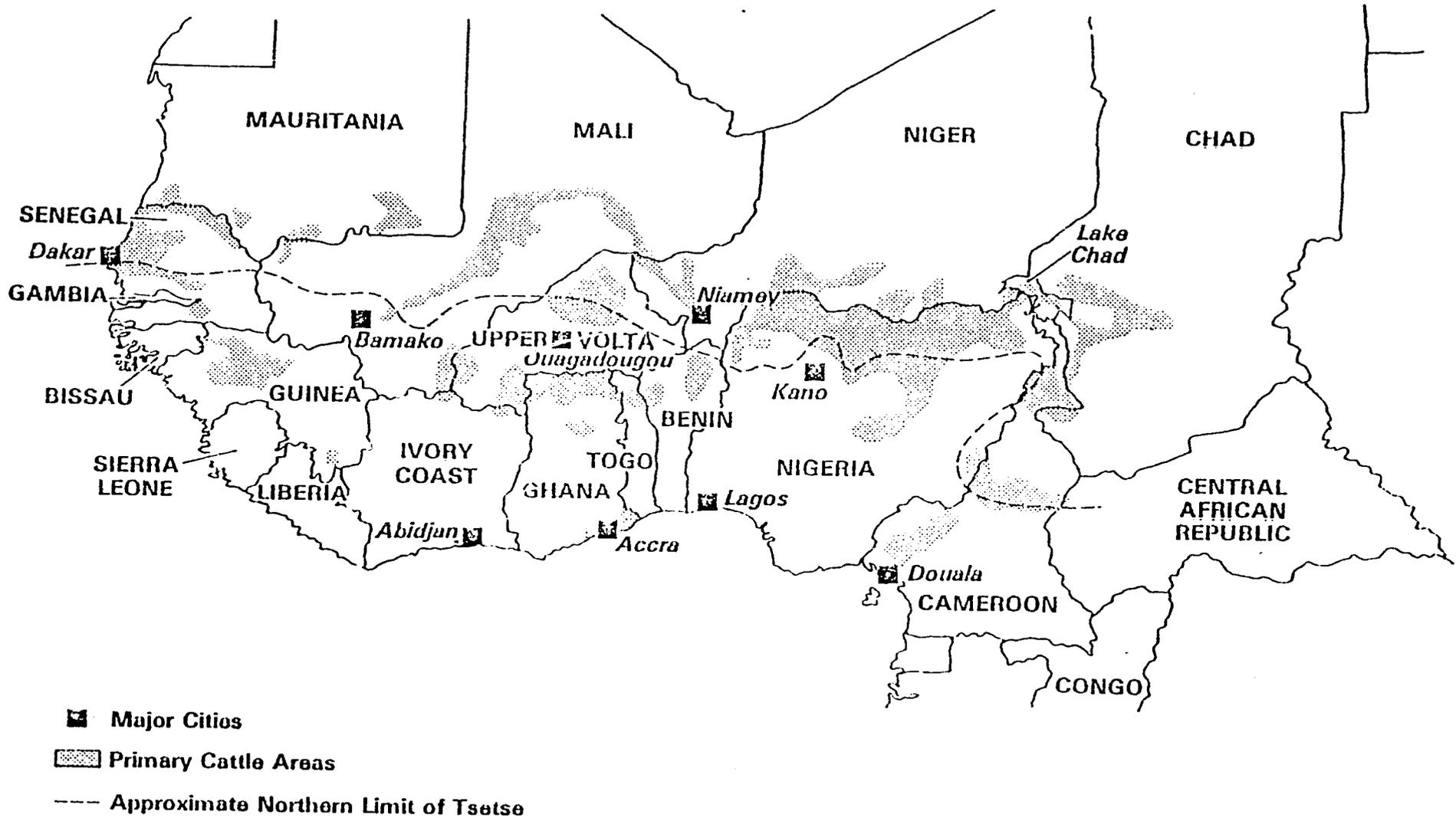
Development Priorities for the Sudano-Sahelian Region

What could be termed the re-emergence of USAID's interest in Sub-Saharan West Africa stems from three principal events: the 1968-1973 drought period; the passage of the 1973 Foreign Assistance Act (FAA); and the growing interest in reversing the process of "desertification" which is threatening the future development of the Region.

The 1968-1973 Drought Period.--- The 1968-1973 Sahelian drought caused world attention to focus on the development problems of the West African Region. Although the drought affected most of the countries of the region to a greater or lesser degree, the six countries now collectively known as the Sahelian Countries -- Mauritania, Senegal, Mali, Upper Volta, Niger, and Chad -- were the most severely affected and were provided with concessional food assistance under Food For Peace and other programs. The impact of the drought on the livestock population and herd structure is reviewed in Appendix Tables VIII, IX, XII and XIII. The economies of the Gambia and the northern provinces of Ivory Coast, Togo, Dahomey, Cameroon, Central African Republic, Ghana, and Nigeria were also affected. It became evident that substantial progress in expanding both regional food crop production and export earnings would need to be made if the Sahelian

Map 1

WEST AFRICA: PRIMARY CATTLE PRODUCTION AREAS



After R.G. Harrison Church, 1966

countries were not to become permanently dependent upon concessional food assistance. (See AID, 1976a and AID, 1976b).

The Foreign Assistance Act of 1973.-- The significance of the Foreign Assistance Act of 1973 (FAA) is that it directs AID to focus attention upon the "critical problems of the functional sectors which affect the lives of the majority of people in developing countries: food production; rural development and nutrition; population planning and health; education, public administration and human resource development." It also directs AID "to give highest priority to undertakings submitted by host governments which directly improve the lives of the poorest of their people" and, by implication, the least economically developed countries, such as those of the Sahelian Region.

Quoting from a report of the House Foreign Affairs Committee,¹ "We are learning that if the poorest majority can participate in development by having productive work and access to basic education, health care and adequate diets, then increased (economic) growth and social justice can go hand in hand."

Following from these legislative mandates, the overall AID strategy for current programs for 1976 and beyond for the agricultural sector are:

1. to increase agricultural production both quantitatively and qualitatively (higher yields and greater nutritive value) and;
2. to assure adequate food supplies and assistance for the rural poor.

The program content is expected to emphasize activities which:

1. develop and disseminate technologies that provide the small farmer with more productive and nutritious crops which can be produced profitably;
2. support and strengthen "economic policy packages" which provide necessary incentives to small farmers to increase the use of productive inputs and expand production;

¹Quotation and outline of review drawn from AID/TO, Circular A 448, "FY 1976 Program Budget Submission Guidance," July 6, 1974.

3. reform land ownership and strengthen security of tenure for users of the land;
4. broaden access to improved technology, needed inputs, information, financing, and markets, including delivery systems;
5. create supporting physical infrastructure -- farm-to-market roads, extension/service infrastructure and the like.

In examining the general AID guidelines for the agricultural sector, the absence of direct reference to animal protein or conservation of resources should be noted. By implication, live animals and animal products may be considered to be both food and cash crops which have high nutritive values and a ready cash market. They may also be part of the logical family farm production unit package that deserves to be introduced or strengthened. However, strictly speaking, to receive highest priority support under general AID guidelines, livestock development activities should be "complementary" to the expansion of food crop production and should ideally contribute to a reduction in the income disparities between regions and between individual family production units within regions. By any standard, the Sudano-Sahelian Region of West Africa is one of the least advantaged areas of the world. If there is to be any reasonable expectation of economic development and improvement in family incomes, increased emphasis must be given to conservation of natural resources for this and future generations.

The Desertification Process in Arid Regions.-- The problem of "desertification" in arid regions such as the Sahel is a growing international concern.¹ Although without precise definition, a simple and

¹Because of the role of overstocking in the desertification process and the potential to relieve pressure on the rangelands through "stratification of production," the author was privileged to assist the Secretariat of the United Nations Environmental Program (UNEP) in preparing a feasibility study of a transnational project entitled, "Management of Livestock and Rangelands to Combat Desertification in the Sudano-Sahelian Region (SOLAR). (Ferguson and Vandermaele, 1976). The anagram SOLAR resulted from an earlier title, "Stratification of Livestock Production in Arid Regions." Portions of this review have been adopted for inclusion in an action program document for the 1977 World Conference on Desertification. See also; G. Boudet, A. Bourgeult, J. Coulomb, D.S. Ferguson and F. Vandermaele, "Sur l'Etude de Faisabilité Sur la Gestion du Bétail et Des Terrains des Parcours Pour Combattre La Désertification Dans les Régions Soudano-Sahéliennes (SOLAR)," UNEP, Nairobi, 1976.

graphic definition of the term is "the development of desert-like landscapes in areas which were once green." A more practical definition is the decline in yield or net returns from units of land that accompany natural or induced environmental changes. It differs from drought, which is a temporary meteorological phenomenon. Desertification processes may be accelerated by drought periods, but the semi-permanent and permanent changes in natural productivity which occur are induced largely by the actions of man. Thus, desertification is also a human phenomenon, as it is caused by man and directly affects his welfare and as it may permanently alter the ability of individuals and societies to produce the food and raw materials necessary for economic growth.¹

It is generally agreed that overstocking and the lack of managed grazing patterns in the Sahel are the most important causes of desertification in the Region and that desertification is a symptom of more fundamental problems of rapid population growth and the inability of individuals or communities to adopt known land management and conservation technologies. If current desertification trends cannot be reversed quickly, the countries of the region may permanently lose the capacity to feed themselves and the ability to support a growing population at even current subsistence levels. For these reasons, mastering the critical problems of overstocking is one of the keys to the medium- and long-term economic development of the Sahelian Region. Thus, the emphasis in this review is on describing land use patterns and identifying those zones where desertification processes are most severe, while emphasizing the positive potential of the livestock sector to contribute to long-term growth.

¹For a detailed discussion of the desertification process see: Warren, et al., Ecological Change and Desertification (Univ. College London, 1976) and Kates, et al., Demographic, Social and Behavioral Aspects of Desertification (Clark Univ., 1976). These are discussion documents (in process) prepared for the 1977 Conference on Desertification to be sponsored by the United Nations Environmental Program (UNEP).

Defining the Concept of Stratification in Livestock Production

Most, if not all, of the many studies relating to West African livestock development have endorsed in principle a livestock development strategy based upon the stratification of production by eco-climatic zone and stage of production.¹ The term "strategy," employed most frequently in military parlance, implies the skillful management of scarce resources to gain the better of an adversary -- an appropriate term to describe the Herculean management and change programs required to gain mastery of the poverty and environmental deterioration prevalent in the Sudano-Sahelian countries.

The term "stratification," literally "to arrange in layers," has a less specific meaning and is rarely defined in the literature except by examples. The examples fall into two separate but related conceptual categories.

- a. Stratification of the process of meat production into separate layers or stages -- breeding cow/calf herds, growing out, fattening, processing -- with each stage located geographically to take advantage of the comparative advantage of each eco-climatic zone (see Chapter IV).
- b. Stratification of land use and management systems or patterns -- extensive grazing, extensive crop production, intensive fodder/pasture production, intensive crop production, mixed farming, conservation and forestry -- sited and planned to make the best use of all scarce resources, the land use potential of specific site locations, the existing infrastructure, population density, product demand and other physical, social and economic factors (Chapters III, V, VI and VII).

The second, more inclusive definition was taken as the operational one for the purpose of this review. First, it is more compatible with the data requirements for sector analysis, providing a basis for preparation of regional and national development assistance programs.

¹See for example, Abercrombie, 1975, AID/Afr, 1972; AID/REL SO/WA, 1974; IBRD, 1975; Matlock and Cockrun, 1974; and SEAE, 1974.

Second, livestock production does not occur in isolation but as part of complex national and regional land use and socio-economic systems. As population increases, there is increasing competition between grazing and cultivation as land uses. In addition, red meat must compete with other forms of quality proteins and with more basic subsistence requirements in the very limited budgets of the low income persons who dominate demand for meat (see page 57). Third, the documented desertification which is occurring is not caused exclusively by overgrazing but also by shifting cultivation, burning, and the unwise design of development projects. Fourth, all non-optimum (uneconomic) land use patterns are subject to modification and are potential targets of development by individuals and nations. The more nearly optimum uses of resources will include at least part of the modifications usually lumped together as stratification by stage of production.

In the review and analysis, emphasis has been placed on identifying action programs which would have an impact on the largest number of persons. This is for the very practical reason that all residents of the Sudano-Sahelian Region have a personal interest in preserving the land resources for their own use and that of future generations. The actions of individuals and small production units taken collectively are causing the observed environmental damage, and reversing these trends will, in turn, require collective action, in some instances restricting the activities of individuals. Therefore, gaining the support of communities for collective actions to protect the land resources is an absolute necessity and will require education of millions of individuals as to the causes of desertification and reorientation of land use practices on a massive scale. Gaining the support of individuals and communities will be easier if action programs improve average incomes. If incomes can be increased, this will allow local and national governments to capture part of the increased incomes either as taxes or user-beneficiary charges or fees, thus also helping them to assume the financial support of action programs past the initial donor-subsidized phases. The analysis also clearly indicated that greater community regulation of land use and settlement patterns will be necessary if accelerating environmental deterioration trends are to be reversed and damaged land rehabilitated.

CHAPTER II

WEST AFRICAN GRAZING AND AGRICULTURAL LAND USE SYSTEMS

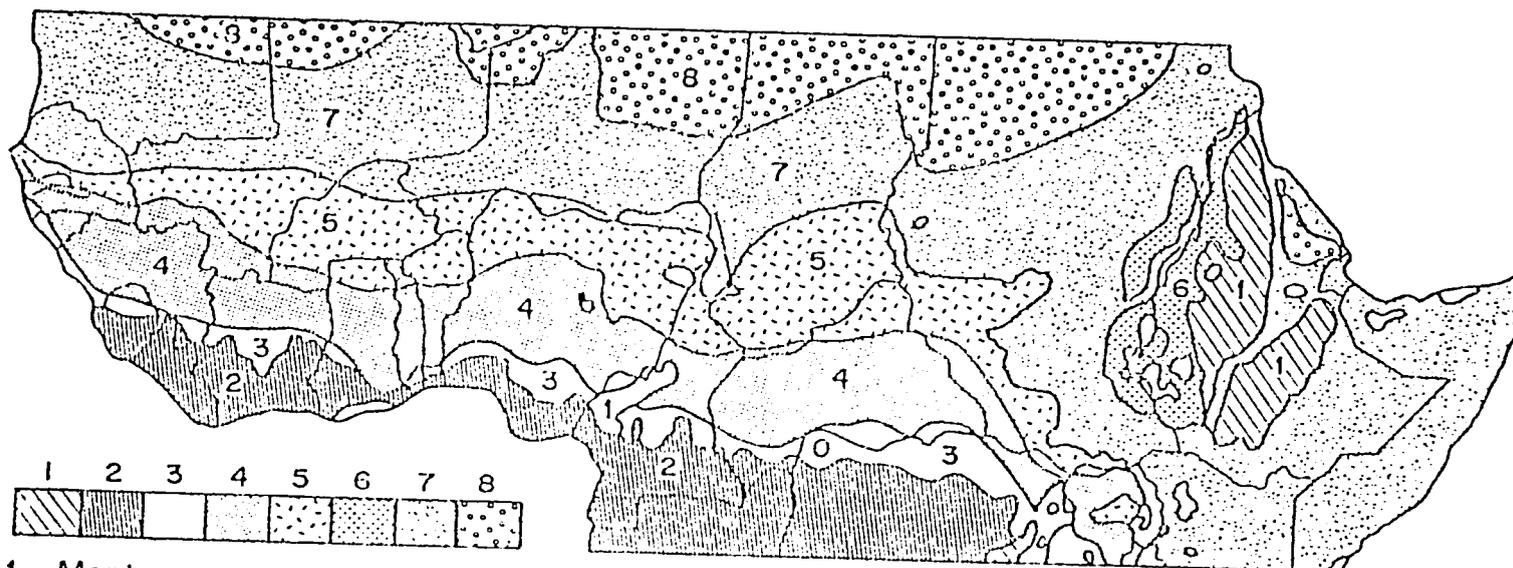
"The objectives of rural development programs are to increase the overall productivity of a region and also to increase the participation of low income farmers in the expansion of agricultural output and income and thus to reduce disparities between classes of farmers. To realize these objectives requires knowledge of the variability of resources within and between regions and between groups of small farmers and on the factors that explain the existing distribution of resources, levels of productivity and variations within them." (Lele, 1975, p. 54.)

Introduction

West Africa is often accurately portrayed as having very similar climatic and physical conditions across broad east-west climatic and vegetation zones. Vegetation zones are depicted in Map 2 and the estimated area of each zone in Appendix Table I. However, apart from the obvious changes resulting from decreasing annual rainfall as one proceeds from the rain forest north to the Sahara desert, there is considerable local variability in land use opportunities (see Chapter III). Taking the comparatively small area of Cameroon north of the Adamaoua Plateau (12 - 16° north) as an example, 16 natural plant communities occur. A recent survey mapped and described nine major land resource zones with differing soils, vegetation, and land use patterns. These they subdivided into 29 soils unit categories with widely differing land use capabilities because of slope, elevation, drainage, and responsiveness to management. In addition, there are 54 separate ethno-linguistic groups represented in a population of only 1.4 million persons, with population density varying from less than 3 to over 100 per square kilometer.¹

¹USDA-SCS/FAC, Land Use and Land Capability Survey of Cameroon North of the Adamaoua (Washington, D.C., 1976). Maps in Annex 1, 250,000 scale.

MAP 2 SUB-SAHARAN WEST AND CENTRAL AFRICA: NATURAL VEGETATION AFTER OXFORD ECONOMIC ATLAS



- 1 Montane grassland, forest and thicket, undifferentiated
- 2 Tropical moist forest
- 3 Tropical forest-savanna mosaic. Undifferentiated tropical woodlands, savannas and steppes
- 4 Relatively moist types
- 5 Relatively dry types
- 6 Tropical woodlands – Ethiopian
- 7 Tropical wooded steppes and grasslands
- 8 Desert

Within the Sudano-Sahelian Region, there is diversity caused by rainfall, soils, population density, and other socio-economic factors, and specific ethnic groups or castes within linguistic groups have become specialized in the exploitation of various ecological niches. Broad categories included agriculture (crop production), livestock husbandry, fishing, and various craft occupations (Horowitz, 1969).

Within crop-dependent groups, sub-categories include:

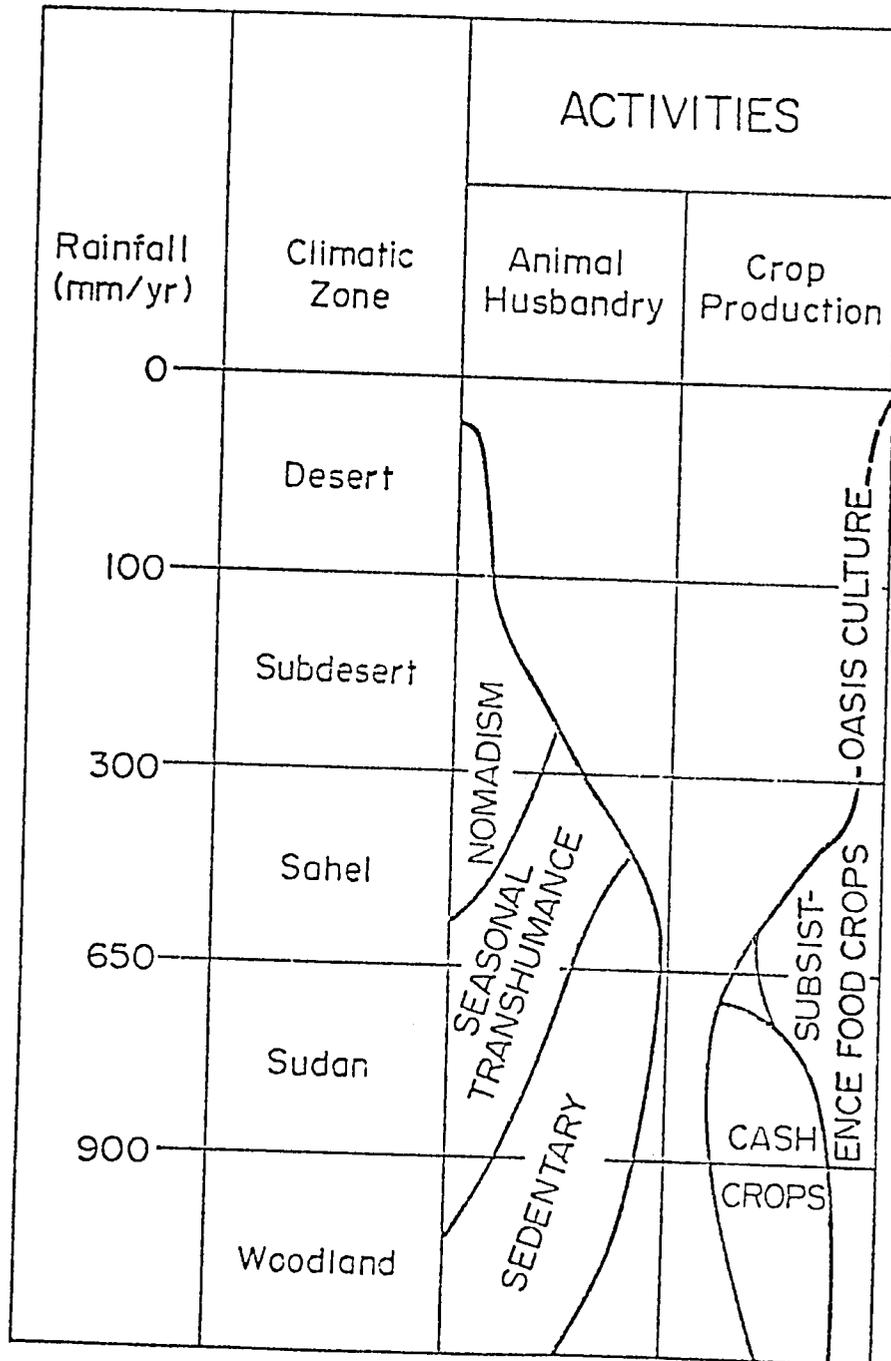
1. Planting agriculture - yams, manioc, bananas, and tree crops in forest and Guinean zones.
2. Sowing agriculture - sorghums, millets, groundnuts, and cotton in the Savanna and Sahelian zones.

Within the livestock-dependent groups, sub-categories include:

1. Semi-transhumant - grazing patterns rarely over 25-30 km centered around a sedentary village, family units grow most of their own food crops and occasionally cash crops in the Guinean and Sudanian zones.
2. Transhumant pastoralist - grazing pattern normally includes a "long" seasonal transhumance movement, may grow part but rarely all of food crops, family members travel with the herds in the Guinean, Sudanian and Sahelian zones.
3. Nomadic pastoralists - grazing pattern less predictable depending upon localized occurrence of rainfall and vegetable growth, limited to the Sahelian and sub-desert zones.

The spatial relationships of each group to annual rainfall and to each other are illustrated in Figure 1, and a rough estimate of the percentage of the population in each category in the six Sahelian countries is given in Table 1. The available data suggest that 76 percent of the rural-agricultural population are crop dependent, an additional 11 percent are sedentary persons with an important livestock enterprise, and 13 percent fall in the transhumant or nomadic categories. There are often no clear-cut distinctions between groups, and both management and land use patterns form a continuum depending upon rainfall levels, soil fertility, and other factors.

FIGURE 1: SUDANO-SAHELIAN REGION: Distribution of Agricultural Activities by Climatic Zone



Modified from W.G. Matlock and E.L. Cochran, A Framework for Evaluating Long Term Strategies for the Sahel-Sudan Region, Vol. II, A Framework for Agricultural Development Planning (MIT, Center for Policy Alternatives, Cambridge, 1974).

TABLE 1

SAHELIAN COUNTRIES: ESTIMATED PERCENTAGE OF CROP AND LIVESTOCK-DEPENDENT POPULATION, MID-1975

	% Crop Dependent	% Livestock Dependent				% Total Rural	% Urban	% Total Population
		Sedentary	Transhumant	Nomadic	Total			
Mauritania	23	15	5	45	65	85	15	100
Senegal	65	10	-	-	10	75	25	100
Mali	66	10	4	10	24	90	10	100
Upper Volta	80	5	5	-	10	90	10	100
Niger	60	15	5	10	30	90	10	100
Chad	70	10	5	5	20	90	10	100
Percent Total	66	10	4	7	21	87	13	100
Percent Rural	76	11	5	8	24	100	-	-

For sources of estimates see Appendix Table III.

The data indicate that these subsistence activity groups are not restricted to defined climatic zones, and it is common to find both crop- and livestock-dependent family units resident or seasonally resident in the same locality. Their differing systems of management and land use are symbiotic to the extent that they represent a degree of specialization and they tend to use different soil units. Some trade of cereals and other food items occurs for meat, milk, and milk products. However, the potential for conflict is increasing as population and hectarage required for food and cash crops increase. The review illustrates the extreme complexity of local situations which require careful analysis in both pre-project and project implementation phases of development programs.

In the sections which follow, the typical agricultural production systems and units which occur in the Sudano-Sahelian Region are described, focusing upon livestock management and land use patterns. Important distinguishing features include the types of food and cash crops grown, species and breed types of animals raised, length of transhumance patterns, and ethnic or linguistic group affiliation.

Sahelian Region - Nomadic and Affiliated Groups

The Sahelian Region may be divided into two principal subregions: 1) the north, or true, Sahel subregion with less than 400 mm rainfall, within which very little rain-fed cultivation occurs and 2) the southern Sahel subregion with rainfall in a range between 400-600 mm, which is a zone of interaction between sedentary agriculture and nomadic or, more accurately, transhumant pastoralists. The term "nomadic" has been retained because of its common usage, although it is a misnomer to consider West African livestock owners as "nomads" as almost all family groups have a home village or campsite which they inhabit for a

prolonged period each year.¹ The production units which are closest to being "nomadic" are those that practice long distance transhumance into arid Sahelian and semi-desert zones. Because rainfall is concentrated in a very short period of the year and tends to fall in brief, intense showers, the location of rainy season range pasture and surface water in the sub-desert zone may be unpredictable. Herdsmen seek out those areas which have the best seasonal grazing (Matlock et al., 1974). However, there are only a more limited number of locations with temporary or permanent water which provide secure dry season camps, usually in the southern part of their cycle.²

Those Sahelian Region ethnic groups which have traditionally been livestock dependent are the Maures of Mauritania and Mali, the Tuareg of Mali and Niger, "white" Arabs of Chad, and some groups of Peul in Mauritania, Mali, Niger and Chad. The more arid the locality, the fewer cattle and more sheep, goats and camels in each herd. A general indication of their spatial distribution may be inferred from Map 3, as most livestock breed types are named for ethnic groups which husband them.

¹ Webster's defines a nomad as "a person who roams from place to place without a fixed pattern of movement." By this definition, there are few true nomads in that most livestock-owning groups have consistent patterns of displacement and a defined home location. Webster's defines migratory as "moving habitually or occasionally from one region or climate to another," a term which accurately describes West African grazing patterns. The term transhumance originally referred to the migration of livestock from high European Alpine valleys in the summer to low valleys in the winter but has been adopted to describe the West African migratory pattern, which is based upon wet and dry season pasture availability. "Nomadic" and "transhumant" groups are often accurately described as "pastoral" because social organization is based on livestock raising as the primary economic activity. Definitions taken from Webster's Third New International Dictionary (Unabridged), 1971.

² The location of late dry season campsites is determined primarily by availability of water. Some transhumance routes, such as those south of the buckle of the Niger River in Mali, actually move south in the rainy season, exploiting seasonal meadows, returning north in the dry season to the River valley. Others are located near oases or permanent springs in desert mountain areas.

In the pre-colonial period, the Maures and Tuareg controlled not only the true Sahel but also large areas to the South. There, they controlled communities of sedentary agriculturists with the relationship between the groups being that of lord to vassal. Some of the sedentary communities were located well into the Sahelian Region along fossilized river valleys and inter-dune depressions where runoff from desert showers collects, providing sufficient water to mature short season varieties of sorghums and millets (Baier and King, 1976).

Within the farming system, the crop-dependent communities provided the pastoralists with food grains and other services, such as herding and the drawing of water from hand-dug and hand-drawn wells. With colonization and independence, non-voluntary relationships have been officially abolished, but group specialization continues on a salaried and trade/barter basis.

As a consequence, crop-dependent communities that spread the languages of their former masters are a prominent feature of the Sahelian Region. These include the Bella (Tuareg), Haratine (Maures) and Rimaibe (Fulani). Where they have accumulated enough livestock, they have occasionally become pastoralists, but a majority continue to live in semi-permanent villages and are crop-dependent (see page 27).

With the imposition of colonial rule, the Sahelian Region also became safe for immigrants from the over-populated Sudanian zone. These included crop-dependent, semi-transhumant, and in Niger, pastoralist Fulani. To indicate the racial complexity of the Region, the ethnic composition and stock ownership patterns of two localities in the zone of intermixing -- the Guidimaka Region of Mauritania and the Sahel ORD of Upper Volta -- are given in Tables 2 and 3 respectively.

The variability of transhumance patterns within the 4,000 km wide nomadic zone is too great to describe in detail. Both settlement and seasonal transhumance patterns in an arid environment are determined primarily by the availability of stock water. The evidence shows that regardless of locality, seasonal transhumant families tend to follow the same routes, which are limited to well-defined areas of displacement, in order to avoid conflict between groups for water and range sites. In the comparatively brief rainy season (6-8 weeks), herds are dispersed

TABLE 2
 MAURITANIA TENTH REGION (GUIDIAMAKA): ESTIMATED
 CATTLE, SHEEP AND GOAT POPULATION
 BY ETHNIC GROUP, 1975

Group	Cattle	Sheep	Goats
<u>Pastoralist</u> (Maure)	85,500	107,000	133,000
(Per Capita)	(--)	(--)	(--)
<u>Short - Transhumance</u>			
Peuhl and Toucouleur	31,600	28,000	5,600
(Per Capita)	(2.82)	(2.5)	(0.5)
Sonike	26,900	50,000	8,000
(Per Capita)	(1.12)	(2.1)	(0.3)
Haratione	6,000	15,000	3,400
(Per Capita)	(0.43)	(1.1)	(0.3)
Sub Total	64,500	93,000	17,000
(Per Capita)	(1.43)	(1.9)	(0.4)
TOTAL	<u>150,000</u>	<u>200,000</u>	<u>150,000</u>

Source of Data: BDPA/FAC, Project de Developpement du sud Est Mauritania Tome IV, annex 3, Elevage (Paris, June, 1975).

TABLE 3
UPPER VOLTA: SAHEL ORD HUMAN AND LIVESTOCK POPULATION BY ETHNIC GROUP, 1974

	Persons	Cattle	Sheep/Goats	PER CAPITA	
				Cattle	Sheep/Goats
Predominantly Pastoral:					
Touareg	2,700	13,500	16,200	5.0	6.0
Bella	36,100	62,000	280,000	1.8	7.8
Peuhl	103,500	374,600	344,000	3.6	3.3
Maures	-	-	-	-	-
Sub-Total	142,300	450,100	640,200	3.1	4.7
Predominantly Sedentary:					
Peuhl (Rimaibe)	55,400	95,300	153,500	1.7	2.8
Sonrai	16,200	3,250	34,900	.2	2.2
Mallebe	2,800	2,800	7,600	1.0	2.7
Maurance	1,800	-	2,000	-	1.1
Foulce	18,400	1,800	18,000	0.1	1.0
Mossi	21,200	4,150	23,900	0.2	1.1
Gourmantche	6,400	2,600	12,800	0.4	2.0
Diverse	7,800	-	7,100	-	1.0
Sub-Total	130,000	109,900	259,800	0.8	2.3
TOTAL SAHEL	<u>272,300</u>	<u>560,000</u>	<u>900,000</u>	<u>2.1</u>	<u>3.3</u>

Source of Data: ACCIR/CIDR, Secheresseou Sahel (Haute Volta) Enquete - Projects (Redaction Provisoire)
ACCIR/CIDR, No. 156, January 1974.

throughout the Sahelian and semi-desert zones. As the rains cease, herds regroup farther south around persistent surface water sites (October-December). As the dry season progresses, herds become more concentrated around those locations with permanent water (see Chapter VII and Figure 5).

Various informal agreements existed between herding groups to govern the use rights to specific range sites. These are referred to generally as "pastoral codes." These agreements began to erode with the democratization of the society, which began with the colonial era, and the trend was accelerated by the post-World War II development of permanent deep wells in the grazing zones (see Chapter VII).

The basis of many of the codes was the right to use specific watering points or wells. Although grass and browse are not considered to be ownerable (see page 27), wells are the property of the individual or group who dug the well. While Koranic law requires that a good host provide water and feed to persons in transit, it does not require that they be allowed to remain until feed and water become exhausted. Thus, group ownership of watering points provided some informal control over stocking density. The most severe overgrazing in the Sahelian Region is occurring around publicly-owned deep wells, most of which have been constructed by donor-financed projects. As they provide almost unlimited supplies of water and are public rather than group property, there is no social system (private) control over stocking densities or grazing patterns. The public authorities have been reluctant to ration access to an element as vital to survival as water. The ease of watering cattle coupled with the absence of management are responsible for the severe desertification around most well sites (see Chapter VII).

Concurrently, in the post-war period, the livestock population began to grow at unprecedented rates because of a long period of unusually favorable rainfall, the democratization of livestock ownership rights, the development of public watering points which did provide access to comparatively underutilized range land, the control of communicable diseases, and immigration of herds from the south attracted by the then superior grazing conditions. The impact of the drought period was initially to level off the rate of growth of herds, followed by severe mortality in 1972/73 when there was a near-total failure of rainfall. See Appendix Tables VIII and IX.

Within the southern portion of the Sahelian region, with enough rainfall to mature food crops in favored locations (400-600 mm), the seasonal transhumance patterns become, as a rule, shorter and even more circumscribed within defined localities.

To describe these limited movement patterns in the Sahel ORD of Upper Volta, Barral coined the term "zones of endodromie," within which a relatively fixed number of herds and dependent families live following an annual transhumance cycle (Barral, 1974). Zones usually include both predominantly crop-dependent and livestock-dependent family units. The characteristic of each zone is:

1. A defined number of perennial watering points -- wells, mars (shallow lakes), puisards (hand-dug wells) -- used by a given group of families;
2. dry season pasture accessible from these points;
3. agricultural lands used by both groups generally near to the permanent watering points;
4. temporary rainy season watering points which permit seasonal dispersal of the herds to outlying areas;
5. rainy season rangeland accessible from the temporary water points.

According to Barral, the geographic extent of the zones is becoming smaller. As persons owning livestock have become progressively more dependent upon their crop-growing enterprises, less range land is being "reserved" near permanent watering ponds for dry season grazing. Many range sites near permanent villages are under continuous grazing pressure and are deteriorating rapidly. Further, those soils which provide the most secure sites for cultivation -- the bas fonds and sandy soils with good water retention properties -- are also the most productive range sites. In many localities, the bas fonds are under continuous cultivation, and any expansion of land under cultivation for subsistence food production must occur on upland sandy soils where the risk of crop failure in drought years is greater, as is the risk of environmental damage. Because of the multiple land use systems which occur in each "endodromic" zone, localized development plans should encompass entire zones wherever possible.

To summarize, the rigid ethnic boundaries between crop-dependent and livestock-dependent groups, which were maintained for centuries, are being eroded under the influence of population growth, drought, the policies of modern nation states, and the growth of a monetized economy. Ancient antagonisms between groups, often resulting from a former military or political dominance of one group over the other, remain as an important element in national politics and, consequently, policies towards livestock and Sahelian zone development.¹

A note on West African concepts of the ownership of land and vegetation is in the concluding section of this chapter.

Sudano-Guinean Region - Semi-Transhumant and Transhumant Pastoralist Groups

In the Sudano-Guinean Region, livestock-dependent family production units comprise a small minority -- usually less than 10 percent -- of the population in most communities. However, they manage the majority -- perhaps 70 to 90 percent -- of the cattle. Estimating the actual numbers or percentages is nearly impossible given the nearly total absence of agricultural census or farm survey data and the reluctance of owners (or herdsman) to provide exact information on ownership patterns.

The largest and most widely dispersed ethno-linguistic group of cattle-dependent persons is comprised of those who speak various dialects of the Fulfulbe language. They are found throughout the Sudanian Region from Senegal to the Republic of Sudan, a distance of over 4,000 kilometers. Based upon linguistic evidence, their point of dispersal was the Fouta Toro/Fouta Djallon districts of Eastern Senegal and Guinea. In Senegal, Fulfulbe speakers include the Toucouleur. In English-speaking countries they are known as Fulani and in French-speaking countries, as Peuls or Peuhls.

¹Long civil wars pitting arid zone against Sudanian zone peoples have plagued Chad, Sudan, and Ethiopia. In a reversal from pre-colonial times, crop-dependent ethnic groups now control governments in Mali, Chad, Niger, and Northern Nigeria and determine policies towards livestock and arid zone development. Only in Mauritania and Northern Cameroon have livestock-dependent groups remained preeminent in local politics.

The evidence suggests that there have always been two distinctive subgroups of Fulfulbe-speaking peoples; those that are at least partially dependent on crop growing for family subsistence needs and those that have maintained a more separatist, pastoralist pattern (Murdock, 1959). This hypothesis is supported by the many localities within which are found both Fulani living in sedentary villages or in close association with crop-dependent villages, and other groups which (typically) live in temporary structures and maintain a more pastoral existence. The two groupings recognize a common ancestry and a common set of interests and values based upon grazing and cattle ownership. However, they rarely intermarry with each other and almost never intermarry with local crop-dependent ethnic groups.

Semi-Transhumant Stock Owners.-- Looking first at sub-group I¹ (those living in or operating out of sedentary villages), they are found in small communities scattered throughout the Sudanian and Guinean Zone.

Their eastward dispersal from Senegal began at least 600 years ago and was generally peaceful but was linked to the rise and fall of various kingdoms and the spread in Islam.² They were apparently welcomed into the communities where they settled because of their superior knowledge of animal husbandry. As they were a minority, they were subject to local chiefdoms and were forced to live near local villages for protection. In Northern Nigeria and Cameroon, they rallied to the banner of the Fulani Jihad (religious war, circa 1800) led by Usman dan Fodio, overthrowing the established Hausa chieftaincies and becoming the ruling group. It may be hypothesized that the willing participation of the

¹For the best overall discussion of transhumant Fulani community in Nigeria, see Hopen, 1958.

²For a discussion of the history of the dispersal of the Fulfulbe speaking people, see Hopen, 1958 and Stenning, 1959. Simultaneously, a wave of livestock-dependent Shua (black) Arab tribes was expanding westward from the Republic of Sudan into Chad, extending as far as Serbewel District of Cameroon on Lake Chad (where the tribes appear to have filled similar niches in the local agricultural systems). (Regna, 1974)

pastoralists in the Jihad was, at least in part, motivated by the desire to free themselves from the payment of tribute to local chieftaincies for the rights to graze their cattle.

The degree of livestock versus crop dependence depends upon the luck and skill of the herdsman. There is little question that family units would in preference accumulate enough livestock so that crop production to support subsistence needs would not be necessary (Dupire, 1962). Those without sufficient cattle of their own often become herdsmen for more fortunate kinsmen or for groups of sedentary farmers. Where they operate within the Sudano-Guinean Region, they usually practice short distance transhumance within a well-defined geographic area rarely exceeding 25 - 30 km from the home village. It is noteworthy that they almost always husband the breeds of livestock believed to be indigenous to the locality, including the various breeds of trypano-tolerant cattle (see Map 3).

Although the semi-transhumant Fulani are well integrated into the local farming system, aside from communities where they are a majority or are the politically dominant group they have not acquired rights of land ownership -- even on the plots of land that they cultivate. Two projects with the objective of evolving more optimum community land use patterns integrating livestock- and crop-dependent households are described in Chapter V.

Pastoralist Fulani.-- The most difficult management system to characterize is that of the Fulfulbe-speaking subgroup which has maintained a more separatist and pastoral existence. The people are commonly referred to collectively as Mbororo (literally, bush Fulani) because they tend to graze their animals in less accessible rangelands. They are found in communities from Eastern Mali and Upper Volta across

¹For the most comprehensive discussion of Mbororo society and husbandry patterns, see Stenning, 1959. Other discussions are found in Dupire, 1962. Possible cultural relationships between the "Royal Peuls" of Mali and Mauritania and the Mbororo have not been studied (Regna, 1976, personal communication). For a discussion of Malian Peul society, see Rupp, 1975.

Niger, Nigeria, and Chad and into Sudan Republic and in plateau areas of Cameroon and the Central African Republic. They tend to use the most marginal land resource zones, practicing long distance transhumance in the arid zones of Niger and Chad and a short distance transhumance in Cameroon and Central African Republic (see Map 3).

Those that transhume long distances almost always live in temporary structures constructed of thatch and poles (and recently plastic tarpaulins), which can be disassembled and moved when grazing conditions warrant. Although older persons and small children may remain with a small herd of cows in permanent base camp areas where short season millets may be grown, the entire family usually transhumes with the herds. Because of more frequent movement, they are rarely able to produce all of their subsistence, starchy food crop needs. Whole communities have been known to migrate long distances and establish new transhumance patterns in order to escape disease, taxation or overgrazed rangelands. (Stenning, 1959). During the drought, some family groups from Mali and Niger settled temporarily as far south as northern Ivory Coast and Ghana.¹ With the end of the drought, many families remained in Ivory Coast. They almost universally husband Red Fulani cattle, which appear to be related genetically to the Ankole type cattle of Uganda, Rwanda and Zaire.

Because they have weaker ties to local crop-dependent communities and specific geographic areas of transhumance, the problems of their integration into national and regional development plans are more difficult. Although this pattern of husbandry will continue for some time in the future, as they do tend to use more marginal agricultural areas, the expansion of population and cultivation will inevitably require further restrictions on their movements and in the range resources available for their use.

¹Several projects to create designated "zones of welcome" were proposed in Ivory Coast in order to minimize conflict with local residents and to encourage them to remain with their cattle, thus expanding the Ivorian herd more quickly (Cote D'Ivoire, 1973).

Crop-Dependent Production Units

With the exception of the true Sahel, with less than 400 mm of rainfall, a majority of rural persons are members of predominantly crop-dependent family production units. They comprise at least 75 percent of the rural population of the Sahelian countries. The subsistence food crops grown vary with rainfall. In the more arid areas, the tendency is to grow a variety of crops which differ as to soil requirements, tolerance to soil fertility and moisture, and length of growing season. As an example, farmers in the 10th Region of Mauritania, an area with 500-650 mm of rainfall, cultivate fourteen separate varieties of cereal and leguminous crops using both upland (sandy soils) and low-lying soils (bas fonds). The diversity of crops grown reduces the risk of complete yield failure in either drought or flood years (BDPA, 1975 and Downs and Rayna, 1976). The subsistence farmer's strategy appears to be to minimize the risks of crop failure in either drought or flood years rather than to maximize average yields over a period of years.

Although crop-dependent, it is the exceptional rural household which owns no livestock, as most own at least some poultry, goats, sheep, and, in some localities, pigs and donkeys. The small stock will be one of the local African breed types. Small stock are usually to be scavengers, but during the crop-growing season, sheep and goats may be herded by a young person or staked out in order to prevent damage to growing crops.

The percentage of crop-dependent households that own cattle is believed to be small but may be increasing. Cattle are widely owned by the more prosperous farmers and by heads of villages; but because pastoralists are no longer able to maintain a monopoly on cattle ownership in the Sahelian region, and because cattle are one of the few liquid investments available to farmers and to persons with savings accumulated through migrant labor or salaried employment, many persons are buying cattle as an investment.¹ There is some evidence that crop-dependent persons in arid areas tend to view livestock ownership as part of the risk avoidance

¹In Eastern Senegal, Mauritania, and Mali, flows of funds from persons who have migrated to France are substantial and often are invested in cattle (Downs and Regna, 1976).

strategy, because livestock can be sold for cash to buy food when food and cash crops fail. Consequently, management of livestock by sedentary farmers may be less "rational" than that of pastoralists when it comes to allocating labor for herd management and deciding on the optimum time to sell animals.

Crop-dependent and salaried persons rarely manage their own herds directly but contract herding and management to paid herdsmen who are usually from one of the Fulfulbe-speaking groups. Payment may be in cash, in part or all of the milk produced, a share of the calves weaned, or in exchange for food grains. The contracting-out of management appears to be advantageous to both parties. The owner is freed from the opportunity costs of herding, watering, and either producing or reserving feed on or adjacent to the village settlement. For his part, the herdsman gains access to capital resources and, in some localities, the land resources which he needs to support his family. However, the contracting-out of herding and management activities is generally believed to be a constraint to the expansion of animal traction, small-unit animal feeding, and mixed farming. These are discussed in more detail in Chapter VI.

For various reasons, the percentage of rural family production units that own cow/calf herds is likely to remain small. These reasons are a) the severely overstocked grasslands and rangelands near the more densely populated farming areas, b) the absence of land-tenure arrangements which permit individuals or communities to reserve adjacent land for village grazing use, and c) the expansion of the hectareage of land under cultivation. However, provided the feed/fodder constraint on small farms can be broken, an expansion of animal traction and small unit feeding may provide a key link in a regional livestock development strategy.

A Note on Land Tenure in Relation to Forage Resources

Under traditional African land-tenure systems, land is the collective property of the tribal group which first settled the land. Members in good standing in that group are allotted land without charge

by the chief or the land priest, while non-members require permission of the chief to cultivate land. Non-members of the group may be required to pay a fee in cash or in kind. After a variable number of years under cultivation, exhausted plots (go-back land) are allowed to revert to volunteer grasses, weeds, and woody vegetation.

Although land and crops under cultivation are the de facto property of the person cultivating the land, volunteer vegetation on land not currently in use is considered to be common property and a gift from Allah. This includes both vegetation on go-back lands and on any grasslands or rangelands. According to Downs and Reyna, for an individual (or the state) to claim ownership of grass and to charge a fee for its use would be as unreasonable to an African herdsman as for an American to claim ownership of the air and charge a fee for its use (Downs and Reyna, 1976, p. 83). A Fulani proverb states that grass and browse are owned by "everyone and no one."

This concept of ownership of the traditional dryland crops, but not volunteer vegetation, carries over into community herd and flock grazing protocols. During the normal cultivation and harvest cycle, it is the responsibility of the stock owners to keep livestock out of unfenced croplands. Persons whose animals damage standing crops are responsible for such damage and may, in addition, be fined heavily by local courts. On the other hand, following the traditional harvest season, it becomes the responsibility of persons with irrigated dry season crops to protect them from stock damage. Too frequently, village flocks and herds are left entirely unguarded during the dry season and are allowed to trail, unattended, out to graze in the morning and back to the village in the evening where they are watered, completely denuding the land around each settlement. Historically, as village perimeters become exhausted, the entire site could be abandoned and a new village constructed on more fertile land. With few localized exceptions, this is no longer a practical possibility. Soil conservation practices are not part of most African farming systems.

As a consequence of this exploitive land use tradition, the non-ownership of forage, and the division of labor between crop farmers and stock managers, individuals are discouraged from reseeding go-back lands with either grass or legumes because they would not directly benefit from the expense or labor of establishing a pasture crop. Tens of

thousands of hectares of land are left fallow annually without replacing the vegetative cover, contributing to soil erosion and environmental deterioration. Persons choosing new plots or village sites to replace those abandoned inevitably choose the most fertile soils, usually marked by the presence of good stands of perennial grasses. This effectively removes the best remaining rangelands from the grazing cycle.

In 1962, a law was adopted in Niger which defined a "pastoral" zone north of the 400 mm isohyet within which no cultivation was to be permitted. The dual objectives were to protect farmers from the risk of crop failure and to preserve a cultivation-free range area. It did not prove possible to enforce the law because many pastoral zone communities grow crops, and because a continual stream of new settlers flowed into the zone. Many of these same persons were those most severely affected by the 1968-1973 drought period.

In the context of West Africa, an investigative survey of land tenure as it relates to the use of rangelands demands a high priority. In both Anglophone and Francophone countries, non-adjudicated land is assumed to belong to the state. Consequently, there is a tendency to assume that fairly radical changes in land use codes present no legal problem, as these can be imposed by decree. However, where introduced land tenure or use codes are in conflict with traditional ones, implementation could be socially disruptive and costly.

There are scattered references in the literature to "pastoral codes," which are said to have been effective in limiting conflicts between groups, but it is less clear that they were effective in limiting damage to land and range resources (Bernus, 1974a and 1974b, IBRD/IDA, 1975). There are numerous studies, specifically of land tenure (see, for example, Pohoryles and Szeskin, 1973), but the literature search has not revealed any surveys focusing upon how various Sudano-Sahelian Region communities perceive use rights to natural vegetation (forage) and how and whether they have historically rationed or limited access to these resources. Investigative surveys are required which concern areas of overlap between non-formalized codes and formal (civil) regulation of use and conservation codes and bylaws. It might be possible to model formal codes after the Nigerian Grazing Reserve Law of 1965, which was drafted originally by a USAID technician.

Because the range resources are finite and subject to environmental deterioration if mismanaged, it should be obvious that the livestock population of the Sahelian Region and the northern portions of the Sudanian Zone cannot continue to increase indefinitely. Because the human population is expected to increase, attention must be given to the redeployment of livestock-dependent persons, either with or without their livestock, outside of traditional grazing zones. Throughout history, arid zones have compelled people to move to areas of better agronomic potential, either by peaceful or forcible expansion. Opening new areas for either seasonal migration or resettlement, and developing programs to equip some persons to find employment outside of the Sahel must be part of any long-range strategy for the arid zone. For those that remain, any improvement in average per capita subsistence incomes will require both an expansion of food crop production for family use and, wherever possible, creation of alternate forms of employment as the population increases.

In the chapter which follows, the major land resource zones of the Sudano-Sahelian region are described. The land use potential of each locality has determined both the existing land use patterns and those which can be evolved through regional land use planning.

CHAPTER III

REGIONAL STRATIFICATION BY LAND RESOURCE ZONE

Sudano-Sahelian Land Resource Zones

Land is the basic unit of all agricultural production.

Conceptually, land can be divided into categories based on a variety of criteria, including soils, vegetation, climate, elevation, population density, and location. Modern systems of soils classification in use throughout the English-speaking world have been broadened to include a concept of "best potential use" of particular soil units in defining cartographic units. That is, a determining factor in defining each category of soil is the appropriate (optimum) management system which, if carried out systematically, would maximize the long-term productivity of the land. Soils with higher use potential normally justify more intensive development, that is, more intensive use of productive inputs such as labor, capital, and management per unit area. On soils of "low" use potential, only extensive application of inputs is usually economically and technically justified. Other things being equal, farm units of equal size on high-potential soils will provide higher net family incomes than those on low-potential soils.

In West Africa, as in other parts of the world, there is a good correlation between natural soil fertility and rural population density. Other things being equal, population tends to be concentrated on the most productive soils and on soils where the risk of crop failure is less in drought periods. Conversely, population density tends to be low, as are family incomes, on soils of low use potential. There are obvious exceptions to these general patterns, which are noted in the sections that follow. It is generally on those soils which are overpopulated in relation to natural productive potential where income per family unit is lowest, and frequently the most severe rates of erosion and environmental damage are occurring. It is also a fact that these are often the localities with the least agricultural development potential (see Summary section).

In order to suggest the resource base variability within the Sudano-Sahelian region and to provide a basis for identifying and evaluating priority livestock projects which reflect local resources, a preliminary and highly generalized categorization of the land resource zones of West Africa has been devised (Figure 2). Neither time nor resources available to the author have permitted these zones to be mapped, nor has it been possible to estimate their geographic extent or the human or livestock populations. It should be obvious from the discussion that "best potential use" is a subjective term which depends upon a wide range of factors, not the least of which are population pressure and national development priorities.

Development Potential and Constraints of Major Zones (See Figure 2, following)

1. Zones Where Extensive Grazing is the Best Use of Land Resources.--

Because of soil moisture and fertility relationship, the most productive rangelands, grasslands, and pastures of the world are found on soils with good to excellent use potential. However, because livestock, particularly the unimproved African breed types, are inefficient in their conversion of fodder into valuable product, fodder production and livestock feeding tend to give away to food and cash crop production -- more intensive uses of land -- as soon as population pressure or price relationships dictate. Because of the comparatively low prices which have prevailed in West Africa for livestock products in relation to food and cash crops and because of growing population pressure, grazing as an exclusive land use on upland soil units of moderate to high productive potential in the Sudano-Sahelian Region has all but disappeared.

As a consequence, "range management" most often involves the management of soil units with low to moderate productivity and use potential on which the "intensive" use of labor, capital, or management per unit area is not financially justifiable. Even modest increases in these inputs are rarely profitable unless the number of animal units with access to the land resource can be limited (Chapter VII).

FIGURE 2: SUDANO-SAHELIAN REGION: MAJOR LAND RESOURCE ZONES AND SUB-ZONES

1. Zones Where Grazing Is the Best Use of Land Resources.
 - 1.1 Arid rangelands with less than 400 mm rainfall - crop production excluded by low rainfall, low soil fertility, and lack of water for irrigation. Many range sites severely degraded with greatest damage near permanent watering sites.
 - 1.2 Arid rangelands with 400-600 mm rainfall - with low population density - short season grain varieties may be grown locally on sandy soils with good rainfall retention properties and on bas fonds or low-lying soils and depressions. Many range sites severely degraded. Settlement constrained by lack of persistent water sources, depth to aquifers, and/or low use potential. Range sites provide dry season grazing for semi-transhumant herds.
 - 1.3 Seasonally flooded grasslands - where permanent settlement (and grazing) excluded by soil characteristics and seasonal flooding often provide the key survival links in the seasonally transhumant grazing cycle because of persistent watering sites and better dry season vegetation quality. Environmental damage limited by forced seasonal rotation resulting from flooding.
 - 1.4 Sudano-Guinean Rangelands - sub-zones of low population density and/or modest land use potential where grazing remains the best potential use. Trypanosomiasis generally limiting.
2. Agricultural Zones with Parallel (Non-Integrated) Sedentary Farming and Extensive Grazing.
 - 2.1 South Sahel Zone (400-600 mm) - zone of intermixing between pastoralist/livestock-dependent family units and sedentary crop-dependent units; cash crop opportunities limited, livestock exports principal cash crop. Severe desertification occurring in village perimeters and near watering points.
 - 2.2 North Sudanian Zone (more than 550 mm rainfall), less than 5 mo. growing season, high population density - best arable soils used for near permanent cultivation with fallow land and marginal soils used for grazing. Shortened shifting cultivation cycle and overgrazing causing severe desertification.
 - 2.3 South Sudanian and Guinean Zone (more than 800 mm rainfall, 5-7 mo. growing season). Conditions similar to 2.2 but rain-

Figure 2 (continued)

fall and longer growing season provide greater range of cash and forage crop possibilities. Locally, trypanosomiasis, limiting lower population density, tends to permit long cycle shifting cultivation to continue, minimizing degree of desertification.

3. Agricultural Zones Where Livestock Production Is a Minor Activity.
 - 3.1 Subzones with very high agronomic potential, such as alluvial and volcanic soils and most irrigated lands.
 - 3.2.1 Subzones where intensive cultivation and techniques are practiced.
 - 3.2.2 Subzones where erosion of soil and soil exhaustion are critical problems.
4. Zones Where Land Use Potential Greatly Exceeds Current Land Use Intensity.
 - 4.1 Potentially irrigable soils of the Savanna and Sahelian region.
 - 4.2 River valley systems of the Guinean Zone - Onchocerciasis and/or physical and locational factors limiting.
 - 4.3 Upland soils of modest to excellent potential - trypanosomiasis and/or physical and locational factors limiting.
5. Zones Reserved for Limited Use or Multiple Use Purposes.
 - 5.1 Forest and Conservation Reserves.
 - 5.2 Game and Hunting Reserves.
 - 5.3 Desert and Wastelands.

Arid Rangelands (Zones 1.1 and 1.2).-- Looking briefly at the constraints to development of the Sahelian Region, on most range sites the grass species have been reduced to seed forming annual grasses with few of the deep-rooted and more productive perennial species remaining. Experience has shown that the volume of dry matter produced can be increased substantially by assuring that annual species are not overgrazed in the wet season, allowing these species to set seed for the following year's regrowth. Thus, the regulation of the numbers of seasonally transhumant stock that flow north into the zone is critically important to increasing the productivity of the zone.

Because rainfall is unreliable as to seasonal quantities and distribution, management units must be correspondingly large. At the current time, there are no managed grazing areas in the Sahelian Region. One possible development model is described in Chapter VII.

Because the drought reduced stock numbers by up to 30 to 40 percent, a brief period exists for some range sites to partially recover and, possibly, for national range services to work out voluntary procedures to regulate grazing patterns and stocking densities. However, because of the temporary lower stocking densities, average grazing conditions are improved and the annual rate of national herd expansion is probably on the order of 3 to 4 percent per year. At this rate of growth, the pre-drought population will be regained within 10-15 years (Boudet et al., 1976, p. 20). To have a reasonable chance of success, programs to limit the expansion of herds to some reasonable level in relation to safe stocking densities must be initiated on a priority basis.

Seasonally Flooded Grasslands (Zone 1.3).-- A special category of West African range resources which occur primarily in the Sahelian Region is seasonally flooded grasslands (Zone 1.3). These include the flood plains of the major river systems, such as those of the Senegal, Niger, Benue, and Lagon/Chari, and the margins of the large number of seasonal or permanent lakes and mares. On these range sites, environmental damages are a minor problem, as seasonal

flooding prevents continuous grazing. However, they often provide a key link in the annual grazing pattern of many seasonally transhumant herds, allowing the use of uplands with only seasonal water sources. The projected taking up of these grasslands for irrigation projects by reservoir flooding, or the prevention of flooding by the construction of dikes, could seriously disrupt seasonal grazing patterns. The impact would be to place greater pressure on more fragile upland rangelands, indirectly contributing to overgrazing and resource deterioration. As a minimum, environmental impact statements required for such schemes should include a cost evaluation of their impact on regional grazing patterns.

Sudano-Guinean Rangelands (Zone 1.4).-- Because of higher and more predictable rainfall, development opportunities are somewhat greater within the Sudano-Guinean land resource zones where grazing is the best permanent (or temporary) land use. Generally speaking, the volume of range forage growth per unit area is greater and persists for a 6 to 9 month period. On the other hand, native range species tend to grow rapidly and have a high cellulose/fiber content when mature. They are therefore of lower feeding value than those native to the arid zones. The low population density characteristic of this zone often reflects modest soil fertility and, less commonly, absence of permanent water sources. Livestock production is constrained by the tsetse fly-trypanosomiasis complex, biting flies (*Stomoxys*, *Tabanids*), ticks and the tick-borne disease complex, and various mineral deficiencies related to severely leached soils. Some range sites near to agricultural zones provide wet season grazing for short distance transhumant herds. Others, particularly those in the Guinean Zone, provide dry season grazing for transhumant herds based in the Sudanian Zone.

Generally speaking, desertification (that is, permanent damage to land resources) is less a severe problem in this zone than in the Sahelian Region. However, even on high potential rangelands such as the Adamaoua Plateau in Nigeria, Cameroon, and the Central African Republic, overgrazing has reduced grass cover on some sites to the point that the periodic hot fires which formerly controlled the woody species no longer

occur, and bush regrowth has created a suitable environment for the reinvasion of the savanna and riverine tsetse fly species. The buildup of the fly population was made possible by unwise restrictions on hunting, which allowed the game population (the favored [and necessary] host for the tsetse), to expand its formerly restricted range (IBRD, 1974). As on other rangelands, improvements in the productivity of land and livestock cannot be made without limitation as to the numbers of animals using the land and, not uncommonly, a seasonal rest rotation management plan.

A variety of development models are possibilities for individual range sites:

- a. Grazing reserve development - allocation of land for the exclusive use of extensive grazing for an indefinite period (see Chapter VII).
- b. Community "ranch" development - allocation of land of marginal agricultural use potential within a community for grazing allocating higher potential soils to crop production (see Chapter V).
- c. "Mixed farm development" - sponsored resettlement activities on better soils, encouraging the development of small-scale mixed farms possibly with access to commons land for stock grazing.
- d. Large-scale private or parastatal ranch development - either breeding herds or steer feeding enterprises (see Chapter V). Choice of model would depend upon many factors, including population pressure, land use potential, trained manpower availability, and the potential of that activity to be complementary to the development of other zones.

2. Agricultural Zones with Parallel (Non-Integrated) Crop-Dependent and Livestock-Dependent Production Units.-- A characteristic of the most economically important land resource zones of West Africa, which support large human and livestock populations is the co-existence within the same locality of parallel, non integrated crop-dependent and livestock-

dependent extended family production units. The patterns may be described as a north-south continuum, with major changes in development potential occurring roughly on the 600 and 900 mm isohyets.

South Sahel Zone (Sub-zone - 2.1).-- The south Sahel Zone, with 400 to 600 mm of rainfall, is the zone of intermingling between "pastoralists" and "sedentary" crop-producing families. Development opportunities are severely limited because of the absence of a suitable cash crop excepting livestock production, which explains, in part, the severe problems of overgrazing and the desire of all households to accumulate livestock.

The gradual trend toward greater crop dependence was accelerated by the drought, during which, depending on locality and source of estimate, 30 to 40 percent of the Sahelian Region livestock population died from malnutrition and other causes (see Tables VIII and IX).

At the present time, there are no suitable soil building rotations for this zone. Village perimeters are often marked by a ring of nearby barren soil as the result of shifting cultivation, the indiscriminate cutting of trees for fuel, browse and construction materials, and overgrazing by village flocks and herds.¹ In those areas of greatest human and stock density, the length of the fallow cycle may no longer be adequate to allow soils to regain lost structure and fertility. Several recent surveys among persons resident in the Sahel have determined that most needs were related to farming rather than to livestock husbandry problems. This may be, in part, because grass is considered to be a free good, but also because the food shortages of the recent drought period are well remembered (Downs and Reyna, 1976, p. 1).

This implication is that research directed toward the evolution of suitable soil maintenance activities for the southern part of the Sahel Region is a critical development priority. In the design of development activities, the interrelationships between co-existing subsistence production systems and the necessity of obtaining the cooperation of diverse

¹Because of devegetation, the location of existing towns and villages and abandoned settlements are easily identifiable from satellite imagery (Reining, 1973).

ethnic groups, if land use patterns are to be modified, must be recognized. Destocking to allow more nearby optimum range use presumes a concurrent expansion of subsistence food crop production. Most donors now tend to favor the design of integrated rural development projects for this zone in recognition of these facts (see, for example, IBRD/IDA, Niger, 1975). It should be noted that development of public services, such as water, schools, and clinics has tended to encourage greater concentration of cultivation and overgrazing around larger villages.

It must be emphasized that the rural population of the Sahelian Region greatly exceeds that which can be supported by subsistence livestock production alone.

It would be shortsighted indeed to ignore the possibilities of arid zone agriculture which have been pioneered in other parts of the world, including such practices as water spreading and climax agriculture.¹

Cash Crop Zones (Zones 2.2. and 2.3).-- In the zone between 550 to 900 mm of rainfall, groundnuts - a leguminous crop - are the principal cash crop. For this zone, cultivation practices and crop rotations do exist in theory, which will preserve productivity and increase yields, but there are few examples of their successful widespread adoption by small farmers (Sargent, 1974). Some of these do include fodder crops and grass leys in the rotations, but adoption of these is constrained by low returns to producing fodder for unproductive African breed types. In some localities, bovine animal traction is well established and small unit feeding is expanding (see Chapter VI). It is possible that fodder or grass leys in the rotation for use in feeding animals used in traction

¹Water spreading involves the construction of small diversion ditches in order to slow runoff and aid rainfall infiltration at pre-selected sites which may then be cultivated. Climax agriculture is an attempt to duplicate the micro-climatic conditions which occur in climax vegetation communities by selecting a variety of food or commercial crops to fill naturally occurring "niches" - an approach being pioneered in the Tapi Vert (green carpet) Project in Niger.

could provide a more widely used package, which would make both organic farming and cattle feeding profitable enterprises for many farm units.

In the zone with more than 900 mm of rainfall, cotton is the principal cash crop. Because of higher and more predictable rainfall, there are greater possibilities for including soil building crops in the rotation (Ruthenberg, 1974), but in many localities, animal husbandry is constrained by trypanosomiasis and the short supply of trypano-tolerant cattle for use in traction programs (McLeroy, 1975).

3. Zones Where Livestock Production is a Minor Activity (Zones 3.1 and 3.2).-- Zones where grazing as a land use is largely excluded fall into two categories: those of very high use potential where grazing cannot compete as a land use, and those where population density excludes grazing except by village sheep and goats.

The first category of land is of very minor extent in the Sudano-Sahelian Region and is limited to a few areas of alluvial and irrigated soils. Generally speaking, desertification is of minor importance.

The second category includes more mountainous or upland plateau soils where cattle are largely excluded by population density. Although comparatively small in geographic extent, these zones do support a comparatively large share of the human population. They are some of the least advantaged areas in West Africa because land pressure all but excludes the production of cash crops. These include the Dogon tribal areas in Mali, the Atakona chain in Togo and Dahomey, and the Mandara Mountains in Cameroon. Severe overpopulation in relation to the land resource is also a problem of the Mossi Plateau in Upper Volta.

Several groups, notably the Dogon and Kerdi of Cameroon, have adopted terracing to preserve soil and water. The rate of soil fertility loss and techniques to further preserve water and intensify production in these enclaves should be investigated. However, the contribution of the "montagnards" to economic development would in most cases be greater if at least the incremental growth in population could be resettled in "new lands areas" or assisted in finding employment outside of subsistence agriculture.

4. Zones Where Use Potential Greatly Exceeds Current Use Intensity (Zones 4.1, 4.2 and 4.3).-- In most countries and larger political subunits, some land resource zones are underpopulated or underexploited in relation to use potential. In some cases, their underutilization can be explained by historical factors only, but in most cases, physical, locational, and environmental factors also play a part. As examples, many potentially productive river valleys, such as those found in the Volta River system, are almost uninhabited because of onchocerciasis, or river blindness, spread by the simulium damnosum fly, which breeds in rapidly flowing streams. The vector is currently being eradicated as part of a twenty-year transnational project coordinated by the IBRD.

In other localities of the Sudanian Region, the full exploitation of the range and grasslands and the introduction of mixed farming systems will require the control of trypanosomiasis and its vector, the various species of tsetse fly. In some locations, both animal and human forms of trypanosomiasis are present (Wright, 1973).

These underexploited areas are sometimes identified as "new lands" or "frontier areas." They are rarely in arid climatic zones, and desertification is not an immediate problem. However, the ever-present threat of environmental deterioration exists unless their development is managed. Soils units with moderate to high use potential within the Sudanian and Guinean Zones are the logical locations for resettlement programs. If settlers were to be selected with preference given to persons from seriously overpopulated localities, resettlement could become an important link in the regional plan to combat desertification. Other soils with lesser agricultural use potential, such as those in the South Sahelian Zone, could be reserved either permanently or temporarily for grazing, forestry, game conservation, and recreation.

Environmental safe development must be preceded by detailed land use planning if the threat of long-term desertification of these new lands is to be avoided. Environmentally safe development will include the identification and introduction of new farming systems, location and construction of access roads and other infrastructure, training of extension staff and settlers, and formulation of policies and regulations

to protect the environment and provide for their enforcement.

5. Limited and Multiple Land Use Zones (Zones 5.1, 5.2 and 5.3).-- Most of the West African countries have set aside large land reserves, often located adjacent to "new lands," for watershed protection, forestry, game protection, recreation, and tourism. Most of the forest reserves of the Sudano-Sahelian region are, in fact, savanna woodlands where cultivation, settlement, grazing, and sometimes hunting and gathering are prohibited activities. Their productivity as forests for the harvest of wood and timber is severely limited by unselected varieties and grass fires. Multiple use possibilities include grazing, watershed protection, game protection, and reserves for future resettlement. It should be noted that the Nigerian Grazing Reserves were established in Forest Reserves (Bates, et al., 1975).

Game and hunting reserves have been established in a variety of habitats. Limited use lands are already coming under increasing pressure from farmers and livestock owners. It is also of concern that they are often reservoirs and foci of animal and human diseases and disease vectors (Wright, 1973). Some modification of their boundaries and uses permitted (or prohibited) within them may be required in order to facilitate regional development. Nonetheless, these nonagricultural land uses do deserve support in the context of national and regional development programs.

On Choosing Priority Land Use Management Sites and Project Models

Throughout the Sudano-Sahelian Region, wide margins exist between actual productivity and potential productivity as measured by output per unit area of croplands, rangelands, and grasslands. Some lands are "underdeveloped" in relation to potential, and others are "overexploited" in relation to long-term human and livestock "carrying capacity" of the land resources. In many locations, the natural productive capacity of the land resource or its potential is being permanently modified by mis-

management and erosion, and permanent and irreversible environmental damage or "desertification" is occurring.¹

Stating the dilemma in human and ecological terms, existing land use patterns in Sudano-Sahelian West and Central Africa are endangering the long-term capacity of the land resources to support a growing population. Environmental changes are occurring under the impact of man's efforts to provide even the basic subsistence food and cash income requirements necessary to support minimum subsistence levels of living.

Unfortunately, there have been few surveys of the extent of deterioration for specific soil units or range sites, and it is not possible to establish the comparative impact of the lack of grazing management, historical trends toward greater sedentarization, or the shortening of shifting cultivation on the trends observed.²

Determining the localities where desertification is occurring and the severity of the problem is a prerequisite for the rational choice of a project model and its location. Determining whether an environmental crisis exists depends upon the economic importance of the endangered site, the geographic extent of the damage and the period of time, and the cost of restoring land to the original state of natural productivity. Should surveys indicate that a given soil or range site would regain lost productivity within a modest timeframe (5-10 years) if properly managed, then the threat to longer-term recovery is minimal. On the other hand, should surveys indicate that "much" land (more than 5 percent) has been degraded by erosion and has lost fertility to the point that "long" periods (more than 10 years) of retirement or intensive management would be required to regain former productive

¹Paraphrased from UNESCO, Man and the Biosphere, MAB-3 Arid Grassland Research Format.

²Another careful survey of the data on desertification in Africa has failed to identify more than impressionistic estimates of localized changes (Kates and Johnson, 1976.) Nor, apparently, are there established indices of how damage could be measured. The FAO has constructed a map of desertification hazards for the arid zones but none of actual damage (Dr. H. Dregne, personal communication).

levels, then an environmental crisis could be stated to exist.¹ Should an objective analysis of trends and surveys indicate that existing management patterns are resulting in "severe" desertification in economically important zones, then governments, with the assistance of donor agencies, could be justified in undertaking crash programs which might not otherwise meet accepted standards of cost/benefit ratios or social feasibility. In the choice of project model, the environmental cost of no action or slow evolutionary change must be considered in the analysis.

On the other hand, where the rate of desertification is "slow" or where indigenous production systems can be shown to be adjusting to changing man/land ratios by adopting more intensive forms of management and conservation techniques, then the logical choice may be that of slow evolutionary action programs. Conceptually, the only cost of "slow" improvements in productivity is the products not produced because "optimum" technology is not being adopted more rapidly.

A recommendation is to assist the statistical services and survey units of the Sahelian region in collecting the necessary baseline data and developing the analytical framework to monitor trends in crop yields, soil and range conditions, and herd productivity over time. As a prerequisite, land use and land use capability surveys are required for much of the Sudano-Sahelian Region. With these, more nearly optimum program recommendations for specific localities can be defined for inclusion in national development plans.

The evidence indicates that the most endangered resources and the largest "at-risk" population elements and lowest incomes are to be found in the Sahelian region where rainfall levels are less than 600 mm per year (Sub-zones 1.2 and 2.1). This represents about 6 million persons, or one fourth of the population, of the six Sahelian countries (Appendix Table 5). The lowest incomes are believed to occur in the

¹In any land use system, environmental changes occur and small parcels of land (for example, cattle trails) may be allowed to suffer permanent damage so that the land can be used productively. Damage to a desert area with a low carrying capacity may be less significant than erosion in a high potential zone.

zones of intermixing between pastoral grazing and sedentary farming communities (roughly 400 to 600 mm rainfall) where rainfall levels are too low and unreliable to support cash crop production (Sub-zone 2.1). However, the sale of livestock represents one of the few sources of cash revenue for this zone. Further, because export-oriented development societies have bypassed this zone, there are only the most rudimentary extension services. Other areas with severe income and environmental problems include the several mountain enclaves (Sub-zone 3.2).

However, the problems of desertification and overgrazing are not limited to arid areas or marginal soils. On the best arable soils of the Sudano-Sahelian Zone the rule is nearly continuous cultivation without the use of adequate organic or mineral fertilizers or crop rotations required to preserve soil productivity. Particular problem areas are the groundnut and cotton production areas in Senegal, Mali, Upper Volta, Ghana, Togo, Dahomey, Niger, Northern Nigeria, Chad, and Northern Cameroon (Sub-zones 2.2 and 2.3). However, there are other zones where desertification is a minor problem, which presents substantive developmental possibilities (Sub-zones 4.1, 4.2, 4.3 and 4.4).

Criteria for Priority Site Selection.-- In the pre-selection of localities to be the focus of development activities, three differing criteria could be used:

- a. Those sites or zones with the lowest incomes and least advantaged groups (generally Sub-zones 1.1, 1.2, 2.1, and 3.2).
- b. Those sites or zones where serious and continuing loss of productive potential is occurring (generally Sub-zones 1.1, 1.2, 2.1, 2.2, [locally] 2.3, and 3.2.2).
- c. Those sites and zones where conditions of usage are known to be substantially below potential, providing profitable development possibilities (generally Zones 2.3, 3.1, 4.1, 4.2 and 4.3).

In choosing sites or zones for priority development, the tendency has been to give preference to those in category (c) which provide the greatest potential of technical, economic, and social viability. This tendency is the root of the basic dilemmas for development of the Sudano-

Sahelian region. The majority of soils are marginal from the standpoint of natural fertility and land use potential. Traditional agricultural and livestock production patterns, which are capital, modern cash input, and management extensive systems, have evolved. Modifying use systems will require the use of more capital and cash inputs and private and public management which may not be justified by short-term economic and financial returns in least advantaged and most fragile or damaged areas. If the international community and major donors wish to assist the Sahelian region countries with the development of these resource zones, they must be prepared to provide such assistance on highly concessional terms and on a long-term basis.

In Chapters IV, V and VI, some of the more common development activities which relate specifically to livestock development are described and evaluated.

CHAPTER IV

SCHEMATIC VIEW OF STRATIFICATION BY STATE OF PRODUCTION

Introduction and Key Assumptions

Most previous analyses of the appropriate strategy for livestock development in West Africa endorse in principle the concept of stratification of the production process into three distinct states, or layers:

Primary Producers. Units with cow-calf herds, selling "immature" stock rather than range mature animals.

Intermediate Stage Producers. Units growing out "immatures" to larger sizes suitable for slaughter for fattening.

Fattening Units. Units fattening grown out or thin range animals before slaughter.

In the "ideal" regional model, production units in extensive range areas would specialize as primary producers. They would be encouraged to sell all surplus males as "immature" rather than as range mature animals. Livestock sector development activities would thus focus upon creating the necessary infrastructure and price incentives to encourage the sale of immature animals.

A key assumption of these proposals is that by selling animals at younger ages, the stocking rate of "extensively" managed rangelands could be initially reduced, and, by maintaining somewhat larger and more productive breeding herds on a given range site, incomes could be equaled or improved through the sale of larger numbers of immature animals, albeit at substantially lower per kilogram and per head prices.

A second key assumption is that stock owners would collectively agree to limit stock numbers in accordance with approved stocking rates in order that fertility and milk yields could be increased and mortality decreased.

Alternative strategies for the medium-term development of primary producers and extensive land use zones therefore include:

- a. The production of (very) immature animals, which would require "longer" periods of growing out outside of the primary production zone but would allow a somewhat larger increase in the size of the breeding herds of primary producers.
- b. The production of semi-mature animals, which would require a "short" period of growing out on grass or farm by-products to reach the same weights and value before slaughter but would permit a modest increase in the size of breeding herds.
- c. The production of range mature animals suitable for immediate export and slaughter; that is, the sale of fewer but larger and more valuable animals which could either be exported as carcasses or as live animals.

These alternatives will be considered further in later sections of this chapter.

Intermediate state production units would be located for the most part in higher rainfall zones. Examples of most of the proposed intermediate stage units are already in existence and thus can be evaluated objectively as to their technical, economic, and social feasibility. They vary from small-scale (peasant) animal fattening and traction units on "mixed" farms to large-scale (modern) parastatal ranches and feedlots. Presumably, they would use a combination of natural rangelands, improved pastures, crop by-products, and agro-industrial by-products in animal feeding and fattening activities (Chapters V and VI).

The key assumption is that intermediate stage production units are (or can be made to be) technically, economically, and socially feasible. A key issue is the relative emphasis which should be given to small-scale (peasant) versus large-scale (modern) units. The former would have an impact on more persons and could provide an important element in the expansion of mixed farming and soil-conserving crop rotations.

The progressive industrialization of animal slaughter and meat handling activities within the surplus regions is an integral part of some, but not all, of the stratification proposals. The assumption of

the advocates is that slaughter in the surplus zone would increase the "value added" and, consequently, employment and export earnings accruing to the meat surplus regions, which have few alternative opportunities for industrialization.

More assumptions are that the rate of economic growth and net export revenues can be increased by slaughter in the production zone. Where slaughter in the production zone is economically feasible, prices to primary and intermediate stages could be increased, making further modifications of production and marketing patterns more economically and socially feasible.

Basic Outline of the Strategy

The program objectives of regional "strategy of stratification" in general terms would include:

1. The progressive integration of the family production units within and between regions in order to take advantage of each category of production unit and natural regions.
2. The progressive diversification of sedentary farm units to include either animal traction or animal fattening enterprises in the farm business, increasing the profitability of including fodder crops or grass leys in crop rotations.
3. Where economies of scale are sufficient, creation of specialized large-scale private or parastatal intermediate stage production and complementary marketing units.

The goals of stratification by stage of production would be:

1. To delay the premature slaughter of the large numbers of thin and immature animals currently offered for sale, increasing their live weight and value before final slaughter.
2. To create a greater demand for thin and immature stock (higher prices) sufficient to encourage sales (destocking) of all but breeding herds and followers from extensive range subzones.
3. To create a greater demand for industrial and agricultural by-products, thereby increasing the profitability of industry and related farm production enterprises.

Framework for Evaluating Components of the Strategy

In order to indicate the scope of stratification by stage or production and marketing and provide a basis for identification of priority project activities, a simplified model of the West African meat production and marketing sectors is provided in Figure 3.

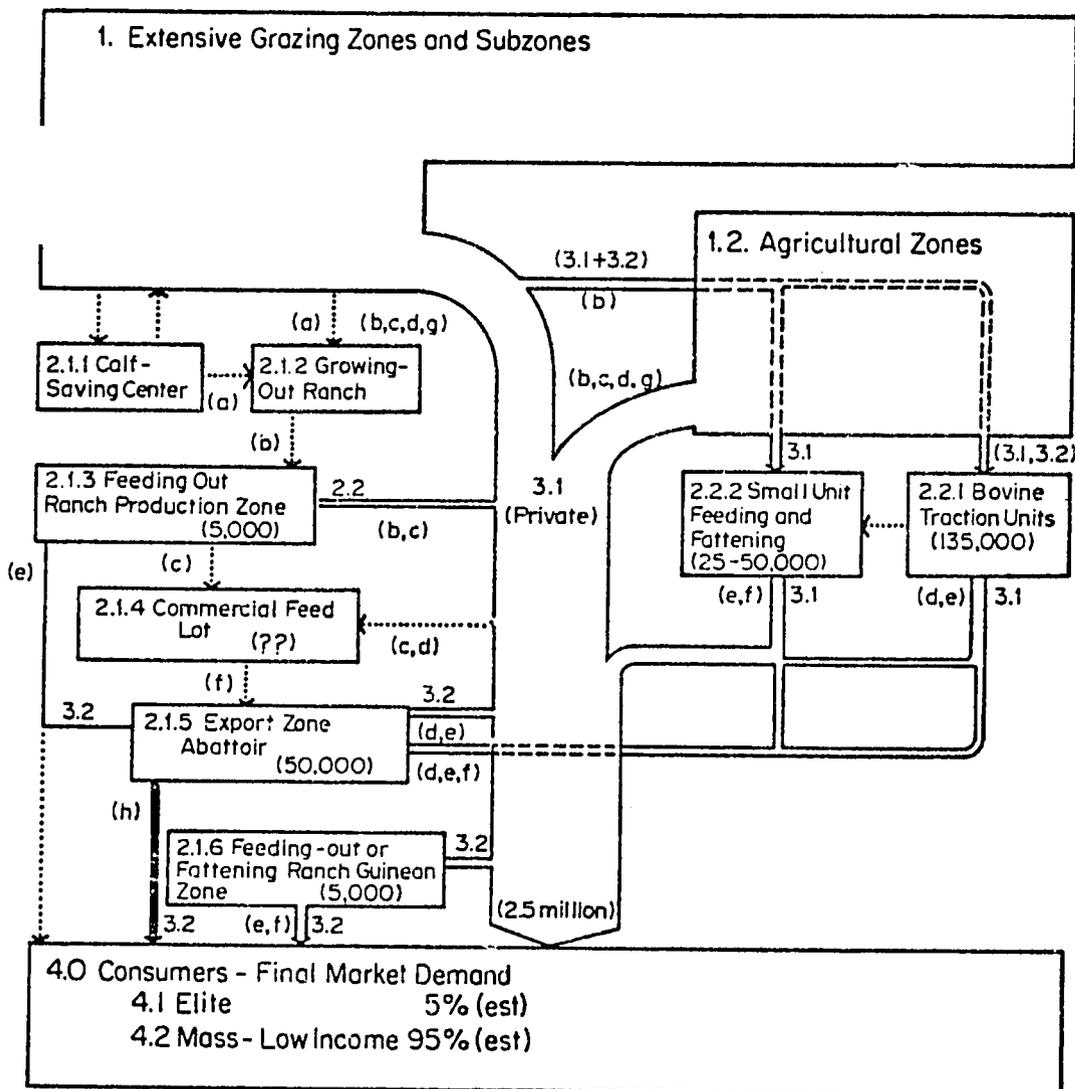
The figure contains four essential stages and various sub-stages:

- 1.0 Primary Production Zones
 - 1.1 Extensive Grazing Zones and Subzones
 - 1.2 Agricultural Zones and Subzones
- 2.0 Intermediate Stage Production Units
 - 2.1 Public and Large-Scale units
 - 2.1.1 Calf-saving centers
 - 2.1.2 Growing out (re-élevage) ranches
 - 2.1.3 Feeding and Holding Ranches
 - 2.1.4 Commercial Feedlots
 - 2.1.5 Export Zone Abattoirs
 - 2.1.6 Feeding out and Fattening Ranches (Guinean zone)
 - 2.2 Small scale (peasant) units
 - 2.2.1 Animal (Bovine) traction units
 - 2.2.2 Small unit feeding and fattening
- 3.0 Marketing Channels between Primary Producers and Consumers
 - 3.1 Private - commercial trade links
 - 3.2 Public - parastatal trade links
- 4.0 Consumers - Final Market Demand
 - 4.1 Elite - quality-conscious consumers
 - 4.2 Mass - low income consumers

A description of Figure 3 follows. Live animals produced in the various land resource zones are channeled through the marketing system represented by the flow arrows.

Zones for which extensive grazing remains the best (or dominant) land use are depicted separately from those in which agricultural (crop) production is the dominant economic activity and mixed farming, including

FIGURE 3 West Africa: Existing and Proposed Production and Marketing System Links



Source: Author

small unit feeding and animal traction, occurs (see Chapter III). In some instances, individual animals may pass through one or several intermediate stage production units before reaching final consumers. These are described in more detail in Chapters V and VI.

For simplicity of presentation, it is assumed that final demand (consumption or disappearance) is limited to red meat produced within the region and that no exports outside the region occur.¹ In Figure 3, the width of the arrows suggests the comparative number of animals currently passing through each link. In addition, all animals slaughtered and consumed, including those slaughtered in the production zone by a local butcher, are assumed to enter the marketing system. Therefore, the arrows are not proportional to either value or volume (ton kilometers) of trade.

Categories of Animals Offered for Sale.-- Animals offered for sale in the supplies regions exhibit a nearly infinite array of sizes, weights, ages, degree of conditioning, and breed types and may be further subdivided into steers (castrates), entire males, cows, and heifers. For the purpose of analysis, the supply of animals may be lumped into a more limited number of categories which correspond generally with those demanded by, or subsequently issuing from, intermediate stage production units plus cull cow and heifer and chilled carcass meat categories. These categories are indicated in Figure 3 by lower case letter as follows:

<u>Age/Quality Category</u>	<u>Age (mo.)</u>	<u>Weight (kgs)</u>
a. calves or weaners	8 - 18	50 - 150
b. immature male	18 - 30	150 - 250
c. semi-mature male	30 - 48	250 - 300
d. mature male	+ 48	300 - 450
e. grass fattened	(all ages)	300 - 450
f. feedlot fattened	(all ages)	300 - 450
g. cull cows - heifers	(all ages)	200 - 350
h. chilled carcass meat	--	--

¹This is not to imply that imports and exports do not occur but, until recently, they have been a minor component in regional supply/availability balance tables.

Ultimately, it is consumer demand that is responsible for the evolution of marketing systems and determines the structure of demand for various grades or categories of product and the price of each grade or category. At the present time (Figure 3), the private marketing subsystem dominates the marketing sector, providing buying, assembly, and transportation services, transforms the primary product (live animals) into the form demanded by the consumer (carcass meat and products).

The age/quality categories of animals offered for sale by primary producers result in a range of carcass and meat grade categories, which are subject to differing consumer demand (price) structures. Further, each age-quality category is subject to different per-head marketing costs. The price (value) of individual animals at farm gate is thus a derived price determined by consumer demand and by marketing costs.

In the following sections, the private and parastatal (or public) marketing sector's performance, consumer preferences, and the structure of prices for live animals at various points in the marketing chain are examined.

Marketing Sector Performance and Consumer Preference

The private live animal and meat marketing sector is a highly complex system which assembles livestock from several million production units scattered over many millions of square kilometers.

The marketing chain begins with a comparatively large number of small-scale buyers who visit the many primary markets. They may buy directly from the producer or through a local/customary intermediary. Animals are moved on hoof to larger intermediate markets, where they are resold to a smaller number of large-scale cattle merchants who are believed to be linked by powerful trade associations, which are alleged to act in constraint of trade.¹

¹For a more detailed review of the structure of the marketing trade, see component reviews by CRED team members Shapiro, Staatz and Herman.

Opinions are divergent as to the cost efficiency of the current marketing system linking primary producers and final consumers. Although often condemned as "inefficient" (in labor efficiency) and "wasteful" (in terms of shrinkage in marketing), the private marketing system does function effectively in assembling, sorting, and moving to final markets over two million head of cattle and three million sheep and goats annually. It varies sources of supply depending upon season and adjusts to changing price and demand conditions. It functions across international boundaries, coping with currency exchange problems and a bewildering array of formal and informal taxes and fees. It is internally financed and is a major employer in labor surplus economies. However, there is not general agreement as to whether the privately organized trade would respond in a supportive way to programs directed toward greater regional stratification in production, and consequently whether major interventions in the marketing system are justified by publicly supported agencies. Obviously, the necessity for intervention would depend upon the conceptual model of stratification adopted.

It is instructive to note the kinds of actions which have been proposed and/or attempted in the past to "modernize" the marketing trade essentially along western lines:

- a. Introduction of auctions in major collection and distribution markets to facilitate purchases by large-scale buyers.
- b. Elimination, by regulation or licensing, of some of the middlemen in the marketing chain (Entente States).
- c. Attempts to monopolize cattle buying and export through the creation of large government or parastatal agencies accompanied, in some instances, by prohibition of the export of animals on hoof to protect the financial interest of the agencies (Mauritania, Mali).
- d. Construction of publicly-owned, mechanized export abattoirs to "eliminate shrinkage in marketing," to gain control of foreign exchange from meat exports, and to assure taxes are paid on animals exported (all six Sahelian states).

e. Construction of publicly-owned wholesale meat distribution facilities and cold stores in consumption centers to provide outlets for the carcass meat.

f. Establishment of fixed prices for each category of animal and meat to assure "fair" prices to producers and consumers, actions which require public inspections, grading, and grade/price enforcement services.

The national efforts to replace various sector marketing links and functions with public or parastatal ones have not been successful for a variety of reasons.¹

First, there has been a consistent overestimation of the availability of animals of suitable quality, either for direct export or for export following slaughter in "surplus" zone abattoirs. These overestimations have occurred because actual or potential productivity of traditionally managed herds has been overestimated, and it was assumed that producers were holding back mature stock which they could sell if they would change their "attitudes" about marketing surplus animals. Consequently, facilities have been overbuilt, increasing the fixed and variable cost per unit of throughput when operated below capacity. The "savings" from reduced shrinkage and the elimination of some of the middlemen (and their presumed excess profits) have not been sufficient to offset these cost factors.²

¹In the 1960s, the government of Mali attempted to implement a parastatal cattle buying and export monopoly, which was later abandoned (Stryker, 1973). Currently, the government of Mauritania is attempting to implement a similar monopoly, but lack of operating capital, staff, and an inability to control illegal exports have made the monopsony ineffective (Singleton, 1975). Also, the government of Ghana has established a company with a monopoly on cattle and meat importations, but the status of the enterprise is not known by the author.

²There are literally dozens of production-zone abattoirs in sub-Saharan Africa which have either been abandoned or operate only at a fraction of their design capacity. For a listing of these in 1973 in West Africa, see FED, 1974. For a detailed analysis of the reasons for the failure of a 100,000 head per year abattoir, see: Uganda, Min. of Animal Industry Game and Fisheries, Report of the Committee on the Marketing of Livestock Meat, Fish and the Products in Uganda (Entebbe, 1969). The author was a member of this Commission.

Second, there has been a lack of recognition of the many service functions provided by the private trade, which have proved difficult to duplicate in public or corporate agencies. Individual private sector traders tend to specialize in a limited range of activities. Through the trading/buying/selling process, animals are effectively sorted into categories or grades destined for either local or export (distant) consumption, and a value (price) is established for each animal which reflects true market value. It acts to adjust the source of supply in response to seasonal supply variations and marketing routes, reflecting changing marketing costs. Butchers tend to specialize in a limited range of clientele who demand (can afford) different qualities of meat.

Third, there has been inadequate analysis of the structure of demand for meat.¹ Although consumption of meat is correlated with family income, most consumers of meat are low-income persons for whom western concepts of quality (as measured by color, tenderness, and marbling) have little meaning. Meat is seldom, if ever, roasted or fried, but rather is boiled to provide a sauce used to garnish the local starchy staple food. The traditional method of meat cutting is for the butcher and his assistants to debone the carcass and to sell meat in piles of small pieces composed of variable quantities of red meat, small bones, and edible offals. The edible non-red meat parts thus become a valuable fifth quarter, selling at only slightly less per kilogram than red meat (Ferguson, 1967).

Only in larger urban markets does a demand exist for better quality meat by higher income persons who are prepared to pay a higher price for premium grades of meat and for the extra services provided by butcher shops. This elite quality demand is supplied by the occasional range animal or stall fed animal with a superior finish, provided by the few commercial ranches of feedlot operations, and by meat importations. Other quality-conscious persons buy selected cuts such as the fillet (eye of the loin). Quality beef destined for the restaurant and supermarket

¹For an analysis of the consumer demand for red meat in the Abidjan Market see R. Montgomery, "Declining Demand for Beef in Abidjan: Little AID-cum-Trade for the Sahel," CIRES, Univ. of Abidjan, 1975, mimeo, 32 pp.

trade constitutes a very small share of total demand -- probably less than 5 percent of total disappearance. Although the demand for quality meat is expected to increase, the per-kilogram live weight price differential for fattened animals is very small and may be negative locally.¹ For these reasons, regional programs in support of stratification that result in large, well-fleshed animals are likely to be more financially successful than those that promote fattened animals.

To summarize, the progressive industrialization of animal slaughter and meat handling facilities in the meat surplus regions is not likely to result in improved farm gate prices for primary producers. Public or parastatal agencies are rarely able to meet the price competition of private traders for the following reasons:

a. Production-zone abattoirs capture only a portion of the value of the "fifth quarter," as they must either process edible by-products into low value items, export them chilled or frozen at high unit cost, or sell them locally in competition with cheap red meat from cull cattle, sheep and goats.

b. Public agencies are not able to be as flexible as the private trade in providing buying and assembly services, transportation, and distribution services, or they can only provide these services at higher per unit costs. They also have difficulty in handling the great variety of quality categories offered for sale and the natural seasonality of supply resulting from transhumance patterns.

c. Parastatal companies or agencies are faced with high capital repayment costs and operating costs for management, depreciation, electricity, freight charges and the like in relation to the operating costs of private traders who utilize uneducated laborers, on-hoof, open wagon or truck transportation, and publicly subsidized facilities.

d. Consumer preference in the mass low income market is for fresh meat and offals, which have a much longer shelf life without refrigeration. Thus, chilled/frozen meat will sell at a price

¹ Staff fattened or feedlot animals cannot be moved any distance on hoof without severe weight loss and mortality.

disadvantage except in special markets for quality meat. These special markets in coastal cities are likely to be supplied by world market sources because of the growing deficits and higher meat prices within the production zone.

Given the rapidly escalating costs for energy, capital equipment, and interest rates, the cost advantage is likely to remain with the movement of live animals over shipment of carcass meat on most trade routes in West Africa for the indefinite future. For this reason and given the fact that existing production-zone abattoirs are used at only a fraction of capacity, the SOLAR transnational project evaluation team recommended that no additional production-zone abattoirs be constructed as part of the SOLAR project (Boudet et al., 1976).¹

However, continued public and donor support for activities which improve the efficiency of the private trade, lower the cost of marketing, reduce environmental damage caused by trade cattle, and support the expansion of mixed farming, should be continued. In this category are the following types of activities:

- a. Development agency intervention to purchase thin or immature stock to be channeled into animal traction or small unit feeding programs where necessary.
- b. Demarcation of trade routes provided with overnight grazing reserves, water supplies, and holding reserves, particularly where trade cattle are contributing to overgrazing or land management problems near transport centers.
- c. Improvements to cattle handling, loading, unloading facilities at assembly and terminal markets.

¹ Although somewhat dated, a good summary of the comparative cost of marketing cattle on hoof versus carcass meat is contained in Mittenborf and Wilson, Livestock and Meat Marketing in Africa (FAO, Rome, 1960). For further support of this conclusion see: IBRD/IDA, 1975, Appraisal of a Livestock Development Project in Upper Volta (Report No. 674a - U.V., May 1975); and Morris, Kiefer and Kinard, 1972, Etude de la Practicabilité d'un Abattoir pour la Ville de Marodí, République du Niger (Univ. of Florida, 1972).

d. Collection and diffusion of current market statistics on cattle movements and prices, primarily as an aid to the planning and market monitoring process.

e. Support for the harmonization of live animal transit and fiscal and customs procedures between countries where these constrain the unnecessary free trade between states or regions.

The Structure of Live Animal Prices by Weight and Grade

One of the key assumptions necessary for the implementation of stratification by stage of production is that it is in the economic interest of primary producers in the Sahelian Region to market surplus males and females as immature animals. Before considering whether this is the case, it is necessary to consider briefly the price structure of range cattle in the extensive grazing zones.

Current data on the structure of live animal prices by weight and grade are at best fragmentary.¹ Somewhat better cross-sectional data are available on retail meat prices.² In general terms, highest per-kilogram prices are paid in meat surplus zones for large animals at or near full mature bone structure development and weights. Large range-grown animals of breed types common to pastoral areas best withstand existing marketing conditions. They can be marketed on hoof with minimal shrinkage, and show lowest mortality when marketed by truck and railroad. Because quality in the Western sense of tenderness and flavor is of less importance, large animals with a large "fifth quarter" bring premium prices. Conversely, lowest per-kilogram prices are paid for immature and cull cattle, for which the per-kilogram cost of marketing is high because they are subject to comparatively higher rates of shrinkage and mortality in marketing; and many fixed marketing costs, such as inspection,

¹CRED field studies by Staatz, Herman, and Eddy include the collection of data on prices by weight and grade in the consumption zone, Sudanian zone, and Sahelian zone respectively.

²See for example SEAE/SEDES, 1975, Recueil Statistique de la Production Animale (Paris, 1975).

transit, slaughter fees, and export taxes, are paid on a per head basis.¹ As a result, the price per kilogram for immature cattle is severely depressed in relation to that of range mature animals.

A typical weight-by-age growth curve for African Zebu cattle ages 17-72 months, the value per kg., and total value are shown in Table 4 and in Figure 4. Actual growth curves reflect seasonal grazing conditions, and actual prices and values reflect seasonal supply and demand. The available data suggest that cattle continue to increase in value per kilogram until full mature weights are obtained.²

The data suggest that under African range conditions where seasonal malnutrition is the rule, cattle may more than double in weight between the age of two years and six years but more than quadruple in value (Table 4). Because the marginal cost per unit of time/cash of retaining an animal beyond two years of age is very low, the logical strategy is to keep males in herds until near peak values are obtained.³

The preliminary analysis supports the conclusion that the price per kilogram for immature animals would need to double before it would be more advantageous for primary producers (or ranch managers) to sell immature categories rather than semi-mature and range mature cattle if their objective were to maximize net cash income from a beef production enterprise.⁴

¹The vast majority of cattle slaughtered in the production zone are cull cows and immature animals. Although export taxes are, in theory, on an ad valorem basis, in practice a fixed per capita fee is charged for ease of assessment and collection.

²In Western markets, cattle decrease in value per kilogram after reaching ideal carcass size and ages where tenderness declines (usually 24 months).

³Potentially fertile females are rarely marketed. From some localities immature stock are marketed, apparently to obtain needed cash income. Younger animals are also more likely to die of disease or malnutrition, suggesting that risk may be a factor determining choice of animal to be sold.

⁴Independent projections by Dr. J. Columb (IEMVT) and the author (unpublished data). Projections for East African Rangelands provide a similar conclusion (K. Meyne, personal communication).

FIGURE 4

WEST AFRICA: HYPOTHETICAL WEIGHT AND VALUE CURVES
FOR SLAUGHTER STOCK BY AGE 1 - 6 YEARS, 1975

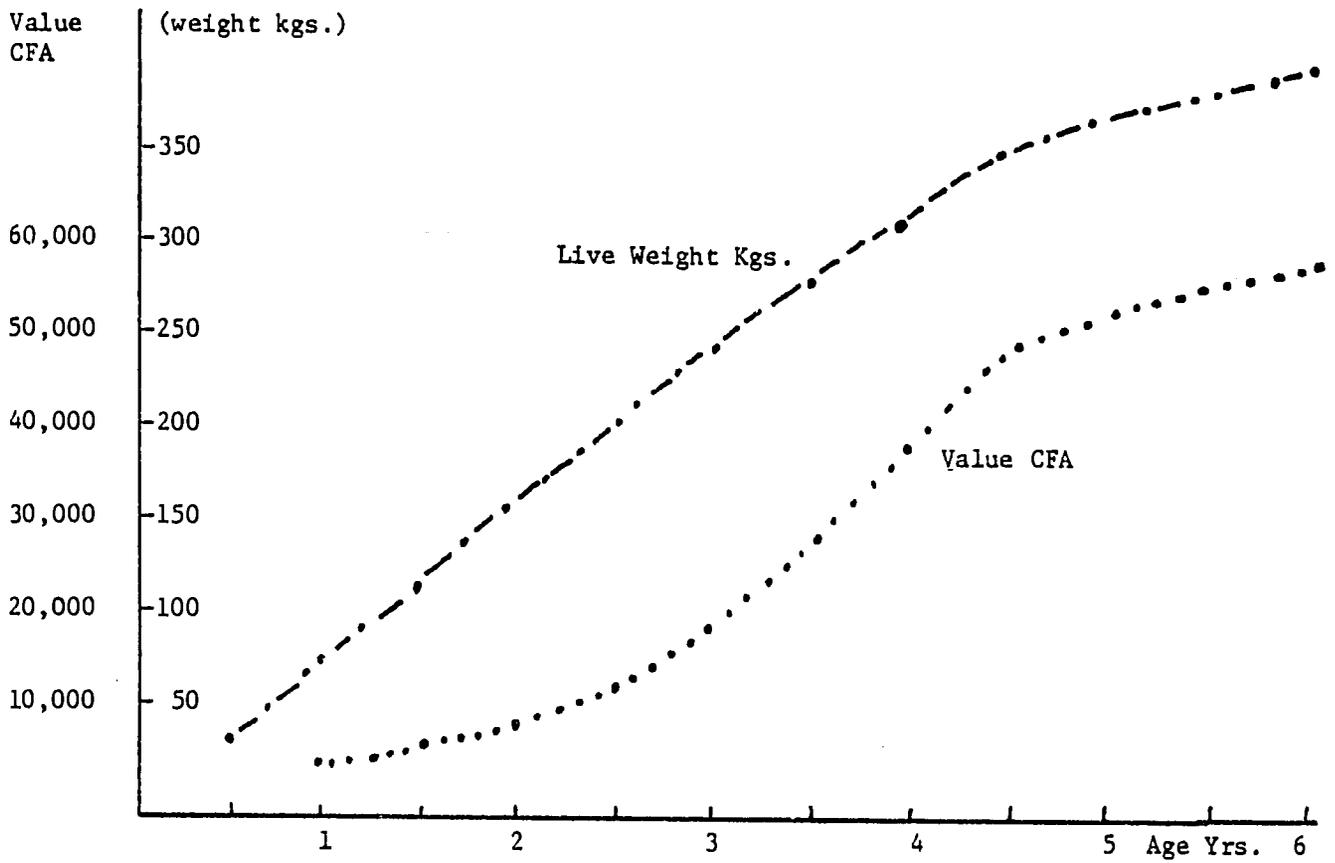


TABLE 4

WEST AFRICA: HYPOTHETICAL WEIGHT AND VALUE OF
SLAUGHTER STOCK BY AGE 1-6 YEARS, 1975

Age (mos)	Weight Live (kgs.)	Value Per/Kg. (CFA)	Total Value (kgs.)
12	120	58	7,000
18	140	64	9,600
24	175	70	12,250
30	220	82	18,000
36	250	108	27,000
48	330	142	47,000
60	380	158	60,000
72	400	160	64,000

Table based on various estimates of growth rates for Zebu breed types under range conditions and current (mid-1975) price levels.

Even if the price per kilogram for weaner calves doubled in relation to mature stock -- a possibility that appears remote, as the profitability of intermediate stage growing out activities is not sufficient to bid up the price of weaner calves (see following chapter) -- it is not clear that the flow of weaners and immatures would expand greatly.

First, assuming beef production is a primary objective, during the inevitable drought periods cows, calves, and weaners are the most susceptible to malnutrition, suffer greatest mortalities, and decline most in value. Stockmen with the non-drought period strategy of retaining animals to range mature weights could, in drought periods, reduce stocking densities on depleted rangelands by selling down the growing out herd first, thus assuring a contingency flow of cash income through the drought period. Retaining males to range mature weights is an effective hedge against drought periods on the part of arid zone livestock owners.

Second, the potential to reduce stocking densities through a strategy of the sale of non-breeding males as weaners is comparatively small. A sampling of available herd age/sex census data from various sources is given in Appendix Tables XI - XVIII and is summarized in Tables 5 and 6. When the 1973 drought year is excluded because severe calf mortality and lowered fertility artificially inflated the percentage in older male categories (See Appendix Tables XII and XIII), in no locality do males over two years of age (36 mo.) exceed 15 percent of the cattle population. These include herd sires in pastoralist herds, pack oxen (Dean and Johnson, 1972), and, in some localities, plowing cattle. Stock appear to be retained longest where there is least demographic (and grazing) pressure and herds are larger, such as near the fertile interior delta of the Niger River in Mali, on the Adamaoua Plateau in Cameroon, and in areas where bovine traction is important (Central Mali). Conversely, there are fewer males in herds where there is greatest demographic (and grazing) pressure and generally smaller herds, such as central Niger and North Cameroon. In no case do males in the post-weaning categories equal that of females. The apparent explanations for the precocious "disappearance" of males are: the presumed, but poorly documented, higher rate of calf

mortality among male calves in the post-weaning periods;¹ the slaughter or sale of male calves and weaners for special occasions or cash needs,² and economic pressure during drought periods when grain prices increase to sell those marginal animals not directly contributing to subsistence food needs.

Summary Section E

To summarize, there is little opportunity to destock rangelands through the sale of immature male animals, particularly in those areas of greatest demographic pressure. Even if all non-breeding herd males could be sold at the age of 18 months, the maximum increase in cow/calf herds which could be realized would be on the order of 10-20 percent.

In localities where a reduction in the number of animal units is necessary or desirable to allow range land to recover or to increase per-head productivity, a reduction in the number of animals in all categories will be required. In pastoral grazing units where effective limitation of animal units has been achieved, some restructuring of the herds would be possible and desirable (see Tables XV and XVII); but it would be necessary for the price per kilogram of immature stock to more than double before it would be more profitable for producers (or ranch managers) to market immature stock rather than semi-mature or mature animals from Sahelian rangelands.

As noted earlier, significant numbers of immature stock are found in slaughter herds, which originate in some localities. This suggests that some herdsmen may be selling immature stock because of economic pressure to obtain needed cash income where herd sizes are small, as they tend to

¹Zebu cows will not continue to lactate without a calf at foot. Thus, male calves are allowed to suckle just enough milk to keep them alive, with most being taken for family needs. Females, with a higher substance economic value, are allowed to suckle a larger share of their dam's milk.

²When selecting an animal for sale to meet cash needs, herdsmen often sell very young male animals, which pose a higher risk of dry season mortality. They retain more mature animals, which are unlikely to die and are still increasing rapidly in value (see Figure 6).

be in Niger. On the other hand, the comparatively low price of these immatures may allow an expansion of intermediate stage growing out activities, such as small unit animal feeding (see Chapter VI).

However, the intermediate-stage animal feeder must incur costs related to purchasing, holding, feeding, and marketing the animal. The impact on the farm gate price to the primary producer for the thin or immature animal he offers for sale will depend upon the profitability of the holding and feeding activity, the added costs of buying and selling (if any), and the sales price differential per kilogram which final consumers are prepared to pay for higher quality carcasses. The evidence clearly shows that the price differential for "prime" quality animals in the West African market is very small and may be negative in production zone markets, but that large, well-fleshed animals do bring premium prices in all markets.

In the following chapter the experience with existing intermediate stage production units and projections for several alternative models are examined.

CHAPTER V

FEASIBILITY OF LARGE-SCALE (MODERN) INTERMEDIATE STATE PRODUCTION UNITS

Calf-Saving Centers and Growing Out Ranches -- Sahelian Region

A number of proposed public and parastatal development activities evolved during the drought period when first reports indicated that catastrophic losses of up to 60-80 percent were occurring in individual herds in some localities. Even during periods of normal rainfall, calf mortality up to one year of age is usually estimated to be approximately 30-40 percent, and during the 1973 drought year, calf and immature mortality losses were believed to be at least twice normal levels (see Tables XII and XIII).

Calf-Saving Centers - Niger¹.-- One of the proposed emergency activities designed to reduce calf mortality was the establishment of "calf-saving centers," which would buy young weaned calves (otherwise expected to die), toward the middle of the dry season and feed them on powdered milk and supplemental feeds. At the end of the dry season, female calves were to be returned to primary producers (as part of the herd reconstruction program) or added to government breeding herds. Male calves, on the other hand, were to be transferred to a series of re-élevage ranches where weaned calves would be "grown out" until roughly two years of age, at which point they would be old enough and large enough to be transferred to finishing ranches, feedlots, or animal traction distribution centers.

The combination of calf-saving centers and growing out ranches is also part of a comprehensive plan to reorganize the entire Sahelian

¹For a description of the proposed calf-saving centers, see: Niger, Service de l'Élevage et des Industries Animales, "Sauvetage des Veaux," May, 1972. This is a project proposal prepared by Niger, Service de l'Élevage.

zone livestock production system (Figure 5, Chapter VIII). The purpose of the calf-saving centers in normal periods would be to reduce the high observed rate of male calf mortality in pastoralist-owned herds. Although the expected sex ratio of male to female calves is roughly 50:50 at birth, the typical herd census beginning with the post-weaning period shows a significantly higher percentage of female immatures than males (see Tables X and XI).

The apparent explanations for the higher post-weaning mortality among male calves were reviewed (see Chapter IV). Where the necessity or preference is for milk consumption or sales rather than deferred income through the sale of mature males, such as is the case in most pastoralist herds, heifer calves have a higher economic value, are fed better, and are retained in herds to expand milking herds. Many male calves at point of weaning are often in very poor condition. The projected performance of calf-saving centers is not an encouraging one. Several centers have been constructed in Niger, and one (reportedly) is to be operated by a Canadian assistance team.

Problems include:

1. Construction, operations, and management costs are high because they must be located in remote areas. To reduce management costs, they are to be linked with extension and input distribution centers.
2. Purchase and assembly costs for young calves would be expected to be very high because of the necessity of operating in nearly inaccessible Sahelian locations.
3. Mortality would be expected to be very high because of pneumonia and intestinal diseases, particularly among male calves, should buyers from the center be willing to buy all calves, including those in the poorest condition.
4. Feeding costs, particularly if imported milk substitutes and irrigated fodder were to be used, would be prohibitively expensive.

TABLE 5

WEST AND CENTRAL AFRICA: PERCENT MALES IN
SAMPLE CATTLE CENSUS DATA AND PERCENT
OVER 36 MONTHS OF AGE

Country/Locality	Males In Sample (Percent of Sample)	Males Over Three Years (Percent of Sample)	Year of Estimate
<u>Mali</u>			
Interior Delta (Mopti) ^{1/}	38.0	15.6	1969
Central Mali (Zebu) ^{1/}	35.0	11.8	1969
South (Ndama & Crosses) ^{1/}	29.0	4.0	1969
<u>Upper Volta</u>			
Ouagadougou (Taurms) ^{1/}	29.3	11.4	1970
South West (Zebu and Crosses) ^{1/}	31.5	15.0	1970
Sahel ORD ^{2/}	26.7	18.5	1973
<u>Niger</u>			
Peuhl Herds ^{1/}	23.3	4.8	1967
Taurey Herds ^{1/}	25.0	6.2	1967
Sedentary Herds ^{1/}	21.8	5.0	1967
Sahelian Zone ^{2/}	19.5	13.1	1967
<u>Chad</u>			
Kanem (Sahel) ^{1/}	31.7	7.7	1967
Other Regions ^{1/}	28.0	6.0	1967
Mao (Lake Chad) ^{3/}	25.9	21.5	1973
<u>Cameroon</u>			
North Cameroon ^{1/}	24.4	1.2 ^{5/}	1965
Adamaoua Plateau ^{1/}	33.6	8.1 ^{5/}	1965
Adamaoua Plateau ^{4/}	33.0	10.8 ^{5/}	1971

FOOTNOTES - Table 5

- 1/ Source of Data: SEAE/SEDES, Recueil Statistique de la Production Animale (Min. de la Coop., Paris, 1975).
- 2/ CEBV, Revue Trimestrielle d'Information Technique et Economique, Avril-Septembre, Ouagadougou, 1974. Because of severe calf mortality, percent of adults increased in late drought period (See Appendix Table XIII).
- 3/ FED, Etude Sur la Situation Actuelle de l'Elevage dans les Pays du Sahel (Euro. Econ. Comm., 1974). See Appendix Table XII).
- 4/ Dean, D. and D. Johnson, Beef Cattle Production on the Adamaoua Plateau (U.S. Peace Corps in cooperation with Cameroon, Min. of Elevage, 1972).
- 5/ Cameroon data reported for males over three years of age only.

TABLE 6

UPPER VOLTA AND NIGER: Gross Herd Composition and
Productivity Estimates Traditionally Managed Herds

Item	Upper Volta				
	Bobo-Diouloosso ORD (Guinean Zone) ^{1/} %	Sahel ORD Sahel Zone ^{2/} %	Manadi Dept. (Sudanian Zone) ^{3/} %	Peuhl Herd (Pastoral Zone) ^{4/} %	Tuareg Herd (Pastoral Zone) ^{4/} %
Herd Composition					
Females	66.1	71.1	64.6	76.1	75.0
Males	33.9	28.9	35.4	23.9	25.0
Total	100.0	100.0	100.0	100.0	100.0
Cow Herd % Total					
Extraction Rate	40.7	43.0	43.7	44.1	42.9
Males	6.3	6.8	5.8	7.0	6.8
Females	4.1	4.7	4.3	5.1	5.7
Total	10.4	11.5	10.1	12.1	12.5
Productivity Coef.					
Calves born/cows	60.0	60.0	66.0	60.0	62.5
Calves weaned/cows	39.0	40.5	44.8	--	--
Mortality					
Calves (0 - 1)	35.0	32.5	32.0	--	--
Others (+ 1)	5.7	5.2	11.7	--	--
Average	14.2	13.7	18.7	11.7	17.0
Average Herd Size	70	--	--	40	20

Footnotes - see next page

FOOTNOTES - Table 6

1/ IBRD/IDA, Appraisal of a Livestock Development Project, Upper Volta (Report No. 674a-UV, May 8, 1975).

2/ R. Gidel, "Etude sur la composition moyenne de troupeau de bovins de Haute Volta et de Cote d'Ivoire en fonction de l'age et du sexe," Rev. Elev. Med. Vet. Pays Trop. (25) 4, 1972.

3/ IBRD/IDA, Appraisal of a Livestock Development Project, Niger (Report No. 881a-NIR, Nov. 14, 1975).

4/ SEDES/Niger, MER, Project de Modernization de l'Elevage Du Zone Pastorale (Juillet, 1973).

Growing Out Ranches.-- To date, no ranches have been constructed specifically for the growing out of weaner calves, although two sites have been proposed in Niger at North Dakoro and North Gouré. The North Gouré Ranch has been analyzed with respect to costs in some detail.¹

Reasons for the delay in funding include.

- a. The extreme difficulty of finding sites for ranches in the southern part of the Sahelian zone which have good range conditions and where the resettlement of cultivators currently use the land would not be a prohibitive development expense.
- b. Successfully leveling out the late dry season growth curve of weaner calves would either require the use of concentrate feeds, which have a high opportunity cost, or producing high energy fodder crops using deep-well pumped irrigation systems at prohibitively high cost in relation to the value added in marginal beef production.
- c. The difficulty of identifying experienced host country (or expatriate) management capable of operating a very intricate buying, forage production, and herd management complex of operations.

Summary.-- Although the proposed calf-saving centers and growing out ranches in the Sahelian zone are technically feasible, they are not likely to be economically feasible because of prohibitively high operation costs. The conclusion must be that the main emphasis in the Sahelian region activities should be on evolution of the traditional production and land use systems rather than on one-step-removed calf-saving centers and re-élevage ranches, as they would not increase the farm gate value of

¹For the economic and technical projections for the two ranches, see SEDES, Etude de Factabilité de Deux Projets de Ranches Nord Dakoro-Nord Gouré et Etude Préliminaire d'un Site dans le Département de Dosso, Tome I, Rapport de Synthèse Tome III, Rapport Socio-Economique (Paris, 1974); and IEMVT, Etude des Pâturages naturels Sahéliens de Région Nord Gouré, République du Niger (IEMVT Etude Agrostologique No. 10, Maisons Alfort, 1965).

immature animals. A corollary conclusion is that most primary producers should be encouraged to retain surplus stock to weights more suitable for semi-mature second-stage production activities. The analysis suggests that activities which reduce the cost of subsistence foods (including powdered milk) would perhaps discourage pastoralists from starving such as large share of male calves, indirectly increasing the medium-term output of meat.

Medium to Long-Term Feeding Ranches

The conceptual purpose of the feeding-out ranch is to feed out semi-mature animals to higher grades and values per kilogram for final marketing and slaughter under improved range conditions. Semi-mature range animals are defined as those between 18 and 30 months of age which require medium to long periods of 6 to 18 months of feeding. A short 60 to 90 day fattening period may be added either at the ranch or on a feedlot closer to final markets or export abattoir facilities. Examples of feeding out ranches are found in Guinean through Sahelian climatic zones. They require fairly large unit areas in order to be economical, but can be located in areas with low population density.

1. Doli Ranch-Sudanian Zone (Senegal)¹

The Sudanian zone prototype of the feeding out ranch is the Doli ranch in Senegal, which was established in 1962. It is located in an area with roughly 600 mm. of rainfall, about 260 km. east of Dakar (80 km. by a very bad track and an additional 180 km by railroad or paved road). It is

¹For a more detailed description of the Doli Ranch see: SEDES/OMVS, Approvisionnement en Viandes de l'Afrique de l'Ouest, Deuxième Partie, Etude Régionale, Production, Commercialisation, Consommations (Paris, 1973); for an alternative technical analysis of the ranch see Anthony Angus Corp., A Feasibility Study For Industrial Meat Production in Senegal (AID Contract Afr./746, August, 1971).

managed by SERES, a parastatal company. The site chosen was one infrequently used by transhumant producers because of the lack of dry season water and mediocre natural range under a heavy savannah forest canopy. Water development represented 50 percent of initial development costs. The estimated stocking rate for the ranch is 10,000 head. The original management plan was the following:

- Buy, in an average year, 6,550 young animals (at an average age of 30 months and at an average weight of 180 to 200 kg.) for a feeding period of about 18 months.
- Resell the animals at four years of age at an average weight of 400 kg. (365 grams per day average gain).

The Doli Ranch was never stocked to more than 50 percent of capacity. The reasons for the financial failure of the ranch were determined to be the following:

- a. No systems set of records or production controls was kept.
- b. The Ministry of Finance failed initially to provide adequate operating capital to stock the ranch and buy necessary equipment to control range fires.
- c. The ranch management was not able to obtain semi-mature animals through regular marketing channels. The trade cattle which they were able to purchase weighed between 250 to 300 kg., and feeding periods were shortened to 6-12 months. The average daily gains were about half of projections (\pm 200 gm.), and many animals actually lost weight on the ranch.
- d. Acquisition and marketing costs were very high on a per-unit basis, and ranch buyers were in competition with dealers moving cattle directly to slaughtering points. The average operating loss per head handled in the 1971-1972 period was CFA 2,374, not including amortization on management costs. The ranch was restudied in 1972 and a new management plan proposed:

To obtain the optimum stocking rate:

- a long cycle for 4,300 head purchased at 160 to 200 kg, live weight to be grazed for 18 to 22 months with an expected gain of 162 kg. per head (365 gm./day).

-- a short cycle during the rainy season of 4 to 6 months for 2,950 animals purchased at 220-240 kg, live weight with an expected gain of 65 kg. (300 gm/day).

In addition, it was proposed to grow cash crops such as groundnuts on the fire breaks (using the hay for forage), and to buy groundnut hay and rice straw as dry season supplemental forages -- propositions which do not appear to be economically feasible.

SEDES (in 1973) proposed that the management plan should be to concentrate on the re-*élevage* of weaned steers purchased at an average age of 12 to 18 months and weight of 120 to 150 kg. To maintain dry season weight gain, they proposed the production of fodder crops using deep-well irrigation. The SEDES team noted that the purchase cattle of that age and weight would require a special buying unit, but noted that ranch management would not be buying in competition with the private trade, which requires larger animals. They further proposed that grown out animals continue to be sold to NUTRISENEGAL (or another feedlot), which would fatten the animals before slaughter.

Given the projected high cost of producing irrigated forage and the high probability that the ranch management could not afford to pay prices for very immature animals which would assure a regular supply to the ranch, the deep-well irrigation systems has not yet been financed and installed.

2. The SODEPRA Ranches -- Guinean Zone (Cameroon)¹

Variations of the longer-term growing-out ranches are two 20,000 hectare ranches currently being developed by SODEPRA, a Cameroonian

¹For a more detailed description of the SODEPRA Ranches see: IBRD, 1974, Appraisal of the Livestock Development Project Cameroon (Report No. 295 - cm. March 6, 1974).

parastatal company on the Adamaoua Plateau, with IBRD credits. Because the ranches are located at a higher elevation (1,200 meters) and in an area with an 8 to 9 month growing season, no supplemental feeding is projected. Semi-mature and thin animals are available from small-owner herds located in the immediate vicinity of the ranch. Grass-finished animals are to be marketed live by road/railroad to markets in Yaoundé and Douala.

Several large, privately owned growing-out ranches have been in operation on the Adamaoua Plateau for a number of years, one of which has a carcass export subsidiary.

Factors in their success are the long growing season and the comparative ease in acquisition and disposal of live animals. Generally, Guinean-zone growing-out ranches would appear to have substantial technical and economic advantages over those in Sudanian and Sahelian zones.

3. Community Group Ranch (Upper Volta)¹

A variation of the Guinean-zone growing out ranch is included as part of the Upper Volta Group Ranch Project. It is of particular interest as it is a pioneering effort to bring together both crop-dependent and livestock-dependent production units in a joint land use management activity.

The Group Ranch Project is part of the financial and technical support being provided by IDA to the Bobo-Dioulasso Organisation Régionale du Développement. The cooperative ranch project is located near the Mali boundary, 100 km. west of Bobo-Dioulasso, which is a major regional road and rail center.

The project zone has about 1,100 mm. of rainfall annually. The objective of the project is to group the population of about 20,000 persons distributed in some 30 villages into nine community-owned land management areas. It is estimated that about 84 percent of the population

¹For a more detailed description of the community ranches see IBRD/IDA, 1975, Appraisal of a Livestock Development Project Upper Volta (Report no. 674a-uv, May 8, 1975).

are subsistence crop farmers and 14 percent are Peul families who migrated into the area from the north and west as recently as 15-20 years ago. They are estimated to own 70 to 80 percent of the cattle. Herdsmen practice a limited transhumance within 35 km. of village sites. It is estimated that only 2.5 percent of the land is under cultivation at any one time, but that about 30 percent is suitable for cultivation and 70 percent is most suited to grazing. Both farmers and stockowners cultivate food grains for family use.

Under the present land tenure laws of Upper Volta, all land is "owned" by the government, and usufructuary rights are assumed by individual farmers for the purpose of cropping. Complicating the picture are the long-standing residents of the area, the crop farmers, who continue to regard themselves as the "owners of the land," and it is the established village leasers who allocate the usufructuary rights to both cropping and grazing lands. Because the Peuls are "foreigners" and new arrivals, they tend to lose out in the allocation of crop land. Although there is no land pressure in the sub-project zone, many serious conflicts between long-time residents and Peuls are occurring in the more densely populated areas of Upper Volta. Because the grazing resource is not owned and there is no control over grazing patterns, there is little incentive for individuals to improve the range resource.

Each group ranch would include about thirty-five Peul families and 150 crop-dependent families, which would collectively be given a long-term land lease by the government. In return, the group would agree to maintain agreed stocking rates and transfer most of their herds to collective management, but individuals would continue to own specific animals in the breeding herd. A five-member elected committee would develop management policies within the provisions of a national group ranch statute, but day-to-day management of livestock would be carried out by a ranch manager after consulting with the committee. The estimated capital development cost per participating family is about \$2,700.

The community group ranch structure has the following advantages:

- a) It provides security of tenure to all members of the community, including the livestock owners.

- b) It provides a formally recognized basis for regulating the present unstructured grazing and crop rotation patterns and stocking density.
- c) It will assure good range management, including range fire control necessary for increasing per unit area and per head productivity. At the end of the period, it is expected that the community will have paid for the capital development costs and will own the infrastructure completely.
- d) It will provide adequate milk for community consumption without the necessity of returning the entire breeding herd to the village each evening.
- e) Since the community owns the land, additional land can be made available for cultivation on a systematic basis as population increases.

Ranch Growing Out Enterprise.-- It is anticipated that each of the 15,000 ranch units can support 5,000 annual units. Three thousand units will be reserved for the individually-owned but collectively-managed breeding herds and 2,000 units for a group-owned steer growing-out enterprise. The management plan is to purchase 1,000 steers annually at an average age of 30 months and at an average weight of 230 kg. These are to be grown out along with the steers produced on the ranch for an 18-20 month period and will be sold at roughly 335-360 kg. Some steers would also be trained for animal traction to be used on individual farm units. The projected profits from the feeding enterprise are expected to more than pay for both the management and debt-servicing costs of the group ranch.

Summary Note.-- In spite of an estimated internal rate of return of roughly 20 percent, the ranches are considered to be a "risky" investment by IDA because of the many potential pitfalls. Nonetheless, it is of interest as a pioneering effort to bring together both crop-dependent and livestock-dependent family units into a community land management activity which could serve as a model for a large portion of the Guinean and Sudanian zone.

It is of particular interest that the Upper Volta Village Livestock Project, with technical and financial assistance by USAID, is taking a very different approach to the solution of the same type of problems. In Phase 1, the approach is to work with individual farm units and selected villages in three ORD's- Kaya, Koupela and Eastern - with the objective of evaluating and defining more intensive production and management options to be financed and extended in subsequent phases of the project (AID/Afr, 1976c).

4. Ekrafane Ranch--Sahelian Zone (Niger)¹

The arid zone prototype of the medium-term feeding-out ranch is the Ekrafane Ranch located about 150 km. north of Niamey, Niger. The ranch is operated on export operations of the Niamey abattoir. Carcass meat is exported to Abidjan and other markets by air freight. In years of average rainfall (400-500 mm.), it was projected that an 80,000 hectare ranch could turn out 8,000 head annually using month-long feeding periods.

Although it was expected to purchase semi-mature cattle in the Sahelian region near the ranch, it was found to be easier to buy cattle from private traders in the large assembly markets near Niamey and move them north to the ranch. The ranch has suffered chronic financial problems because of a shortage of operating funds, drought, and deviations from the "optimum" management plan. As a footnote, the greater volume of vegetation of the Ekrafane Ranch was clearly visible in early earth satellite photographs, and this fact was widely publicized in the popular press.

¹For more detailed descriptions of the ranch see : SEDES: Etude de Factibilité de Deux Projets de Ranch Nord Dakoro-Nord Dakoro, Tome V Eléments Technique et Economique Recueillis Sur le Ranch d'Ekrafane (Paris, 1974); and IEMVT, Etude des Pâturages Matures Sahéliens Ranch-Nord Sunam, République du Niger, Etude Agrostologique, No. 5 (Maisons Alfort, 1963).

Short-Medium Term Fattening Ranches and Feedlots¹

The management objectives of short-medium term feeding and fattening units are to increase the weight and carcass grade of immature and mature range or ranch grown animals through holding for short-term (60-90 day) feeding periods using high energy feeds immediately prior to slaughter. Although there is a vast amount of literature on the modalities of intensive feeding based largely upon experiment station data, there is little practical commercial experience in West Africa.

A fairly wide age/weight range of animals may be placed on feed with, in general, best weight gains attained by well grown but thin range cattle, which tend to make rapid compensatory growth with excellent feed/conversion ratios. Of greater importance is that cattle be sorted into homogeneous age/weight categories before being placed on feed. Better results are obtained under intensive feeding if preceded by a brief 1-6 month range feeding period. Feed stuffs used (or of potential use) in West Africa include many agro-industrial by products (molasses, brewers' grains, cottonseed cake, and various milling by-products) (Vandermaele, 1976). Because of feed cost in relation to conversion rates and meat prices, the feeding of whole grain to cattle in West Africa is not feasible at the present time, nor is it likely to become feasible at any time in the near future.

1. Mokwa Ranch (Nigeria)

The prototype of the combined improved pasture/feedlot operation is the Mokwa Ranch, located about thirty miles north of the Niger River in the western part of Nigeria, in an area with 1,000-1,200 mm. of rainfall annually. Young males weighing 200-250 kg. are purchased from trail

¹For a review of this experience see: IEMVT/SAEA, L'Embouche des Bovins en Afrique Tropicale et à Madagascar (Colloque de Dakar-Sénégal 4-8 Décembre, 1973, Maisons Alfort, 1973), IEMVT/SAEA, L'Embouche des Bovins en Afrique Tropicale et à Madagascar-Acts du Colloque, (Colloque de Dakar-Sénégal, 4-8 Décembre, 1973, Maisons Alfort, 1974; P. Blanc, De l'Embouche Intensive Des Zébus Africains et Malgache (Ateliers Heck, Imp., Paris, 1974).

herds moving on hoof, truck, or rail from Northern Nigeria to the Lagos or Ibadan markets. During the rainy season (May-October) cattle are grown out on improved Gamba grass and Panicum maximum pastures. During the dry season (November-April) cattle are fed in feedlots using a combination of grass and maize, silage, hay, molasses, cotton-seed, and brewers' grains. Cattle are retained on the ranch until they reach 300-400 kg., depending on skeletal development (a period of \pm 200 days). Approximately one hundred cattle are slaughtered on the ranch daily and shipped to selected markets in Lagos. It is claimed that excluding costs related to the experimental (non-commercial) nature of the station, the operation is commercially viable at prices current in 1976.¹

2. Nutri-Senegal (Senegal)²

The prototype of the large industrial feedlot is the Nutri-Senegal feedlot located at Bambylor, Senegal. During the period of successful operation, 1970-1974, it fattened animals purchased both from private traders and under contract from the Doli Ranch. By West African standards, the feedlot is ideally situated 45 km. from Dakar, a major urban center and terminal market for both cattle and export crops. It is near the Atlantic Ocean, which moderates hot season temperatures. Agro-industrial by-products are readily available, as are feed supplements.

The projected management plan was to buy 350-400 kg. animals for a 2.5 month feeding period, finishing them to a sales weight of 500 kg.

¹For a brief note on the Mokwa Ranch see K. Huebl, "L'Embouche Intensive des Zébus Gudali à Mokwa (Nigéria)" in SEDES/SEAE, op. cit., 1974. See also; A. Ruthenberg, "Artificial Pastures and their Utilization in the Southern Guinea Savanna and Derived Savanna of West Africa, Tour d'Horizon of an Agricultural Economist," (Stuttgart-Hohenhem, 1974, mimeo).

²For a description of this feedlot and alternative feeds and costs as of 1971 see: Ankony Angus Corp., A Feasibility Study for Industrial Meat Production in Senegal (AID Contract Afr/746, August, 1971).

The bulk feeds used were peanut hulls and molasses supplemented by grain concentrates feeds with a base of rice, flour, and corn bran -- a ration perfected with the assistance of IEMVT.

The reasons for the financial failure of this commercial enterprise are not known, but are said to include the rising costs of concentrate feeds. Additional factors may be assumed to include the "small market" for finished carcasses in the Dakar market - population 700,000 - (Ankony Angus Corp., 1971, p. 107), the rising cost of air freight, and the price cost competition with the private production and marketing trade.

To the knowledge of the author, there are currently no privately-owned commercial feedlots in operation in West Africa. Given the very high export value of available high protein concentrate, such as groundnuts and cottonseed cakes, and the low feeding value and consequent high handling cost of most alternative by-product feeds, industrial feedlots are not likely to become financially viable in the foreseeable future.¹

¹Several small- and medium-sized feedlots are in the process of construction in Mali with the financial and technical assistance of U.S. AID-MALI Livestock I Project (AID/Afr, 1971 and AID/GOM, 1973). The government of Mali is believed to have restricted exports and prices of by-product feeds in order to encourage this development -- a policy which, in effect, taxes peasant crop producers in support of the feedlot operators and meat consumers.

CHAPTER VI

FEASIBILITY OF SMALL (PEASANT) INTERMEDIATE STAGE PRODUCTION UNITS

Animal Traction/Mixed Farming¹

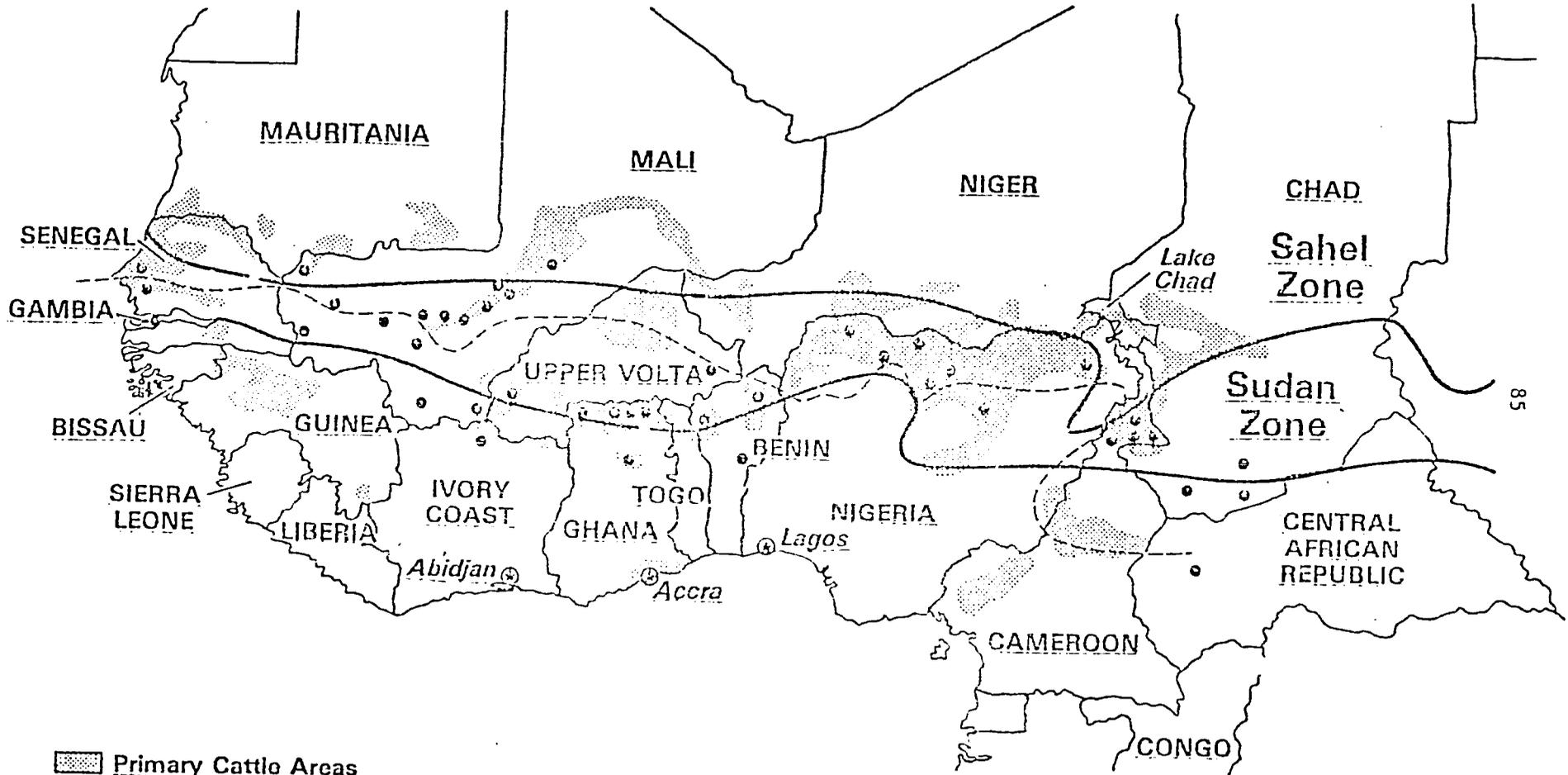
Animal traction combined with small unit fattening has long been viewed as the logical approach to breaking both the labor/energy constraint to maintaining or improving crop yields in many of the agricultural zones of West Africa.² Animal traction provides a small but growing number of small farmers with a source of power for cultivation and carting. Value is added to the farm business through timeliness of early planting, custom work and some carting, some added manure fertilizer, and the increase in value of the animals before final sale. Animal traction is seen as the key component of most packages to increase yields and income in interior dryland areas. It is believed that through better feeding of oxen during the dry season, cattle would grow more quickly and work more efficiently, and teams could be turned over every 2-3 years after doubling in weight and more than doubling in value. The location of centers of animal traction in relation to climate zones is shown in Map 4.

Although marketing is delayed, the evidence suggests that animal traction increases rather than decreases meat supplies, as it increases the value of immature males and results in a heavier animal at slaughter. However, it is doubtful that the value added from cultivation in and of itself justifies the cost of an oxen team and equipment. Combined however with custom plowing and to a lesser extent custom carting, and the feeding out of the animal, it is economically feasible in many localities.

¹Data in this section are drawn from J. Sleeper, "The Role of Animal Traction and Small Unit Feeding in West African Livestock Production," a draft MS prepared under the direction of Dr. Foster, University of Maryland, and the author.

²For example, see: FED Etude sur la Situation Actuelle de l'Élevage dans les Pays du Sahel et des Mesures de Sauvegarde à Envisager, February, 1974; and, C. Uzureau, Animal Draft in West Africa, "World Crops (26) 3, May-June, 1974.

WEST AFRICA: ANIMAL TRACTION CENTERS IN RELATION TO CLIMATIC ZONES



- ▨ Primary Cattle Areas
- Approximate Northern Limit of Tsetse
- Centers of Animal Traction Activities

Production Zones After R.G. Harrison Church, 1966
Vegetation Zones After Matlock and Cockrun, 1974
Map by J. Sleeper, University of Maryland, 1977

Because of the general absence of agricultural census data, the number of bovines actually used for traction is not known for any of the countries of the region. Estimates gleaned from a variety of sources, primarily dated projects documents, suggest that the number is on the order of 400,000-500,000 head for the West and Central African regions, with nearly one half of these in Mali and Senegal (see Table 7).

The use of bovines in traction, however, tends to be localized in those subzones which have the following characteristics:

- a. Friable (light) soils with a minimum of trees, tree roots, or other obstructions to plowing -- conditions found in the Sudanian Zone where trypanosomiasis is also less of a problem (Zone 2.2).
- b. A cash crop (usually groundnuts or cotton) which justifies the expansion of land under cultivation and provides a cash revenue to pay off equipment loans.
- c. Farmers in the locality own herds of cattle from which the oxen can be drawn, reducing the start-up and risk capital per unit and the risk of losses from trypanosomiasis.
- d. Extension programs have provided equipment matched to the size and tractive power of the cattle, provided training for the first entrepreneurs, provided credit for the purchase of equipment, and have made provision for the repair and maintenance of equipment.

These conditions are either found or have been created in the groundnut and cotton growing zones of Senegal, Mali, Ivory Coast, Ghana, Dahomey, Nigeria, Cameroon, and Chad, which corresponds generally with the Sudanian Region boundaries (zones 2.2 and 2.3). Little bovine traction is found north of 600 mm. or south of 1,200 mm. rainfall isohyets.

The most commonly identified constraints to the general expansion of bovine traction include:

- a. The lack of low cost credit and the comparatively high start-up and risk capital requirements --

TABLE 7

WEST AND CENTRAL AFRICA: GENERAL MAGNITUDE ESTIMATES
OF BOVINE TRACTION ANIMAL POPULATIONS
BY COUNTRY, 1965-1974

Country/Regions	1965	1970	1972	1973	1974
<u>Sahelian Countries</u>					
Mauritania	3,500	5,500	5,500	(3,000)	--
Senegal	10,000	14,000	15,000	(16,000)	--
Mali	130,000	180,000	190,000	200,000	--
Upper Volta	2,000	--	--	(7,000)	9,400
Niger	1,000	1,370	2,000	(1,000)	--
Chad	23,500	42,000 ^{a/}	--	83,000	95,000
Sub-Total	170,000	--	--	(310,000)	--
<u>Sub-humid</u>					
N. Nigeria	50,000 ^{b/}	100,000 ^{c/}	--	(100,000)	--
N. Cameroon	24,000	--	--	(17,000) ^{d/}	--
Gambia	--	--	--	--	12,000 ^{e/}
Sub-Total	74,000	--	--	117,000	--
<u>Humid</u>					
Ivory Coast	200	--	--	(2,000)	--
Ghana	(5,000)	7,500 ^{f/}	--	(12,000)	16,000 ^{g/}
Togo	300	500	--	(500)	--
Dahomey	40	--	--	(6,000)	6,300
RCA	500	2,400	--	(2,000)	--
Sub-Total	6,040	--	--	22,500	--

SOURCES OF DATA

Data not otherwise indicated drawn from: SEAE/SEDES, Recueil Statistique de la Production Animale (Min. de la Coop., Paris, 1975). Numbers in brackets the author's estimate. Country estimates in various sources often differ by 100 percent.

- a/ Tacher, et al., "Les Bovins de Culture Attelée au Tchad," Mach. Agr. Trop., No. 29. Jan - Mars, 1970.
- b/ Northern Nigeria, Ministry of Agriculture, Triennial Report, 1954-1962 (Zaria, 1963).
- c/ Laurent, C. K., "The Use of Bullocks for Power on Farms in Northern Nigeria," Bull. Rural Econ. and Soc. (Nigeria), Vol. III, No. 2, Oct., 1968.
- d/ Ferguson, D. S. Field notes. October, 1974.
- e/ IBRD/IDA, Gambia Rural Dev. Project, Report No. 1089a-GM, 1976.
- f/ Kline, et al., Agricultural Mechanization in Equatorial Africa, M.S.U., 1969.
- g/ IBRD/IDA, Upper Region Agric. Dev. Project, Report No. 1061a-GH, 1976.

- a team with equipment now costs on the order of \$400 - \$500, a sum which may exceed by three times the annual gross cash income of a small farm unit.
- b. The dry season feeding constraint -- few farmers produce either surplus grain or store fodder for dry season use; thus, animals are thin and weak at the beginning of the plowing season. Because farm units are very small, the quantity of usable crop residues on any one farm unit is usually too small to provide enough quality feed for a team of oxen for even a short feeding-up period before the plowing season begins.
 - c. The lack of either widely applicable soil building crop rotations which include fodder crops or grass leys for forage production or land tenure systems which allow individuals (or communities) to reserve natural rangelands for the use of village herds (see pg. 27). Again, profitability is related to the costs of the production package, the value of the crops produced, and the increase in value of the oxen before final disposal.
 - d. The comparatively small size of the Sudanian and Guinean Zone breeds of trypano-tolerant cattle, a constraint related to poor feeding but requiring that equipment be engineered for the size and tractive power of local stock.
 - e. The comparatively small percentage of rural families that own cattle and live in an agricultural zone -- less than 10 percent in most Sudanian Zone communities (see Table 1) -- and the difficulty in some localities (excluding southern Chad) in obtaining and marketing oxen.

- f. The inability of the farmer to completely overcome the weeding constraint, either because of the lack of proper weeding attachments, lack of training of the animals, lack of training and skill in the part of the farmer, or lack of sufficient on-farm labor to weed the crops by hand.
- g. The inability of veterinary services to provide more than communicable disease control via mass vaccination campaigns. Most countries lack programs to maintain the health of cattle on individual mixed farm units.

Using some admittedly heroic assumptions, the relative importance of bovine traction can be estimated. Based upon a human population estimate of 50 million persons for the Sudano-Sahelian regions of the six Sahelian countries plus northern Nigeria and North Cameroon, there are on the order of 7-8.5 million individual nuclear family production units. Thus, in global terms, perhaps one family unit in 40 owns a team of oxen -- 39 to 40 depend primarily on hand-held tools.

Looking at the supply/absorptive capacity side of the ledger, animals are typically selected for training at 24-30 months of age and are used for two to six years before sale at six to eight years of age, when they have attained near full mature size and weight. Assuming that animals are retained for four years, on the average, in the traction enterprise, and that there is a 2 percent annual mortality, roughly 125-155,000 head would be added each year to traction units and 110-130,000 marketed for slaughter. This compares to the estimated 25-30 million cattle in the region and 1.5 - 1.8 million male cattle marketed each year. Again, based upon very heroic assumptions, at the most one male animal in ten may be used for traction before slaughter.

Based upon both the very small share of the family production units that own oxen and the small share of males used, there would appear to be a very real potential to expand bovine traction. As the economic value of male animals increases, calf mortality should decrease. In addition, the value of introducing fodder crops and reserving land for village herds

should increase, making modifications in land tenure more socially acceptable.

The advantages of promoting animal traction as a meat production activity are that comparatively large numbers of individual farmers could benefit, and it contributes to increasing food crop and cash (export) crop production. But because of the advantages in drawing oxen from herds found in similar ecoclimatic zones to which they are to be used (because they will then be more tolerant of local climatic and disease conditions), a general expansion of animal traction would be expected to have comparatively little short-term impact on the demand for immature steers produced in the Sahelian region.

Small Unit Feeding (Embouche Paysanne)¹

There are two categories of small fattening units which occur in West Africa. The first, and by far the most important, occurs in localities where there are good farm by-product feeds or naturally growing hay and which are located near urban markets and transportation centers. Important centers of feeding are found in the groundnut producing zones of Senegal, Mali, and Nigeria (groundnut hay) and in the Niger River Valley in Niger where borgou (flood retreat) hay is harvested in the dry season.

The typical pattern is this: the operator, who commonly is also a small cattle merchant or a butcher, to purchase one or two animals at the end of the cropping season (October - November) using funds generated by the sale of cash crops. This is also the season when cattle prices are lowest, because more cattle are offered for sale as herds return from wet season transhumance. Cattle are either penned or staked out with the feed brought to them. They are resold at the end of the dry season when cattle prices tend to be higher and cattle in good condition bring premium prices.

¹For an excellent description of small unit feeding in Nigeria see: Larson and Ndinku, "Report on Nine Cattle Fattening Trials in the Provinces of Sokoto, Katsina, Kano, Bauchi and Bornu," Report No. a-13 to the Ministry of Animal and Forest Resources of the Northern Region, June, 1962. Assistance to small unit feeding is included in, AID/Afr. Mali Livestock Project, 1974.

Value is added in the farm business through the increase in value of the animal and by manure/compost, which can be used on farm gardens to increase yields.

It has not proved possible to estimate the numerical importance of this type of activity from secondary data sources. The constraints to expansion are similar to those which constrain animal traction. Other things being equal, one would expect both enterprises to be profitable in the same localities. However, unlike cattle used in traction, heavy stall-fed animals are not in good physical condition and cannot be walked more than a few kilometers before they must be transported by truck and/or rail to final markets. The growing network of paved roads may extend the locus of profitable feeding-out from major transportation centers.

Because source of origin or age of animals acceptable to small feeders is of less importance than in other types of intermediate production units, it does provide a potential outlet for very immature bulls and steers. There is evidence from Niger of animals as young as nine months of age being placed on feed by small farmers.¹ The critical constraints are, again, feed production and storage and the inability of the feeder to obtain a good feeding margin (premium for quality) unless he has direct access to urban markets.

A second type of small unit feeding occurs locally in the mountainous area of northern Cameroon (and perhaps in other similar areas).² Described as boeuf de case or pen feeding, one or more animals are fattened by the community in a pit enclosure using crop residues. Animals are then slaughtered for special holiday occasions, although they are said to be in great demand by the private marketing trade also.

In some high population subzones, such as the Mossi Plateau, the practice of enclosing small plots which surround family compounds and fertilizing them with night soil and compost has evolved. Although fodder supply

¹Dr. J. Culumb, IEMVT, personal communication.

²Bouef de case feeding is described in "La production de viande par l'embouche dans les conditions traditionnelles du Nord Cameroun," E. Engueleguele in L'Embouche Intensive des Bovins en Pays Tropicaux (Acts du Colloque, Dakar, 4-8 Décembre, 1973, IEMVT, Maison-Afort, France, 1974).

and the supply of animals would be somewhat greater constraints, it may be possible to promote boeuf de case type feeding because the use of manure/compost to maintain soil fertility is accepted, and there is a critical need to identify additional family income possibilities. As a point of departure, the pen feeding of sheep and goats, which can be more easily matched to available feed supplies and are owned by most households, can be encouraged. The per-kilogram price of rams, in particular, exhibits significant seasonal price variability with highest prices paid before Moslem feast days, but both species find ready markets regardless of season.

CHAPTER VIII

A FULL PACKAGE VERSUS PARTIAL PACKAGE
SECTOR DEVELOPMENT STRATEGY

The most controversial issues related to livestock sector development strategy center around what might be called the full package approach, which includes directed land use management as part of that package, versus the partial package or phased approach, to public sector livestock production support activities.

Proponents of the full package approach emphasize the necessity of achieving controlled management of livestock, land and forage resources if production per animal unit and per unit of land are to be increased and if the progressive degradation of very large hectares of rangelands and post-cultivation fallow lands is to be arrested and productive potential preserved for future generations. Project models which may be grouped in this category include the various private, public and communal ranching schemes and controlled grazing areas. In the partial package or phased approach would be grouped the lion's share of most "livestock production support" activities which have traditionally been financed by donors and host countries. In this chapter, some of the issues surrounding this controversy are examined, and a suggested approach to resolving these issues is described.

The Experience with Phased Public Service and Sector Development Projects and Programs

The development of African livestock production is severely constrained by the lack of formal, organized land tenure systems.¹ As the result of perhaps "too successful" public sector development programs, the livestock population of the semi-arid and arid eco-climatic zones increased dramatically in the period 1940-1965 as the result of improved veterinary health services,

¹See, for example, Jahnke and Ruthenberg, "Organizational Aspects of Livestock Development in Dry Areas of Africa," Stuttgart, 1973.

development of public water sources, the opening of some new lands to development, and fundamental changes in the social and political balance between sedentary farmers and livestock dependent peoples (Chapter II). It is generally conceded that the environmentally sound stocking rates of the Sudano-Sahelian region were exceeded by the mid-1960's, given the poor standard of management of the rangelands, resulting in the severe losses due to starvation and malnutrition which occurred during rain-deficit years. Further, any rapid expansion of livestock numbers in the Sudano-Guinean region is constrained by trypanosomiasis and other social, physical and technical problems.¹ Any short- to medium-term expansion of livestock production is largely dependent upon improving the productivity of existing flocks and herds in existing use areas through better feeding, management of breeding, growing-out flocks and herds, and through expansion of small-scale intermediate stage production enterprises (see Chapters IV, V, and VI).

In Western Africa, there have been only limited efforts to introduce managed land use simultaneously with improved veterinary services, village and stock water supplies, firebreaks and other forms of public services and infrastructure on communal grazing lands. The public demand for the continuation of these services and development of infrastructure, without establishing limitations on land use on the part of beneficiaries as a quid-pro-quo for providing them are very strong. Proponents (and beneficiaries) note that traditional African land tenure (and vegetation use rights) are basically egalitarian in nature, as members of livestock-owning groups in general have equal access to these resources. They note that reallocation of use rights to a limited number of individuals or groups of individuals poses the threat of the creation of landless persons as population expands. They note, correctly, that many livestock-dependent groups have been alienated by government action or inaction including the threat of public management of

¹The potential for livestock production in "new lands" areas is substantial. But progress in opening these resource zones to development will be slow. See for example, Dewit and Ochs, "Livestock Development in West Africa," IBRD Permanent Mission for West Africa, Abidjan, 1972.

rangelands and contend that provision of village water supplies, supplement feeds, and mineral supplements are necessary to "regain the confidence" of livestock-dependent groups before change agents attempt to introduce more complex (and potentially socially disruptive) changes in land and herd management. The development hypothesis is that once the "goodwill" of rural residents has been obtained they will be more amenable to accept changes in resource management, which all agree are necessary to increase output per unit area and, in many cases, to preserve these resources for future generations.¹ Unfortunately, there are no examples in the literature of the successful establishment of control over the land use following provision of services, inputs and infrastructure without public participation and enforcement. Nor are there modern examples of traditional social system mechanisms acting to limit livestock population growth or to restrict access to communally-owned resources. In fact, to the extent that development programs reduce the risks involved in owning cattle, they probably have had the opposite effect by encouraging formerly non-livestock-dependent households to invest in cattle (see Chapter II).

Perhaps the most dramatic example of the misapplication of non-packaged development assistance has been the construction of several thousand large bore deep wells across the Sudano-Sahelian zones of West and Central Africa.² These were typically installed in what was believed to be underexploited rangelands. As these water sources are considered by both the government and users as public water, the use of that water and surrounding forage resources has not been governed by "traditional" use rights (see Chapter II). Consequently, large concentrations of cattle have assembled around these wells, particularly in times of water shortage, resulting in the denudation of land for 5 to 10 miles -- the distance cattle and sheep could walk in one day -- around most large bore wells.

¹Clearly, gaining the good will and cooperation of beneficiaries is critical to the success of programs, and increased government services will be required. The issues relate to whether services and infrastructure should be provided prior to or following the agreement of beneficiaries in principle to a defined management plan.

²Those in the Lake Chad Basin are often artesian wells, while others required installation of motor-driven pumps.

The evidence is clear that in environmentally fragile zones, the development of new permanent water sources and animal health campaigns has had the short-term effect of improving herd productivity and incomes. To the extent that they contributed to the rapid expansion of the livestock population and the over-exploitation of previously underused land resources, they have also inadvertently contributed to an acceleration of environmental deterioration. Although there has been no post-project summary of performance versus the "benefits" projected for such capital developments and for veterinary health campaigns, it is clear that they have not attained goals, because long-term improvement in animal nutrition or per unit productivity have not been achieved. Where "new rangelands" have been opened to use, it is doubtful that average herd productivity has been improved significantly. While it is necessary and desirable to continue communicable disease control programs on a general basis to all stockowners (see following sections), a moratorium upon capital infrastructure projects, particularly large volume wells, should be imposed until effective management of existing infrastructure can be achieved.

Managed Land Use and Integrated Action Programs

For a variety of reasons, the governments of the West African countries have established "sedentarization" of nomadic and transhumant producers as a development priority. From the governments' point of view, nomadic groups are difficult to integrate into the new national society. Taxes are easily avoided and animals are often sold when on transhumance in importing countries, depriving the local government of export and slaughterhouse revenue. In addition, the uncontrolled movement of herds is a factor in the spread of communicable disease, offsetting efforts to eradicate disease from national herds. It is clear that the approach to integrated programs must be tailored to both the eco-climatic zone and the prevailing and potential land use of specific localities.

Sudano-Guinean Region. -- The sole examples of functioning managed land use schemes for the Savanna Zones in West Africa are the several grazing reserves located in northern Nigeria. Of the eight schemes initiated with USAID assistance in the 1960's, two schemes were still functioning as designed, following the drought in 1974. These were the first schemes initiated, which benefited from the guidance of mature technical assistance for a full eight years. This provided the opportunity for host country technicians and participating families to grow into the management plan. Simultaneously, counterpart and auxiliary staff were trained as part of AID's project activities.¹

The approach to development of managed land use areas is to prepare a well-defined but flexible blueprint of action based upon established land use management principles and experience gained on similar projects in other parts of the world. The approach recognizes that participating families must give up certain privileges such as the free movement of their herds, follow prescribed grazing patterns, limit livestock numbers, and pay a modest grazing fee to partially offset scheme costs. In exchange, they are assured adequate year-round feed and water for their stock, provided with access to a full range of inputs, and guaranteed a joint lease hold form of land tenure. Compliance with regulations is a prerequisite for continued participation in the scheme.

An important component of planning and implementation phases is the formation of scheme management committees comprised of representatives of the participants, extension agents, and local government to assure the free exchange of views between participating families and government.

The facts are that under the environmental conditions characteristic of the Nigerian schemes, it has been demonstrated that Fulani families will accept the loss of independence, which is part of scheme participation, in exchange for greater security and presumably higher family incomes. Further,

¹For the best description of the schemes and an evaluation of reasons why some continue to function while other failed, see Bates, et al., A Review of USAID Projects in Four Major Livestock Producing States in Nigeria and Assessment of Range Management. (Final report under Project 26U-853 to USAID, Research Triangle Institute, May, 1975.) Nigeria is in the process of revitalizing the six schemes within which the management plan broke down and initiating others as part of an IBRD-financed development loan (IBRD/IDA, 1974).

the condition of rangelands within the reserves is superior to that outside of the schemes (Bates, et al., 1974). Unfortunately, no surveys have been made of the before and after productivity of land per unit area or of cattle and income flows to participants and governments, which would permit more objective valuation of scheme success.

It should be noted that most of the Nigerian schemes have been located either in forest reserves where settlement and cultivation had been prohibited for a number of years or in land resource zones with very low population density. Although they may be characterized as capital and management intensive schemes and may require very large units of land per participating family, they must be judged in relation to the optimum use of particular land resource zones (see Chapter III).

Care must be exercised in generalizing the rather limited grazing reserve experience on a broader scale to arid rangelands and to zones of higher population density.

In zones of higher population density, where crop cultivation becomes a more important factor, the management problems become much more complex and usually involve the integration of several tribal groups and management systems. The principles of management of community grazing lands remain the same -- no progress can be made in productivity without private or communal control over grazing patterns and stocking densities. Community resource management will be easier a) where crop rotations exist or can be introduced, permitting continuous cultivation of land once it is clear for cultivation, thereby reducing the rate of disappearance of rangelands, and/or b) where forage crops or legumes can be included in the cropping cycle. A community conservation plan would also need to include regulation of land selected for cultivation and the reestablishment of grass on fallowed lands.

Sudano-Sahelian Region. -- There are, at the present time, no functioning or actively proposed large scale integrated land use management schemes in the Sudano-Sahelian region of West Africa.¹ Several public and parastatal

¹A pilot demonstration grazing unit is to be developed as part of the AID-supported Niger Livestock and Range Management Project, beginning in 1978.

ranches do exist (see Chapter VI), but they are generally not considered to represent a financially viable development model. Estimates of the projected cost of a fully developed cooperative ranch are as high as \$25,000 per family unit.¹ It is quite probably that both parastatal and cooperative ranches would continue to require long-term public or donor subsidies, because of the high development and management cost in relation to projected revenue per head of livestock and per unit of land.

From a development point of view, there are convincing arguments for attempting to "fine tune" the transhumant grazing systems rather than replacing them with highly capital and public management intensive systems (see Chapter III).

One possible development model for the arid zones (400 mm rainfall or less) would be the creation of suitably large Pastoral Grazing Units, such as are described in the SOLAR feasibility study (Boudet, et al., 1976). Those grazing units would need to be cartographically delineated so as to include those rangelands habitually used by one or several ethnic groups during annual transhumance cycles. They should be large enough to include a reserve of grazing units of sufficient size to provide for the non-exceptional deficit rainfall year. An indicative management plan for such a unit is suggested by Figure 5. The promise of capital improvements can be used as an incentive to gain the cooperation of the direct beneficiary for the management plan.²

By including the entire annual displacement zone, the opportunity exists to make the best use of each of the complementary categories of range sites and to negotiate management plans with all interested groups.

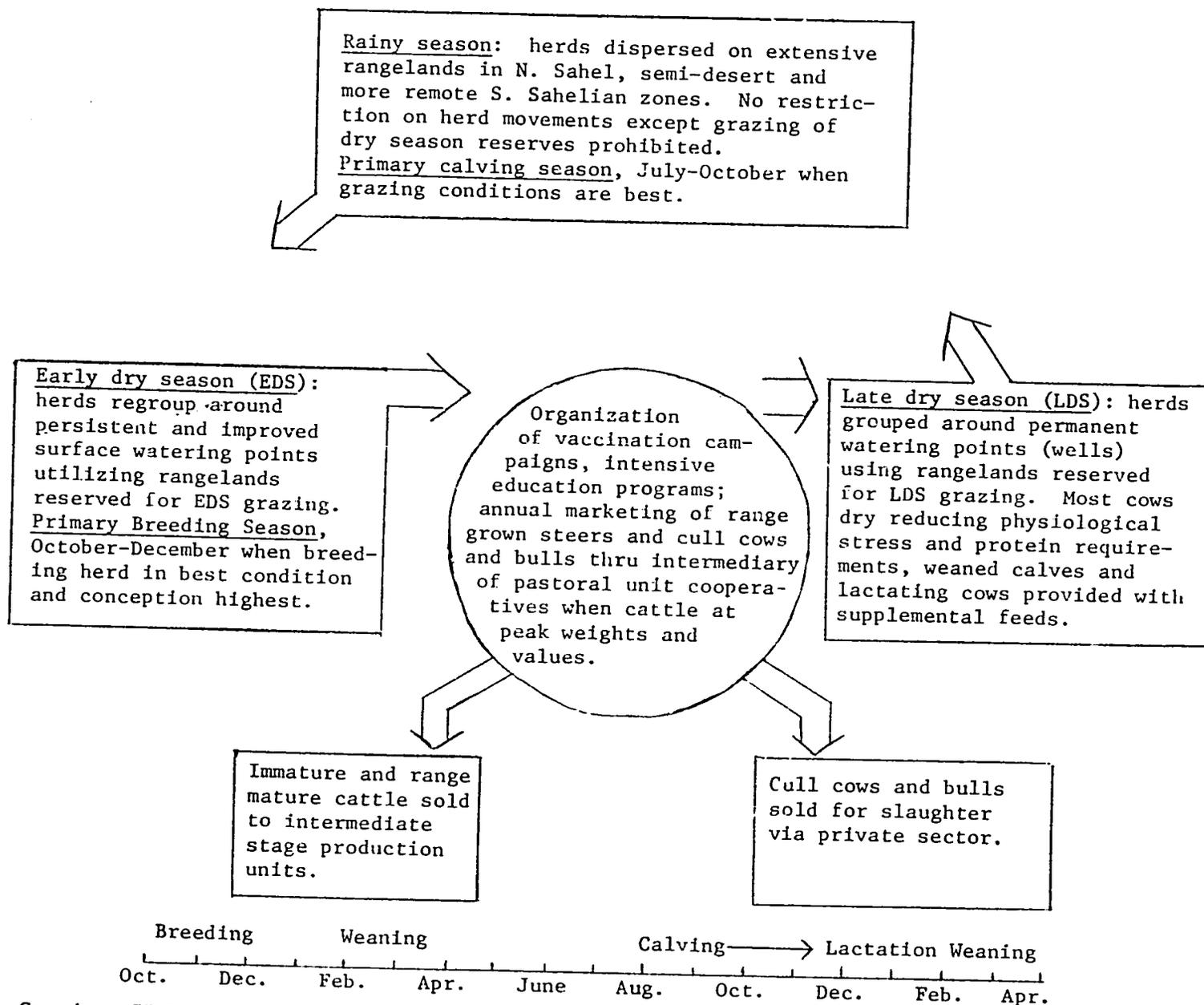
To summarize, experience has adequately proven that the development of permanent water supplies on a portion of an existing transhumant cycle invites sedentarization with inevitable overgrazing and deterioration of

¹For a description of a cooperative ranch model estimated to cost \$25,000 per participating family see: "A Ranching/Mixed Agriculture Program in Niger, A Feasibility Study for AFRICARE," Texas Tech University (June 1978).

²For a slightly modified model see: IBRD/IDA, Appraisal for a Livestock Project, Mali (Report No. 538a-MLI, January, 1975). This project located in the MOpti area includes a number of transhumance cycles which terminate in and around the interior delta of the Niger.

FIGURE 5

SAHELIAN REGION: INDICATIVE MANAGEMENT PROGRAM FOR HERDS AND RANGELANDS - PASTORAL UNITS*



*After P. Grenier, IEMVT, Niger

As a general development model for the arid zone, providing the forage production technology necessary to retain herds on small cooperative ranch type situations would appear to be prohibitively expensive. Although there are no operating models of capital and management extensive grazing blocks in Western Africa, little progress can be made in expanding livestock production on a wide scale unless better management of range and grasslands can be achieved.

Selection of the phased or a more management intensive approach could be made based upon the following:

Rate of Environmental Degradation. -- For a given locality or zone, the extent to which existing community cultivation, grazing technology and practice, and historical approaches to development are resulting in unacceptable rates of deterioration in natural productivity. If the rate of deterioration is unacceptable, urgent and possibly more structured and less socially equitable action programs could be justified as necessary to preserve resources for future generations (see Chapter III).

Social Feasibility. -- The political and financial cost of gaining the acceptance of management plans by target groups as a prerequisite for provision to them of more than basic veterinary health programs.

Expected Rate of Spontaneous Socio-Economic Change. -- The probability of bringing about fundamental changes in traditional land tenure (access to community grazing resources) and herd and grazing management on the part of community members, through community development forms of education followed by mobilization based on "felt needs." Should this approach result in a slower rate of adaption or no adaption of improved land use management, then the "cost" of environmental damage and a lower level of output would need to be considered in project analysis. In short, are the rural social systems flexible enough that given limited guidance and incentives, environmentally sound and socially equitable solutions to problems of resource allocation and responsible management can evolve?

The economic and financial feasibility of alternative approaches considered for each of the land resource zones and community production systems described in Chapters II and III.

Animal Health Programs

Animal and human health programs have always been highly subsidized in Africa. Typically, veterinary services are provided free or for only minimal charges for vaccinations and drugs. Disease control is considered to be a public good because the entire society benefits from greater meat and milk production and the resultant lower consumer prices. Furthermore, many disease control programs cannot be organized on a private basis, thus justifying public participation and subsidy. Issues related to the control as opposed to the eradication of specific diseases have seldom been evaluated as to economic costs and benefits.¹

No one seriously advocates the withdrawal or curtailment of communicable disease control as a method of limiting livestock populations, because a very high mortality rate of all animals regardless of age or sex would occur, resulting in severe dislocation and economic losses. Diseases can be controlled at low cost per animal by mass vaccination campaigns, during which the owners bring cattle to the vaccination site. Thus, it is not necessary for vaccination crews to visit each camp or village.

These annual campaigns are often the sole annual contact between veterinary services and livestock owners when extension education and census-taking can take place.

On the other hand, a go-slow approach to more comprehensive disease control activities in arid zones appears wise. Internal and external pest control involves the use of pesticides and drugs which must be imported and applied repeatedly at comparatively high cost per animal. Their primary effect is to reduce the mortality of young calves, which have a comparatively

¹D.S. Ferguson and T.T. Poleman, Modernizing African Animal Production: The Uganda Tick Control Project (Cornell Int. Agric. Dev. Bulletin No. 42, 1971), provides an economic analysis of control versus eradication of tick-borne diseases in Uganda.

low economic value. The net impact would be acceleration of the rate of herd growth, overstocking, and environmental damage. Similar issues and reservations are raised in relation to investment in input-delivery systems for such productive inputs as pesticides, minerals, and feed supplements in arid zones. In more humid zones, where desertification tends to be a less critical problem and pests and mineral malnutrition more severe ones, the balance shifts in favor of more comprehensive health programs, particularly to protect high-value animals such as milk cows, traction animals, and those on enclosed production units (Ferguson and Poleman, 1971).

The following generalizations can be made:

1. Veterinary health activities and the supply of productive inputs are popular activities with target groups. They reduce the risk of short-term losses and often have a dramatic impact on animal health and productivity.

2. They have received the active support of livestock-owning households, and animal health activities such as tick control have been used as a focus for cooperation and community action programs (Ferguson and Poleman, 1971).

3. Livestock-owning households are willing and should be expected to pay a large share of the cost of disease control and inputs which improve productivity and net income.

The safe rule of thumb would appear to be in localities where control of specific diseases and the use of productive inputs are profitable for individuals and/or communities that are prepared to pay a large share of costs, then initial phases deserve to be financed in national and donor assistance programs. Where the level of malnutrition is high and starvation is the most seriously constraining factor, they are not expected to be profitable at farm level, and the logic for public or donor subsidy is a poor one. It should also be emphasized that the level of current and projected farm prices will also be critical in determining profitability.

It must be emphasized that programs for the control of the two highly dangerous communicable diseases -- pinderpest and contagious bovine pleuro pneumonia (CBPP) -- are indispensable prerequisites for any livestock

improvement programs. However, regardless of zone, wide-spectrum animal health interventions to control or eradicate all animal diseases, including internal and external parasites, are exercises in futility without effective means of controlling stocking rates and grazing patterns.

In the West African region, budgets for the production support industries such as rural development and animal husbandry, are often a comparatively small share of national budgets, given the high percentages of rural residents and the major importance of agricultural exports. In addition, a disproportionate share of the budgets of production support industries go for salaries and staff benefits as opposed to materials and operations support (see, for example, Table XVIII).

Although the case can be made for encouraging the countries of the region to increase expenditures for production support, chronic budget shortages are expected to remain a fact of life for the immediate future. In view of the fact that the Sahelian countries have eliminated per head cattle taxes, the gradual introduction of fees for veterinary services may be the only way of maintaining and expanding animal health services in the medium term. A prerequisite for this approach will be the creation of a revolving fund to purchase goods and supplies to be replaced as sold or expended. A companion audit and management system will also be required.¹

Because of the severe budgetary constraints, assistance should be provided for the design of low-cost input delivery systems. As an example, practitioners could be trained to administer less dangerous treatments, such as parasite control and treatment of external infections. Policies such as fees for payment must be coordinated transnationally to prevent the real possibility of herdsmen moving herds across boundaries to avoid payment of fees or to claim subsidized goods or services.

¹The patterns in most countries to avoid fraud is for all government revenues from the sale of inputs or services to be paid directly into the national treasury. Purchase of all expendable supplies are then financed from subsequent direct government appropriations. When funds for supplies or operating expenses are exhausted, services are often suspended until the following budget period.

Control of Range Fires

An additional category of general sector support activities relates to the control of range fires. Although there are no well-documented estimates of the volume or feeding value of the fodder which is destroyed, guesstimates place losses in the order of 20-30 percent of annual range vegetation production. Several donor-supported projects have financed the construction of firebreaks as part of sector support programs.¹

There are a variety of reasons why range fires occur. Herdsmen are said to burn selectively early in the dry season. This practice removes the greater part of accumulated unpalatable grass stubble and (may) promote (or make accessible to the animals) new and more palatable regrowth, which would serve to help balance the low protein content of grazing available in the dry season.² If set early enough, fires destroy only part of the mature grass and browse. Burning also reduces the habitat for ticks, tse-tse flies, and other biting insects. In at least one area (Assale, Chad), herdsmen burn remaining grass near rainy season farms and camps upon departure to dry season grazing areas in order to prevent other migrating groups from using (and abusing) these semi-permanent campsites.³

Crop farmers burn fields as a means of cleaning crop residues in preparation for the next year's cultivation, but these fires often run unchecked into the surrounding vegetation. Grass around villages and standing crops is fired to provide firebreak against uncontrolled fires originating from other causes. This also reduces the number of poisonous snakes, which are a threat to man and livestock, and rodents, which pose a threat to stored grain supplies. In at least one area (Gourmanche areas of Upper Volta), farmers are said to burn vegetation to discourage migrating pastoralists from camping near their often-isolated settlements.⁴

¹Firebreaks have also been funded or proposed for several of the general livestock development programs, such as the IBRD/IDA- Mauritania Livestock Project.

²AID, Upper Volta Village Livestock Project Proposal, 1976, p. 22.

³Personal field notes from Assale, Chad, December 1971.

⁴AID/Upper Volta: 1975, op. cit. Cowboys accompanying the herds are said to set upon travelers and isolated settlements.

Other sources of fires include hunters who use fire to drive game, persons using fire to harvest wild honey, persons "sweating" trees while collecting gum arabic, and accidental fires set by careless travelers.

Unfortunately and irrespective of cause, many range fires continue to burn uncontrolled for long distances after they have fulfilled their intended purpose. In most areas, there are currently no means of combating fires except through prevention and stricter enforcement of anti-burning ordinances. Fires often continue unchecked for long distances until stopped by natural barriers, such as barren land, river or stream beds, and roads. The control of range fires would require the concerted support of farming and herding communities and local authorities. The extent to which fire is controlled by local enforcement of anti-burning ordinances is not known.

The consensus of opinion of informed persons is that despite the substantial loss of vegetation which occurs, the construction of firebreaks, which must be maintained annually, does not appear to be economically justified unless constructed as part of an intervillage rural road network and/or as unfenced divisions between communal grazing blocks.

Firebreaks are a necessity for all (more) intensive land use developments -- ranches, community ranches, forest reserves, and other areas within which cattle or gam are expected to remain year-round or for a substantial portion of the dry season.

In general, range fires are most intense, widest in extent, and most destructive of vegetation in the southern portions of the Sudanian and northern Guinean zone, in those areas where there is little grazing and population density is lowest. In these zones, greater vegetative growth provides more fuel for the fires. Also, grazing intensity is often less there as an absence of effective natural barriers to the spread of fire.

Although the real economic cost of range fires remains to be established, the direct short-run economic benefits to either individuals or communities would not appear to be sufficient to warrant the general development of firebreaks unless coupled with (more) intensive land use developments.

Toward a Strategy to Develop the Potential of the Range and Grasslands of Western Africa

While this review is a partial one, it supports in large measure the conclusions of the findings and recommendations of the joint FAO/UNDP experts consultation, The Ecological Management of Arid and Semi-Arid Rangelands in Africa and the Near East (Rome, 1974). Portions of the findings and recommendations are paraphrased below.

FAO/UNDP Consultation Findings and Recommendations Summarized. --

a. None of the governments of the region has adequate range service staff, and existing trained staff are often assigned to other duties or services.

b. Water development schemes have generally not been accompanied by adequate land-stock density management, contributing to severe overgrazing, especially around new boreholes (deep wells).

c. Broad spectrum veterinary health services have tended to be counterproductive except where accompanied by marketing or stock population control programs that have been adequate to control the growth of animal units using the range.

Other factors contributing to the failure (non-attainment of goals) of rangeland development projects include:

a. Lack of strong organization in the national governments to direct and coordinate rangeland development.

b. Insufficient participation of or animation (extension education) of the pastoral community in project development and implementation.

c. Lack of adequate professionally trained project management personnel.

d. Land tenure (or management) policies or legislation which inhibit project success.

e. Siting of projects where preexisting conditions of population density or other factors preclude any chance of advancement.

Following from its conclusions, the 1974 Consultative Group recommended the following guidelines and prerequisites for funding of additional rangeland development activities:

a. Governments in the area should be assisted in preparing and enacting rangeland policy which includes guidelines for range development based on ecological principles similar to those published in the report of consultation (EMASAR).

b. As a prerequisite for funding of additional land use projects in range areas such as water development, host countries would agree to:

1. issue a range policy incorporating ecological guidelines;
 2. establish an executive agency with authority to control and coordinate all interdepartmental activity in special development zones, including veterinary health, water development, forestry, and irrigation;
 3. enact such legislation as is necessary to regulate land use;
- and,

4. prepare or cause to be prepared a long-term development plan based on adequate ecological and socio-economic studies.

c. Priority in future range development should be given to programs that build on traditional systems and that encourage local participation in the development process through the establishment of local organizations with limited but guaranteed land use rights.

d. Governments should agree to explore all practical possibilities for reducing and stabilizing human populations within the long-term carrying capacity of the land, including development of alternative forms of livelihood, birth control services, irrigated agriculture, and resettlement outside of endangered areas.

e. Donors should:

1. undertake or commission complete studies and detailed analyses of all past range projects, with reasons for non-attainment of goals, and make these available to the planning units in the region;
2. survey jointly the situation within the region regarding trained manpower and training facilities and develop realistic manpower projections.

To strengthen the capability of states to achieve these objectives, a number of individuals, organizations and consultative groups have recommended the creation of a regional task force to assist host countries in the identification, design, and implementation of programs and projects related to

better land use management and conservation.¹ The functions of the task force could include:

- a. Pre-investment surveys.
- b. Evaluation of ongoing development programs desired to strengthen land use management, particularly on rangelands.
- c. Assisting in the establishment and conduct of appropriate research activities; and
- d. Assisting in the establishment and conduct of appropriate environmental monitoring and possibly early drought warning systems.

¹G.M. Van Dyne, Long Term Development Strategies in Relation to the Environmental Management of the Sahel, Panel on Arid Lands of Sub-Saharan Africa, N.A.S., Rockefeller Foundation, Bellogio, Italy, 1974; IBRD, "Proposal for a Cooperative Effort to Rationalize the Livestock Industries of the Sahel," IBRD, Washington, D.C., 1972; UNDP, "Management of Livestock and Rangelands to Combat Desertification in Sudano-Sahelian Regions (SOLAR)," (Nairobi, 1976).

APPENDIX I

PROJECT (ACTIVITY) CHECKLIST
LIVESTOCK SECTOR PROGRAMS
IN WESTERN AFRICA*

- I. ANIMAL HEALTH AND DISEASE CONTROL
 - A. Primary Veterinary Services
 - 1. Communicable disease control -- vaccination campaigns and surveillance of disease outbreaks
 - 2. Control and monitoring of livestock markets and movements
 - 3. Statistical and reporting services
 - B. Vector-Borne Disease and Pest Control
 - 1. Trypanosomiasis treatment control
 - 2. Internal parasite control
 - 3. Tick and tick-borne disease control
 - 4. Ecto-parasite and biting fly control
 - 5. Streptothricosis control
 - C. Laboratory/Pharmacy Services
 - 1. Disease diagnosis service - manufacture of vaccines
 - 2. Veterinary and drug supplies
 - 3. Pesticide supply
 - D. Field Infrastructure Development
 - 1. Veterinary service posts
 - 2. Stock route control posts and routes
 - 3. Staff and program support (transportation, materials, etc.)

* Checklist of potential sub-project activities related to livestock sector development drawn from former, current, and proposed national or donor-supported programs in western Africa.

II. IMPROVEMENT OF LIVESTOCK PRODUCTION (Low to Moderate Rainfall and Land Capability Zones)

- A. Cooperative and Group Land Use Zones
 - 1. Grazing reserves and societies
 - 2. "Villages" or area grazing associations
 - 3. Firebreak and access track development
- B. Area Development Societies and Extension Services, Low and Modest Land Capability Areas
 - 1. Producer training centers and services
 - 2. Calf-saving centers and nutritional supplemental depots
 - 3. Dry season (and drought period) supplemental feeding
 - 4. Mineral/salt manufacture and supply to producers
- C. Commercial Ranch and Feedlot Development - Parastatal, Private, or Cooperative
 - 1. Breeding -- cow/calf herds
 - 2. Growing-out and feeding-out ranches (medium- to long-term)
 - 3. Short-term (intensive) feedlots

III. INTENSIFICATION OF LIVESTOCK PRODUCTION (Moderate to High Rainfall and Land Capability Zones)

- A. Mixed Farming -- Animal Traction, Animal Feeding, Soil Fertility and Crop Production
 - 1. Supply of animals for traction and feeding and initial training of oxen
 - 2. Forage and feed crop production and storage for on-farm use and cash sale
 - 3. Farm delivery systems for supplemental by-product feeds
 - 4. Mineral/salt manufacture and supply to producers
 - 5. Small unit animal feeding and fattening
 - 6. Small ruminant production and feeding
 - 7. Milk collection and processing

B. New Land and New Production Zone Development

1. Assistance to mixed farms -- animal traction units
2. Settlement (sedentarization), seasonal grazing reserves, migratory producers, demarcation of trek routes connecting dry season and wet season grazing
3. Nucleus herd development, non-livestock owning family groups
4. Farm-to-market roads and other infrastructure

C. Poultry and Pig Production

1. Nursery/hatchery, supply breeding, and production stock
2. Market development, poultry, eggs, pork
3. Feed production, milling, and supply to producers

IV. MARKETING INFRASTRUCTURE DEVELOPMENT AND SERVICES

A. Marketing Infrastructure

1. Cattle trails, assembly markets
2. Holding grounds -- cattle awaiting rail shipment
3. Loading and unloading pens and ramps
4. Railroad rolling stock and scheduling assistance
5. Abattoirs, terminal markets
6. Retail markets and services to consumers

B. Marketing Services

1. Livestock marketing service (purchase for resale or feeding or animal traction)

V. WATER AND IRRIGATION

A. Water Supply Development and Control (Livestock and Multipurpose)

B. Irrigation Schemes

1. Forage, grass, cash crop, rotations
2. Forage production
3. Irrigated pastures

C. Decrue (Flood Plain) and Bas Fond (Marshy Area, Water Course)

VI. EDUCATION AND TRAINING

- A. Formal Training - Manpower Development
 - 1. Participant training
 - 2. Aid to training institutions
 - 3. In-service training
 - 4. Management and planning training
- B. Non-Formal Training
 - 1. Farmer training / demonstration centers
 - 2. Demonstration farms; model farmers; demonstration plots
 - 3. Producer seminars
 - 4. Citizenship training, literacy programs
 - 5. Community development programs
- C. Government Employee Orientation to Industry Problems and Programs

VII. INDUSTRY SUPPORT INSTITUTIONS

- A. National Extension Education Service and Input Delivery Systems
- B. Research Station, Breeding, Seed and Stock Multiplication
- C. Planning and Development Agency, Division, or Institute
- D. Economic and Social Research Agency, Division, or Institute
- E. Range Management or Resource Conservation Division or Service
- F. Land Registry, Water Supply Development and Repair, Road Construction and Repair, etc.
- G. Agricultural Credit and Finance
 - 1. Capital finance
 - 2. Production credit
 - 3. Marketing system credit

APPENDIX II

APPENDIX TABLES

APPENDIX TABLE I

WEST AND CENTRAL AFRICA: AREA OF PRINCIPAL CLIMATIC ZONES
(Millions of Hectares)

	Forest Zone	Forest Savanna	Guinean Zone	Sudanian Zone	Sahel	Sub- Sahara	Sahara	Total
<u>Sahelian States</u>								
Mauritania	-	-	-	-	36	26	41	103.1
Senegal	-	-	4	6	10	-	-	19.6
Mali	-	-	12	18	39	20	35	124.0
Upper Volta	-	-	4	19	4	-	-	27.4
Niger	-	-	-	13	38	14	62	126.7
Chad	-	-	6	39	19	26	39	128.4
Gambia	-	-	1	-	-	-	-	1.1
Sub-Total	-	-	27	95	146	86	177	530.3
<u>Costal States</u>								
Equatorial Guinea	3	-	-	-	-	-	-	2.8
Guinea	1	3	21	-	-	-	-	24.6
Sierra Leone	6	1	-	-	-	-	-	7.2
Liberia	11	-	-	-	-	-	-	11.1
Ivory Coast	12	6	14	-	-	-	-	32.2
Ghana	8	1	12	3	-	-	-	23.9
Togo	-	-	5	1	-	-	-	5.6
Dahomey	-	1	7	3	-	-	-	11.3
Nigeria	14	9	37	32	-	-	-	92.4
Cameroon	21	5	15	5	2	-	-	47.5
Central African Republic	3	6	50	3	-	-	-	62.3
Gabon	26	1	-	-	-	-	-	26.8
Congo (Brazzaville)	14	20	-	-	-	-	-	34.2
Sub-Total	119	53	161	47	2	-	-	381.9
Total Region	119	53	188	142	148	86	177	912.2

Source of Table G. M. de Witt, "Livestock Development in Western Africa" P.M.W.A., IBRD, Abidjan, 1972, mimeo.
Area of zones estimated from "Vegetation Map of Africa", Oxford University Press, 1959. Number 5.

TABLE II

SAHELIAN COUNTRIES: TOTAL AREA AND ESTIMATES OF ARABLE LAND
USED FOR RAIN FED CROPS, IRRIGATION, GRAZING, FORESTS,
AND WASTE LANDS, 1972 (THOUSAND HECTARES)

	Total Area	Arable Percent of Area*	Area culti- vated (1970) Percent of Arable*	Irrigated (1970) Percent of Arable*	Grazing & Permanent pastures	Forests	Other Areas
Chad	128,400	7,000 5.5	1,380 19.7	-	45,000	16,500	59,900
Mali	124,000	11,600 9.3	1,541 13.3	61 0.52	30,000	4,451	77,943
Mauritania	103,000	308 0.3	258 83.8	3 0.01	39,250	15,134	48,423
Niger	126,700	12,177 9.6	3,315 27.2	5 0.2	2,900	15,600	96,023
Senegal	19,700	5,564 28.2	2,119 38.1	92 1.7	5,700	5,318	3,037
Upper Volta	27,420	5,315 19.4	2,291 41.7	2 -	13,755	4,101	4,187
TOTAL	529,220	41,964	10,904	163	136,605	61,104	289,513
Percent of Total	100	7.9	26.0	0.4	25.8	11.5	54.6

Source of Table: W. G. Matlock and E. L. Cockrun, A Framework for Evaluating Long Term Strategies For the Development of the Sahel-Sudan Region, Vol. II, A Framework for Agricultural Development Planning (MIT Center for Policy Alternatives, Cambridge, December, 1974) Table 3.2. Source of data, FAO, Production Yearbook(s), 1971-1972, except those marked * which were calculated by the authors.

TABLE III

WEST AFRICA: ESTIMATED CROP- AND LIVESTOCK-DEPENDENT POPULATION MID-1975* (in thousands)

	Crop Dependent	Livestock Dependent				Total Agric.	Non- Agric.	Total Population
		Sedentary	Transhumant	Nomadic	Total			
Mauritania	240	180	60	540	780	1,020	180	1,200
Senegal	2,600	400	-	-	400	3,000	1,000	4,000
Mali	3,630	550	220	550	1,320	4,950	550	5,500
Upper Volta	4,560	285	285	-	570	5,130	570	5,700
Niger	2,520	630	210	420	1,260	3,780	420	4,200
Chad	2,800	400	200	200	800	3,600	400	4,000
Sub-Total	16,350	2,445	975	1,710	5,130	21,480	3,120	24,600
N. Cameroon	890	180	10	-	190	1,080	120	1,200
N. Nigeria	22,800	2,100	600	-	2,700	25,500	4,500	30,000
<u>Grand Total</u>	40,040	4,725	1,585	1,710	8,020	48,060	7,740	55,800

* In the absence of agricultural census data, the above estimates must be considered to be speculative. They are based on scattered data included in various project evaluations prepared by SEDES, USAID, IBRD/IDA, and the authors' subjective estimates.

TABLE IV

SAHELIAN COUNTRIES: AREA AND POPULATION BY AGRO-CLIMATIC ZONE - 1970

Zone	Average Rainfall	Mauritani	Senegal	Mali	Upper Volta	Niger	Chad	Total
Saharan Zone	0-250	71	-	44	-	60	51	52
Sahelian	250-500	25	21	27	8	30	10	21
Sudanian	500-900	4	61	20	77	10	35	23
Sudano Guinean	900-1,200	-	18	9	15	-	4	4
TOTAL	-	100	100	100	100	100	100	100
Population (Millions)								
North of 600 mm.	-	0.4	0.8	2.0	0.6	1.6	0.7	6.1
South of 600 mm.	-	0.8	3.1	3.0	4.8	2.4	2.9	17.0
TOTAL	-	1.2	3.9	5.0	5.4	4.0	3.6	23.2

Source: S. Bethke, Sahel-Sudano Rainfall, 1974 (FAO/WFP, Rome, October 1974, memo).

TABLE V

SAHELLIAN COUNTRIES: ESTIMATED POPULATION, PER CAPITA INCOME, LABOR FORCE
IN AGRICULTURE AND POPULATION GROWTH RATE SELECTED COUNTRIES
MID-1975

Country	Population (million)	Per capita Income (USA)	Agricultural Labor Force %	Estimated Population Growth Rate %
Mauritania	1.2	175	85	2.3
Senegal	4.0	285	76	2.4
Mali	5.5	70	91	2.4
Upper Volta	5.7	70	89	2.0
Niger	4.2	120	91	3.0
Chad	4.0	85	91	2.4
Total/Average	24.6	134	87	2.4

Source of data: USAID: Development Assistance Program, 1976-1980, Washington, D.C., 1975.

TABLE VI

WEST AND CENTRAL AFRICA: CATTLE, SHEEP/GOAT AND CAMEL POPULATION, ARID AND HUMID COUNTRIES AND REGIONS AND CATTLE EQUIVALENT PER CAPITA, 1968*

Countries/Regions	Human Population (Millions)	Livestock Numbers (1,000)			
		Cattle	Sheep & Goats	Camels	Cattle Equiv.* per Capita
<u>Arid States and Regions</u>					
Mauritania	1.1	2,100	4,800	600	2.40
Senegal	3.8	2,530	2,520	-	.60
Gambia	0.4	220	190	-	.50
Mali	4.9	5,350	11,250	215	1.15
Upper Volta	5.3	2,450	3,820	-	.45
Niger	3.9	4,200	7,950	360	1.15
Chad	3.5	4,630	4,150	355	1.25
N. Nigeria	30.0	7,900	22,500	-	.30
N. Cameroon	1.2	900	1,830	-	.75
Sub-Total	54.1	30,280	59,010	1,530	.
<u>Humid States and Regions</u>					
Guinea	3.9	1,780	870	-	.40
Sierra Leone	2.5	230	210	-	.08
Ivory Coast	4.9	360	1,600	-	.09
Ghana	8.3	560	1,210	-	.07
Togo	1.9	180	1,210	-	.14
S. Nigeria	32.0	500	12,400	-	.05
S. Cameroon	4.5	1,400	1,210	-	.30
Central Afr. Rep.	1.5	570	630	-	.35
Dahomey	2.6	525	1,060	-	.20
Sub-Total	62.1	6,105	20,400	-	.11
TOTAL	116.2	36,385	79,410	1,530	.33

*Population estimates from IBRD, World Bank Atlas, 1971. Livestock estimates from data contained in SEAE/SEDES, Recueil Statistique de la Production Animale (Min. du Coop., Paris, 1975). Cattle equivalent per capita estimated by assuming each cattle or camel = 0.8 Tropical Bovine Unit (TBU) and 10 sheep or goats = 1.0 TBU.

TABLE VII

WEST AND CENTRAL AFRICA: GENERAL MAGNITUDE ESTIMATE OF CATTLE POPULATION
BY TYPE OF MANAGEMENT SYSTEM, 1970* (thousands)

States/Regions	Long Transhumance and Nomadic	Short Transhumance	Sedentary	Ranches Feedlots	Total
<u>Arid States/Regions</u>					
Mauritania	1,300	620	-	-	1,920
Senegal	410	1,200	1,000	10	2,620
Gambia	-	-	220	-	220
Mali	2,400	2,100	850	-	5,350
Upper Volta	300	1,575	625	-	2,500
Niger	1,600	2,190	300	10	4,100
Chad	2,710	1,600	250	-	4,560
Sub-CILLIS Members	8,720	9,285	3,245	20	21,270
N. Nigeria	2,000	3,900	2,000	-	7,900
N. Cameroon	150	650	100	-	900
TOTAL Arid	10,870	13,835	5,345	20	30,070
<u>Humid States and Regions</u>					
Guinea	-	1,420	360	-	1,780
Sierra Leone	-	180	50	-	230
Ivory Coast	-	55	325	5	385
Togo	-	-	190	-	190
Dahomey	-	100	465	-	565
S. Nigeria	-	-	480	20	500
S. Cameroon	-	1,230	150	20	1,400
Central Afr. Rep.	-	620	20	-	640
H. S. & R. Sub-Total	-	3,605	2,040	45	5,690
TOTAL CWA	10,870	17,440	7,385	65	35,760

*Based on data contained in: SEAE/SEDES, Recueil Statistique de la Production Animale (Min. du Coop., Paris, 1975); Data contained in Appendix Table ; and the authors personal estimates. As definitions are not precise, estimates are subject to considerable error.

TABLE VIII

SAHELIAN COUNTRIES: GENERAL MAGNITUDE ESTIMATES OF PRE- AND POST-DROUGHT
CATTLE POPULATION BY CLIMATIC ZONE

Country	Sahelian Region		Sudanian Zone		Guinean Zone		Total	
	1970	1973/74	1970	1973/74	1970	1973/74	1970	1973/74
Mauritania	1,920	1,115	-	-	-	-	1,920	1,115
Senegal	1,410	910	810	900	400	440	2,620	2,250
Mali	3,200	1,880	1,670	1,180	480	580	5,350	3,640
Upper Volta	600	450	1,870	1,700	90	100	2,560	2,250
Niger	4,000	2,200	-	-	-	-	4,000	2,200
Chad	3,600	2,360	900	610	-	-	4,500	2,970
TOTAL	14,730	8,915	5,250	4,390	970	1,120	20,950	14,425
Percent Change	-39.5%		-16.4%		+15.5%		-31.1%	

*Estimates based upon data contained in: SEAE/SEDES, Recueil Statistique de la Production Animale (Min. du Coop., Paris, 1975).

TABLE IX

WEST AFRICA: FAO PRODUCTION YEARBOOK ESTIMATES OF
SAHELIAN COUNTRY AND CAMEROON CATTLE POPULATION
1961/65 AND 1972-74 AND DROUGHT-RELATED LOSSES
(thousands)

COUNTRY	1961/65	1968	1972	1973	1974	Percent Change 1968-1974
Cameroon	1,738	2,400	2,500	2,500	2,500	+4
Chad	4,250	4,630	4,700	2,970	2,800	-40
Mali	4,040	5,350	5,000	4,750	4,500	-16
Mauritania	2,244	2,400	2,200	1,900	1,800	-25
Niger	3,700	4,200	3,500	3,000	2,800	-33
Senegal	1,760	2,527	2,508	2,200	2,266	-10
Upper Volta	1,556	2,448	2,400	2,600	2,400	-2
TOTAL	19,288	23,955	22,808	19,920	19,066	-20

SOURCE of Data: FAO Production Yearbook, 1974.

TABLE X
 CAMEROON: CATTLE POPULATION BY
 AGE AND SEX CATEGORY,
 ADAMAOUA PLATEAU, 1971

Age/Sex Category	Percent
<u>Females</u>	
Cows +3.5 years	40.5
Heifers 9 months - 3.5 years	18.1
Calves	<u>8.4</u>
Sub-total	67.0
<u>Bulls and Steers</u>	
Bulls 9 months - 3.0 years	13.4
Bulls +3.0 years	5.5
Steers 9 months - 3.0 years	1.7
Steers +3.0 years	5.3
Calves	<u>7.1</u>
Sub-total	33.0
TOTAL HERD	100.0

*Age/Sex Estimates from: D. Deen and D. Johnson, Eds., Beef Cattle Production on the Adamaoua Plateau (U.S. Peace Corps in Cooperation with the United Republic of Cameroun, Ministry of Elevage, 1972).

TABLE XI

MALI: ESTIMATES OF ZEBU HERDS AGE/SEX COMPOSITION
CIRCA 1965 (PERCENTAGE)

Age/Sex Category	1965 Study <u>a/</u>	Interior Delta <u>b/</u>	Other Regions <u>c/</u>
<u>Females</u>			
Cows	38.2	36.1	36.0
1 to 2 year old heifers	23.2 <u>d/</u>	15.7	18.4
Calves	<u>9.5</u>	<u>10.2</u>	<u>10.6</u>
Total	70.9	62.0	65.0
<u>Males</u>			
Oxen/Bulls	6.0	15.6	11.8
1 to 2 year old males	13.7 <u>d/</u>	12.5	12.7
Calves	<u>9.5</u>	<u>9.9</u>	<u>10.5</u>
Total	29.2	38.0	35.0

Source: Stryker, J. Dirck, "Livestock Production and Distribution in the Malian Economy" (supplementary report prepared for USAID, Washington, Aug. 20, 1973, mimeographed), Appendix Table A-2.

a/ From Lacrouts, M., Sarniguët, J. & Tyc, J., Exploitation du Cheptel Bovin au Mali (Mali, Ministère du Développement and France, Fonds d'Aide et de Coopération (FAC), 1965).

b/ Estimates derived from survey of 26,000 animals by Dr. Coulomb in the Mopti Region.

c/ Authors estimate.

TABLE XII

CHAD: POST-DROUGHT AGE/SEX STRUCTURE
OF HERDS MAO (TACHER) AREA, 1973

(years)	Females		Males		Castrated		Totals in Percent
	Number	Percent Herd	Number	Percent Herd	Number	Percent Herd	
0 - 1	23	3.6	15	2.4	--	--	6.0
1 - 2	56	8.8	13	2	--	--	10.8
2 - 3	108	16.9	52	8.2	--	--	25.0
3 - 4	120	18.8	41	6.4	--	--	25.0
4 - 5	57	8.3	18	2.8	6	0.9	12.7
5 - 6	44	6.9	8	1.3	6	0.9	9.1
6 - 7	19	2.8	5	0.8	1	0.2	3.9
7 - 8	28	4.4	1	0.2	--	--	4.5
8 - 9	5	0.8	--	--	--	--	0.8
9 -10	9	1.3	--	--	--	--	1.3
10 -11	1	0.2	--	--	--	--	0.2
11 -12	3	0.5	--	--	--	--	0.5
Total	473	73.3	153	24.1	13	2.0	99.8

Source: FED, 1974, Etude sur la Situation Actuelle de l' Elevage dans les Payes Du Sahel et des Maasures de Sauvegarde a Enuisayen (European Economic Community, 1974). Census of herds grouped around seven wells, late 1973.

TABLE XIII

NIGER AND UPPER VOLTA: AGE/SEX STRUCTURE OF HERDS -
SAHELIAN ZONE, SEPTEMBER, 1973

Age (Years)	<u>NIGER</u>				<u>UPPER VOLTA</u>			
	<u>Females</u>		<u>Males</u>		<u>Females</u>		<u>Males</u>	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent
0-1	60	4.1	41	2.8	316	5.1	268	4.3
1-2	61	4.1	53	3.6	274	4.4	243	3.9
2-3	126	8.5	54	3.7	478	7.8	337	5.6
3-4	165	11.2	46	3.1	531	8.6	280	4.5
4-5	197	13.4	31	2.1	537	8.7	180	2.9
5-6	106	7.2	21	1.4	451	7.3	151	2.5
6-7	131	8.9	12	0.8	390	6.3	74	1.2
7-8	136	9.2	17	1.2	507	8.2	68	1.2
8-9	96	6.5	5	.3	330	5.4	22	0.4
9-10	55	3.7	4	.3	262	4.3	14	0.2
10+	55	3.7	2	.1	443	7.2	7	0.1
TOTAL/AVERAGE	1,188	80.5	286	19.5	4,519	73.3	1,644	26.7

Note: Numbers may not add due to rounding.

Source: C.E.B.V., Revue Trimestrielle d'Information Technique et Economique, Avril-Septembre, 1974, Ouagadougou, 1974. Data from sample census of herds Sahelian Zone, September, 1973, by the staff of the Entente Livestock Community (C.E.B.V.).

TABLE XIV
 SAHELIAN COUNTRIES AND CAMEROON: RELATIONSHIP BETWEEN
 CATTLE, SHEEP, AND GOAT POPULATIONS,
 1961/65, 1972/74 (thousands)

SPECIES	1961/65		1972		1973		1974	
	NO.	%	NO.	%	NO.	%	NO.	%
Sheep	14922	28.2	17650	28.9	14980	28.4	14700	28.9
Goats	18728	35.4	20600	33.7	17850	33.8	17150	33.7
Cattle	19288	36.4	22808	37.4	19920	37.8	19066	37.4
TOTAL	52938	100.0	61058	100.0	52750	100.0	50916	100.0

SOURCE: FAO Production Yearbook, 1974, as extracted by G. McLeroy.

Dr. McLeroy's note:

The relationship between the different species in recent years has not changed significantly in official estimates, remaining fairly steady at about 29%, 34% and slightly in excess of 36% respectively for sheep, goats, and cattle. Informal observations would, however, indicate that sheep may be increasing somewhat faster than goats with both species possibly outstripping cattle.

APPENDIX TABLE XV

SENEGAL--DAHRA LIVESTOCK RESEARCH CENTER: CALVING AND IMPLIED CONCEPTION
AND WEANING DISTRIBUTION BY MONTH; UNIMPROVED GRAZING CONDITIONS

Month	Births		Conceptions Percent	Weanings Percent
	No.	Percent		
January	153	5.6	3.3	11.7
February	228	8.3	3.4	17.2
March	232	8.4	4.0	16.8
April	183	6.7	5.6	8.8
May	321	11.7	8.3	5.8
June	473	17.2	8.4	3.3
July	464	16.8	6.7	3.4
August	243	8.8	11.7	4.0
September	159	5.8	17.2	5.6
October	91	3.3	16.8	8.3
November	92	3.4	8.8	8.4
December	111	4.0	5.8	6.7
TOTAL	2,750	100.0	100.0	100.0

Data from Centre de Recherche Zootechnic du Dahra for unimproved Sudanian Zone grazing conditions as reported in USAID project documents (unpublished). Conceptions assumed to occur 9 months prior to births and weanings 8 months post-birth.

TABLE XVI

UPPER VOLTA, GUINEA ZONE: AGE/SEX COMPOSITION OF PRE-PROJECT HERD
 FOLLOWING IMPROVED VETERINARY SERVICES AND ON
 PROPOSED COMMUNITY RANCH, CONSTANT
 15,000 HECTARES

	Pre-Existing Herd		Improved Veterinary Services <u>a/</u>		Enclosed Community Ranch <u>a/</u>	
	No.	%	No.	%	No.	%
<u>Females</u>						
Breeding cows	1,100	42.65	1,012	39.01	3,006	33.51
Heifers, 1-2	202	7.83	214	8.24	846	9.43
Heifers 2-3	190	7.37	206	7.92	820	9.14
TOTAL	1,492	57.85	1,432	55.17	4,672	52.08
<u>Males</u>						
Bulls 3 +	110	4.27	101	3.90	121	1.35
Males 1-2	201	7.79	214	8.24	846	9.43
Males 2-3	149	5.78	163	6.27	820	9.14
Steers 3-4	92	3.57	108	4.17	769	8.57
Steers 4-5	63	2.44	77	2.96	-	-
Steers 5-6	43	1.67	55	2.11	-	-
TOTAL	658	25.52	718	27.65	2,556	28.49
TOTAL ADULTS	2,150	83.37	2,150	82.82	7,228	80.57
Calves	429	16.63	445	17.18	1,742	19.43
TOTAL ANIMALS	<u>2,579</u>	<u>100.0</u>	<u>2,595</u>	<u>100.0</u>	<u>8,970</u>	<u>100.0</u>

a/ Source of Baseline Estimates: IBRD/IDA, Appraisal of Livestock Development Project Upper Volta (Report No. 674a - UV, May 8, 1975), Tables 1 and 7 of Annex 7. Assumed one animal over 1 year of age = 1 animal unit. Technical coefficients given in Table . Original tables show years 1 - 20.

TABLE XVII

UPPER VOLTA, GUINEAN ZONE: TECHNICAL COEFFICIENTS AND ESTIMATED SALES
BY AGE/SEX CATEGORY PRE-PROJECT, IMPROVED VETERINARY SERVICES
AND ENCLOSED COMMUNITY RANCH

	Pre- Project	Improved Services	Community Ranch
<u>Sales</u>			
		(Head)	
Cull bulls	18	16	23
Males 2-3	40	43	-
Steers 3-4	25	28	-
Steers 4-5	23	27	746
Steers 5-6	16	19	-
Steers +6	41	53	-
Sub-Total	163	186	769
Cull cows	112	157	452
Surplus heifers	-	-	256
Sub-Total	112	157	708
Total Sales	275	343	1,477
Mortality + 1 year	153	102	173
<u>Technical Coefficients</u>			
		(Percents)	
Calf mortality	35	27	15
Cavles weaned	39	44	58
Adult mortality	6	4	3
Cow culling rate	10.2	15.5	15.0
Bull culling rate	16	16	20
Offtake males 2-3	20	20	-
Offtake steers 3-4	20	20	-
Offtake steers 4-5	25	25	100
Offtake steers 5-6	25	25	-
Offtake steers 6-7	100	100	-
Bull/cow ratio	10	10	4
Cows in total herd	12.4	39.0	33.5
Offtake rate	10.7	13.2	16.5
Stocking rate ha/AU	14.1	13.0	3.0

Source of Estimates: IBRD/IDA, Appraisal of Livestock Development Project, Upper Volta (Report No. 674a - UV, May 8, 1975), Tables 1 and 7 of Annex 7. Original tables show years 1 - 20. Area limited to 15,000 hectares.

APPENDIX TABLE XVIII

FRENCH SPEAKING WEST AFRICA: BUDGET ESTIMATES FOR VETERINARY SERVICES
AS PERCENT OF NATIONAL BUDGETS, 1970 (MILLION, CFA)

Country	Personnel	Material	Total	Percent National Budget
Mauritania	80.3	32.8	113.1	1.37
Senegal	335.2	113.5	448.7	1.06
Mali	54.5	71.5	126.0	1.08
Upper Volta	115.3	19.1	134.4	1.38
Niger	136.8	109.1	245.9	2.27
Sub-Total	722.1	346.0	1,068.1	-
Ivory Coast ^{1/}	329.4	184.1	513.5	.75
Togo	44.3	6.0	50.3	.63
Dahomey	85.8	19.6	105.4	1.07
Sub-Total	459.5	209.7	669.2	-
Total	1,181.6	555.7	1,737.3	-

Source: SEAE/SEDES, 1975. Recueil Statistique de la Production Animale (Paris, 1975) Table II. Data excludes Animal (Production) Industry.

^{1/} Budget for Animal Industry included.

A SELECTED BIBLIOGRAPHY
OF
WEST AFRICAN LIVESTOCK DEVELOPMENT

Compiled by
Dr. Donald S. Ferguson
and
Mr. Jonathan Sleeper

Center for Research on Economic Development
University of Michigan
Box 1248, Ann Arbor, Michigan, 48106

This bibliography is designed to assist persons initiating studies, project design or project appraisals related to livestock sector or rural development in West Africa. The bibliography does not pretend to be complete or exhaustive nor, unfortunately, does listing imply ease of access. For some items, their North American location is noted. For items not annotated, most titles indicate content -- for others, the literature search is not complete. Several annotations have been taken from an earlier bibliography of Mali Livestock prepared by Dr. D. Stryker of Tufts University. The assistance of Dr. Willford Morris of Purdue University in identifying French language documents and the assistance of the staff of the USDA Library, Beltsville Maryland are gratefully acknowledged.

August, 1976

July 1977

ACRONYMS USED IN BIBLIOGRAPHY OF LIVESTOCK DEVELOPMENT

USAID	United States Agency for International Development
AFR/CWR	AID, Central West Africa Region
AID/AFR	AID, Africa Bureau
AFR/DR	AID, Africa Bureau, Office of Development Resources
REDSO/WA	AID, Regional Development Services Office, West Africa, Abidjan
AID/TAB	AID/Technical Assistance Bureau
ACCIR	Association Champenoise de Coopération Internationale
BDPA	Bureau pour le Développement de la Production Agricole
BRGM	Bureau de Recherches Géologiques et Minières
CEEMAT	Centre d'Etudes et d'Expérimentation du Machinisme Agricole Tropical
CVRS	Centre Voltaïque de Recherches Scientifique
CILSS	Comité Inter-Etats pour la Coordination de la Lutte Contre la Sécheresse dans le Sahel
CDC	Commonwealth Development Corporation
CFDT	Compagnie Française pour le Développement des Fibres Textiles
CIDR	Compagnie Internationale de Développement Rural
CGIAR	Consultative Group on International Agricultural Research
CID	Consortium for International Development, Logan, Utah
ENTENTE	Common market Grouping Ivory Coast, Togo, Dahomey, Upper Volta, Niger
FAO	Food & Agricultural Organization of the United Nations
FAC	Fonds d'Aide et de Coopération (French Development Agency)
FED	Fonds Européen de Développement (European Community Development Agency)
HMSO	Her Majesty's Stationary Office (Britain)
IEMVT	Institut d'Elevage de la Médecine Vétérinaire des Pays Tropicaux
IFAN	Institut Fondamental d'Afrique Noire
INSEE	Institut National de la Statistique et des Etudes Economiques
IRAT	Institut de Recherches Agronomiques Tropicales et des Cultures Vivrières
IBRD/IDA	International Bank for Reconstruction and Development/ International Development Association
IEDES	Institut du Développement Economique et Social
ILRAD	International Laboratory for Research on Animal Diseases
ILCA	International Livestock Center for Africa - Addis Ababa, Ethiopia
LCBC	Lake Chad Basin Commission
OMBEVI	Office M-lien du Bétail et de la Viande
ORSTOM	Office de la Recherche Scientifique d'Outre - Mer
OCAM	Organisation Commune Africaine et Malgache

OMVS	Organisation pour la Mise en Valeur du Fleuve Sénégal
SEAE	Secrétariat d'Etat aux Affaires Etrangères chargé de la Coopération Française
SAED	Société Africaine d'Etudes et de Développement (Haute Volta)
SATEC	Société d'Aide Technique et de Coopération
SCET	
SEDES	Société d'Etudes pour le Développement Economique et Social
UN/ECA	United Nations/Economic Commission for Africa (ECA)
UNDP (PNUD)	United Nations Development Fund
UNEP	United Nations Environmental Program
UNESCO	United Nations Economic and Social Cooperative Organization
USDA/IADS	United States Department of Agriculture/International Agricultural Development Service
USDA/SCS	United States Department of Agriculture/Soil Conservation Service
WIP	Wirtschaft Und Infrastruktur-Planning

BIBLIOGRAPHY OF WEST AFRICAN LIVESTOCK DEVELOPMENT

This bibliography is designed to assist persons initiating studies, project design or project appraisals related to livestock sector or rural development in West Africa. The bibliography does not pretend to be complete or exhaustive nor, unfortunately, does listing imply ease of access. For some items, their North American location is noted. For items not annotated, most titles indicate content -- for others, the literature search is not complete. Several annotations have been taken from an earlier bibliography of Mali Livestock prepared by Dr. D. Stryker of Tufts University. The assistance of Dr. Willford Morris of Purdue University in identifying French language documents and the assistance of the staff of the USDA Library, Beltsville, Maryland are gratefully acknowledged.

- Abercrombie, F. D., 1974. Range Development and Management in Africa. (AID/ODS, Washington, 1974). Bulletin Publication describing basic approach to range development and management projects in Africa which have been supported by AID. Includes photos and maps. 59 pp.
- Abercrombie, F. D., 1974a. "Sahel Program Concepts," AID/AFR/D.S. Technical Staff Paper, March, 1974. Mimeo 9 pp.
- Abercrombie, F., 1975. "A Sectoral Approach to the Cattle Industry in West Africa" in, Development Digest, Vol XIII: 2 April 1975. Describes a strategy for development, treating the region and the industry as a whole, that is a sectoral approach. Would build upon the natural comparative advantage of each eco-climatic zone.
- Abercrombie, F. and A. Moeller, 1974. "Mauritania, Range Program" in Trip Report - OMVA Livestock, Memo to Dr. P. Lyman, AID/Afr/DS, May 28, 1974. Memo in AID/Afr/DS Files, Washington, D. C. Includes range site descriptions of a general nature of of May 1974.
- Abercrombie, F. D. and G. B. McLeroy. "Procedures for Planning Integrated Range/Livestock Programs," AID/AFR/D.S., September, 1974. Mimeo 37 pp. Detailed discussion of the data and procedures required in developing and planning livestock and land use related programs in Africa. Basic livestock planning document for AID programs.
- Adu, S. V., 1972. "Eroded Savanna Soils of the Navrongo-Bawku Area, Northern Ghana," Ghana J. Agric. Sci., 1972, Vol 5, Part 1, pp. 3-12. Soil erosion in the Navrongo-Bawku area is due to a combination of high intensity rains and inadequate vegetation cover. Water, the main agent of erosion, causes mostly sheet erosion and some gully erosion. In moderately eroded areas, 0.9 m of soil have been removed; in severe areas, all the A and B horizons (Solum) have been removed, exposing an impervious substratum. For soil rehabilitation to be effective, there is need for: soil surveys; research on

soil physical characteristics affecting erosion; fertility investigations; and working out of new agriculture systems.

- AID, 1972. Desert Encroachment on Arable Lands: Significance, Causes and Control (Office of Science and Technology, TA/OST 72-10, Washington, D. C., August, 1972). Review of implications, causes and possible technical control methods to retard desertification. The authors define desertification to include not only active dune formation but the disturbance of soil and moisture conditions by man and animals which retard or prevent vegetative growth.
- AID/Afr, 1971. Africa Regional: Entente Fund - Livestock Sector, Capital Assistance Paper, AID - DCL/P-947, Feb 5, 1971. Proposal and recommendations for the review of the development loan committee related to the first Entente Livestock Sector Loan. Budgeted amount \$6 million.
- AID/AFR, 1972. "Development and Management of the Steppe and Bush-Grass Savannah Zone Immediately South of the Sahara." AID Inhouse Report, October, 1972. Contains a collection of strategy and program summaries prepared by AID persons or consultants for each of the AID sectors of interest, agriculture livestock, human resource development and health.
- AID/Afr, 1972. "A Sectoral Approach to Development of the Livestock Industry of West and Central Africa," December, 1972. Mimeo 19 pp. AID position paper for first Brussels conference of donor agencies concerned with the West African drought affected countries. Proposes that a "sector" approach is required by donors in order to assure that the broad spectrum of interrelated problems are considered in development activities for the Region.
- AID/Afr, 1974. Sahel Recovery and Rehabilitation Program - Upper Volta (AID/Afr Program Assistance Paper, January, 1974). Describes medium term assistance program activities in Upper Volta.
- AID/Afr, 1974. "Eastern Senegal Livestock Project (Prop)" October 10, 1974. Project proposal for range management project located south of Bakel in extreme eastern Senegal. A medium team Sahel recovery project, Phase I activities include more detailed "final design" survey. Contains cost projections and outline of the ethnography of groups participating in the project.
- AID/Afr, 1974. "Eastern Senegal Livestock Project Project Proposal (PP)," AID/Afr, December, 1974. Description: Grant for the establishment of a managed grazing reserve in the Bakel area of Eastern Senegal including firebreaks, improved veterinary health delivery and training. Implementation delayed pending acceptance of final design team report, completed November, 1975. Grant: \$2,068,000. Design Officer: R. Shoemaker.

- AID/Afr, 1974. "Mauritania AID, Non-Capital Project, Paper (PROP) Mauritania Livestock Project," May 28, 1974. Mimeo about 120 pp. Project design officers, John Blumgart and Rex Hendrix. Describes proposed livestock project to be located in Guidimaka Department (Sylibaby) of extreme southeastern Mauritania. This is an area of intermixing between sedentary Sarakolle, Toucouleur, semi-migratory Peul and Maures. The paper proposed development of three "range areas" which would build upon normal transhumance patterns. The management plan would force continued transhumance via rotation of permanent wells. This project has been substantially revised in concept.
- AID/Afr, 1974. "Upper Volta Eastern ORD Project Proposal," Project No. 686-11-110-710, 25 October, 1974. Description: Grant to provide core financing for the delivery of an intermediate technical package to the small farmers and herders in the south eastern district of Upper Volta. Joint project with UNDP/FAO, AID project manager in place, 1975. Three technicians in place, July, 1977.
- AID/Afr, 1975. Ghana. Development Assistance Program FY 1976 - FY 1980, Ghana, Vol IV, Annex D, Agriculture Sector Assessment (January, 1975). Focus exclusively on crops and crop production with only passing reference to livestock or animal protein production or potential.
- AID/Afr, 1975. "Mali: Mali Livestock Sector Grant, Program Proposal (PP)," January, 1975. 59 pp plus appendices. Description: Grant to provide support for three principal project activities including survey, tsetse eradication and development of under populated lands east of Bamako, development of grazing resources in the Dilly area (Sahel Zone) north of Bamako and various training and extension activities. Design Officers: H. Hellman and J. Blumgart.
- AID/Afr/1976b. "Entente Food Production Project, Project No. 625-H, 1976. Contains valuable review of the institutions supportive of rural development in the Entente, reviews basic (FAO) crop production data post 1950 and state of the arts related to food production research and technology in Upper Volta and Niger.
- AID/Afr, 1976c. Chad: Development Assistance Program 1976 - 1980, AID, 1976. Contains detailed discussion of the livestock sector of Chad prepared by W. H. M. Morris, Purdue University.
- AID/Afr/CWR, 1973. "Appraisal of Proposed Tsetse Fly Eradication and Land Use Development Project in the Haute Vallee (Siby - Narena) Mali," AID/CWR, 1973. 33 pp plus annexes. Negative review of proposed growing out range/ranch development in a sparsely populated area of the Upper Valley of the Niger south of Bamako. Negative finding based upon the economics of Tsetse control in relation to expected benefits and anticipated social problems in reorganization of land use.

- AID/Afr/CWR, 1974. "Scope of Work Sahel Livestock Team Senegal, Mali, Mauritania," Second Draft, April 5, 1974. Scope of work medium term design teams for livestock projects in Senegal (Bakel), Mauritania and Mali (Kayes North).
- AID/Afr/CWR, 1974. "Central/West Africa (Afr. CWR) Development Assistance Plan (DAP) Substitute Strategy Framework," September 27, 1974. Mimeo 77 pp. Briefing paper for development assistance plan teams (October - November, 1974) outlining proposed policy and programmatic framework, agriculture, livestock, health/population and education/human resource sectors. Team reports included in regional summary and country specific documents.
- AID/Afr/CWR, 1975. Development Assistance Program FP 1975 Central West Africa Region, Section 1, Overview, Section 2, Program Conclusions and Project Recommendations, November, 1975. Report and summary recommendations of development assistance plan teams for the Region October - November, 1974.
- AID/Afr/DS, 1974. "An Approach to the Recovery and Stabilization of the Sahelian - Sudanian Range and Livestock Industries," Afr/DS Technical Staff Paper, January, 1974. Mimeo 50 pp. The authors state that the only feasible means of reversing progressive range deterioration on West African range lands is to reduce animal units more closely in line with long term carrying capacity and introduce rotational grazing. Contains projected cost estimates for grazing control projects in various ecological zones. Contributors included F. Abercrombie and A. Moeler.
- AID/Afr/DS, 1974. "Approaches to Agricultural Development in the Sahelo - Sudanian Zone," AID/DS, Sector Analyses Division, January, 1974. Brief outline of a position paper on Sahelian development prospects, concepts and priorities. Drafted by G. Nelson and M. Billings.
- AID/Afr/DS, 1975. "Sector Lending a Framework," State Cable No. 168117, July 5, 1975. Discusses criteria loans/grants for sector support programs and necessary analysis for evaluation and approval.
- AID/Lagos, 1970. "Non-Capital Preliminary Project Paper (PPP) Livestock Development - Nigeria," August 13, 1970. Last project proposal for livestock industry in Nigeria which was never implemented. Reviews AID experience in Nigeria. Draft by H. C. Kriesel.
- AID/GOM, 1973. "A Conceptual Program to Increase Meat Production, prepared by mixed AID/GOM team," March, 1973, mimeo, 60 pp. Recommendation of a broad program to promote mixed farming and cattle holding operations in semi-migratory and sedentary areas, to support an animal health effort in the Sahelian zone, to inventory Sahelian range resources with a view to inventory Sahelian range resources with a view to their future development, and to conduct studies and research in support of the livestock sector. The team included H. Helman, M. Billings, R. Henry and W. McKeel (AID), Dr. Boubacar Sy (Mali), W. Morris and J. D. Stryker (Consultants).

- AID/REDSO/WA, 1974. "Multi-Year Sahelian Planning Paper," REDSO/WA, July, 1974. Mimeo. Collection of papers by the staff of the Regional Development Services Office for West Africa designed to provide a "Strategy" for AID programs in the Sahel. Contributions included R. Stacy, M. Horowitz, D. Wisenborn, W. Morris.
- AID/REDSO/WA, 1974. "Sahelo-Sudanian Crop Production Possibilities," REDSO/WA, July 20, 1974. Mimeo. Prepared by W. Morris, R. Stacy, and D. Wisenborn.
- Ahn, D. M., 1970. West African Agriculture, Vol 1, West African Soils (3rd Ed, Oxford 1970). 332 pp.
- ACCIR/CIDR, 1974. Sécheresse au Sahel (Haute-Volta) Vol I, Enquête - Projets (Reduction Provisoire) Vol II, Annexes Générales, Annexes Climat, January, 1974. 138 pp. Report of team to define possible interventions in the Sahelian region of Upper Volta. Contains estimates of current crop and livestock production and productivity. (Perdue)
- Ankony Angus Corporation, 1971. Feasibility Study for Industrial Meat Production in Senegal (AID/Afr/746, August, 1971). 388 pp. Team Leader: C. H. Mangon. Feasibility study for an integrated beef production and marketing corporation which would include a breeding ranch to produce feeder calves growing out farm (6 - 18 mo); a feed lot with irrigated grain and fodder crops for dry season feed supply; and, an abattoir. The ranch location would have been in or near the Richard Toll Irrigation scheme on the Senegal River, 250 km northeast of Dakar. Project Development cost of \$2 million were not subscribed. Contains detailed analysis of potential markets for superior quality cattle and meat in West Africa and composition, analysis and cost of alternative concentrate rations.
- Bailhache, R. et A. Robinet, 1969. "La Gestion Révisionnelle du Ranch Sahélien D'Ekrafane, République du Niger, Analyse Technique et Financière," Colloque Sur l'Élevage, OCAM/IEMVT, (Fort Lamy, Tchad, 8-13 Décembre, 1969). Estimated productivity coefficients and price levels necessary to supply 1,200 tons annually of carcass beef for export from the Niamey, Abattoir. (Perdue)
- Bale, J., D. Conte, D. Goehriuy, D. Simonett, 1974. Remote Sensing Applications to Resource Management Problems in the Sahel. Report under contract No. AID Afr-C-1058 by Earth Satellite Corporation, July, 1974. A thorough and objective report on the uses and limitations of remote sensing in Sahelian management problems. A must reference for persons proposing its use in dry land areas.
- Barral, H., 1967. "Les Populations d'Éleveurs et les Problèmes Pastoraux dans le Nord-Est de la Haute-Volta," Cahiers ORSTOM Série Sciences Humaines, 4:1 1967. (LC)

- Barral, H., 1970. Utilisation de l'espace et du peuplement autour de la mare de Bangao (Haute-Volta). (Fac. Prat. Hautes Etud. Vi. Sect. Sci. Econ. Soc. Etud. Rurales, 37/39: 65-84, Paris, 1970). (USDA)
- Barral, H., 1970. Etude Socio-Géographique pour un Programme d'Aménagement Pastoral dans le Nord-Ouest de l'Oudalan, (ORSTOM, Centre de Ougadougou, Octobre, 1970). Report by the ORSTOM for the Direction de l'Elevage et des industries Animales under convention FAC 24/C/68F. Factability study for a fattening ranch in an area lacking surface water near the Mali boundary in North Central Upper Volta. The analysis indicated that because of location (logistics) input and product prices, a ranch was not feasible but recommended the installation of a deep well (Forrage Christine) at Tin Arkachen would provide water for a pastoral reserve of 50,000 ha. including 20,000 ha. of virgin range. The well has been constructed but not equipped with a diesel pump.
- Bares, J. F., 1974. Bibliographie Sur le Sahel, (CMCF and FFHC, 1974). 219 pp.
- Bates, J. D., G. Howze, F. A. Abercrombie and H. Van Blake, 1975. A Review of USAID Projects in Four Major Livestock Producing States in Nigeria and Assessment of Range Management, Final Report, RTI Project 26U-853, Prepared for USAID, Research Triangle Institute, May, 1975. 171 pp. Post project evaluation of principal AID supported livestock sector projects in Northern Nigeria. Includes cost estimates, factors contributing to success/failure. Report emphasizes the long gestation period required by most livestock project training and development activities to achieve objectives.
- Beazer, W. F. and J. D. Stryker, 1976. "Financing Recurrent Government Expenditures for Livestock Development In Mali," report prepared for the Government of Mali and USAID (Contract No. 688-203-1) February, 1976. Investigates various income streams to the government of Mali directly from the Livestock Production and marketing sector and the probable impact of taxes and other potential sources of revenues (fees by users and service charges) on government finance.
- Becker, John A., 1974. "An Analysis and Forecast of Cereals Availability in the Sahelian Entente States of West Africa," Final Report Contract No. AID/CM/AFR-C-73-20, January, 1974. Sobering appraisal of the short run probability and potential of two Sahelian countries, Upper Volta and Niger to produce sufficient food grains for domestic requirements. Project a cereals deficit measured in terms of caloric requirements over the next decade.
- Bederman, S. H., 1974. Africa, A Bibliography of Geography and Related Disciplines, 3rd ed. (School of Bus. Admin., Georgia State U., Atlanta, Georgia, 1974). Extensive bibliography which includes references related to agriculture and rural development.

- Berg, Elliot, 1975. The Recent Economic Evaluation of the Sahel (Univ. of Michigan, Center for Research on Economic Development, June, 1975). Reviews economic performance of six Sahelian countries during the period 1960-1974 and the underlying causal relationships.
- Bernus, E., and Savonnet, 1973. "Les problèmes de la sécheresse dans l'Afrique de l'ouest, Présence Africaine, 88:131, 1973. Contains a resume of French Colonial policy related to animal production and water development.
- Bernus, E., J. Boutrais et P. Pelissier, 1974. Evolution et Formes Modernes de l'Elevage Dans les Zones Arides et Tropicales, Cah. ORSTOM, Ser. Sci. Hum. 11:2, 1974, pp. 115-118. Listing of priority subjects for research related to tropical African livestock production and marketing of a social, spatial and economic nature.
- Bernus, E., 1974. Les Illabakan (Niger), (Atlas des Structures agraires au Sud du Sahara, No. 10, ORSTOM, Paris, 1974). Geographer's study of the Taureg of North Central Niger. Detailed description of nomadic/transhumance patterns and management practices (AID/W).
- Bannal, H., 1974. "Mobilité et Cloisonnement Chez les éleveurs du Nord de la Haute-Volta," Cah. ORSTOM Ser. Sci. Hum. 11:(2), 1974, pp. 127-135. Describes the seasonal movement and grazing patterns of transhumant herds in the Sahel of Upper Volta. The author defines geographic units of 23 zones within which defined groups of people with their livestock inhabit. Each zone includes rainy season pasture and several permanent dry season watering points and grazing areas. Implies reasonably fixed overtime - does not mention patterns to south - re eastern OPD - observation suggests these primarily Peul - Bororo types.
- Bernus, E., 1974. "L'évolution récente des relations entre éleveurs et agriculteurs en Afrique Tropicale, l'exemple du Sahel Nigérien," Cahier ORSTOM, Ser. Sci. Humaine, Vol. 11: 2, 1974, pp. 137-143.
- Bishop, Dwight R., 1972. Livestock and Meat Marketing Patterns and Costs in the Entente and Adjoining Countries, Ouagadougou, Upper Volta: Council of the Entente, September, 1972, mimeo. 35 pp & appendices. The author was Chief of Commerce and Transportation Division of the Entente livestock community, 1970-72. This report is based on his observations of markets, the major livestock routes, and slaughterhouses within the region. It contains a large amount of primary data on marketing patterns, transportation methods, marketing costs, and slaughtering and meat processing facilities. Estimates are also given of livestock numbers and trade and of taxes imposed on cattle.
- Blanc, P., 1974. De l'Embouche Intensive Des Zébus Africains et Malgaches (Ateliers Heck, Imp., Paris, 1974). Review of results of experimental intensive feeding trails of African Zebu cattle - prepared as thesis from, L'Ecole Nationale Vétérinaire de Toulouse, France. Contains an extensive bibliography.

- Bobibaugh, Jerry B., 1972. Educational Development in Guinea Mali, Senegal and the Ivory Coast, U. S. Government Printing Office, Pub. No. (OE) 72-44, Washington, 1972. 141 pp. Describes the structure of formal education and the existing institutions in Guinea, Mali, Senegal and Ivory Coast, which are based upon the French educational system. Provides some basis for equating educational programs between systems.
- BDPA/SEAE, 1960. La Culture Attelée et la Modernisation Rurale dans le Sud du TCHAD (Operation No. 25-05-64, BDPA/SEAE, Paris, 1966). Survey, January-March, 1966, by the BDPA of the progress and problems related to the expansion of animal traction in the cotton zone of Chad. Includes detailed discussion of tribal make-up of zone and the influence of tribe on acceptance of traction as an innovation. Survey Team: Leynard, Georges, Icard and Casse.
- BDPA, 1975. Projet de développement du Sud-est Mauritanien: Tome 1, Projet; Tome 2, Environnement de projet; Tome 3, Normes Techniques et normes économiques; Tome 4, Elevage, Infrastructure, (BDPA No. 75.032, Paris, 1975. Four volume study, financed by FAC. Contains simulated projections of grain production by variety and rainfall probabilities and average household budgets for each of the major ethnic groups in Southeastern Mauritania. Proposed program would include seed protection, storage, animal traction and water for "sedentary" villages.
- BGRM, Rep. du Niger, 1970. Modernisation de la Zone Pastorale - Etude Hydrogéologique, Atlas, (Bureau de Recherches Géologiques et Minières Août, 1970). Atlas locating wells, springs, mares, indicating construction, approximate flow of water and persistence for the entire pastoral zone of Niger (1:200,000 scale map). Would provide rough estimate of pre-existing livestock water availability by season for project zones, and suggest locations lacking adequate water for range development. (J. Greigert). Similar atlases exist for most of the Sahelian region.
- Caldwell, J. C., 1975. The Sahelian Drought and Its Demographic Implications (Overseas Liaison Committee, American Council on Education Paper No. 8, December, 1975). Evaluation of impact of drought period on demographic trends. Survey indicates that because of food aid, the numbers of drought related deaths was small and it did not affect growth rates measurably.
- Caldwell, et al, 1975. Population Growth and Socio-Economic Change in West Africa (Columbia Univ. Press, New York, 1975). 754 pp. In depth review of demographic research in West Africa with country specific chapters.
- Calvet, H., et al., 1974. La paille de riz dans l'alimentation animale au Senegal, Rév. Elev. Méd. Vet. Pays. Trop., 27(3)347-362. Experimental results indicate that rice straw, properly supplemented with

protein, salt and minerals, can provide 30-70 percent of the energy requirements of a feeding ration and can produce gains of 400-800 grams per day. In Senegal 150,000 tons of rice straw could provide feed for up to 100,000 head of cattle. Highest gains 734g/day per 111 days with a ration composed of 10 kg rice straw, .87 kg ground nut cake and 2 kg molasses. No economic analysis.

Cameroon, Le Premier Ministre, Secrétariat Général, 1970. "Effets de la Secheresse et des Inondations dans le Nord-Cameroon, Campagne Agricole 1970-71, Rapport Provisoire de la Mission Dépêchée au Nord-Cameroon, Novembre 1970. Thought provoking report by senior government staff on the unusual 1970 growing season which began with a short period of torrential rains resulting in severe flooding followed by drought. They conclude floods and drought are intensifying because of progressive deterioration of vegetative cover in Northern Cameroon.

Candler, 1974. "Evaluation Report - MSU Livestock Sector Models," March, 1974. Mimeo 26 pp. A critical review of the Nigerian and Korean Livestock Sector Econometric Models, their methodology, logic and predictive capability.

Capot-Rey, R., 1962. "The Present State of Nomadism in the Sahara" in, Problems of the Arid Zone, Proceedings of the Paris Symposium (UNESCO, Paris, 1962).

CEEMAT, 1968. Techniques Rurales en Afrique, No. 13, Manuel de culture avec traction animale, (Paris, 1968), 336 pp. Technical bulletin related to the selection and training of animals design and construction of equipment for animal traction in Africa.

CEEMAT, 1967. Techniques Rurales en Afrique, No. 14, Essais de matériel agricole à traction animale. (FAC Paris, 1967). Technical bulletin on the evaluation of materials and equipment designed for application or use in animal traction in Africa.

CVRS/BIRD, 1974. "Projet de Développement de l'Elevage dans l'Ouest Voltaïque, Volet Ranching, Rapport Sur l'Etude Socio-Economique," CVRS/BIRD, Ouagadougou, 1974. Pre-feasibility study for the IBRD Financed Livestock Project. Bobo Dioulasso, ORD. (Perdue)

Charreau, C., 1974. Soils of Tropical Dry and Dry-Wet Climatic Areas of West Africa and Their Use and Management. Agronomy Mimeo 74-26, Dept. of Agronomy, Cornell University, Ithaca, New York, 1974. Mimeo 433 pp. A series of lectures by Professor Charreau of the Institut de Recherches Agronomique Tropicales (IRAT), Spring Semester, 1974. Very complete discussion of factors affecting agronomic potential and yields related to soil and climate under various cropping systems. Visiting Professor under AID Grant CSD 2834.

- Clyburn, L., 1974. "A Range Management Strategy," AID/AFR/CWR Technical Staff Paper, March, 1974, Mimeo 5 pp. Contains elements of necessary incentive package for improving migratory production systems in the CWR.
- Clyburn, L. ed., 1974. "An Approach to the Recovery and Stabilization of the Sahelian - Sudanian Range and Livestock Industry" AID/AFR/CWR Tech. Staff Paper, January, 1974. Collection of papers related to range development. Includes global capital and recurrent cost estimates to develop 100,000,000 hectares as grazing reserves to include access roads, firebreaks, stock water and cattle handling facilities. No estimate of manpower requirements for proposed program. Estimated total capital cost, \$91,000,000.
- Clyburn, L. E., 1974. "The FAC Outline of a Livestock Development Strategy for the Sahel States -- A Commentary," AID/CWR, June, 1974. Mimeo 22 pp. Commentary by L. E. Clyburn on AID Translation, "French AID to the Sahelian Countries Stricken by the Drought," February, 1974.
- Clyburn, L., 1974. "Grazing Patterns in the Sahel - Sudan Region," AID/AFR/CWR Tech. Staff Paper, March, 1974. 9 pp. Points out that overgrazing around permanent villages is a severe problem and concludes that a "massive village range management program is needed," to preserve the land base in the Sudanian zone.
- Clyburn, L., 1974. "Some Uses and Potential Users as a Land Use Capability Map and a Linear - Programmed Optimizer Model of the Sahel States and the Republic of Cameroon," AFR/CWR Technical Staff Paper. October, 1974. Brief description of proposed modeling (Mali) and Land use capability surveys (Mali and Cameroon) as AID/CWR development activities.
- Cocheme, J. and P. Franquin, 1967. A Study of the Agroclimatology of the Semi-Arid Area South of the Sahara in West Africa (FAO/UNESCO/WMO Interagency Project on Agroclimatology, Rome 1967).
- C. D. C., 1971. Nigeria, Review of Livestock Industries: Outline of a National Cattle Development Program and Identification of Projects Suitable for IBRD Financing (June, 1971). 100 pp. plus 38 annexes. Team members: R. Woodhead, J. Foley, W. Ferguson, F. Wilson, and A. A. Stacey. (Perdue)
- CGIAR, 1972. "Animal Production and Research on Tropical Africa, Report of the Task Force commissioned by the Livestock Sub-Committee," September, 1972. Task Force Members: B. Nestel, D. J. Pratt, M. Thome, and D. Tribe. Excellent summary of the need for coordinated multi-disciplinary research on livestock development in Tropical Africa. The Task Force recommended the establishment of a Research Center (ILCA) in Addis Ababa, Ethiopia.

CID/AID, 1976. Final Design Report Eastern Senegal Bakel Range Livestock Project, Project No. 685-11-120-202, Logan, Utah, January, 1976. Chief of Party - J. M. Cheney. Report containing "the observations and recommendations" of the range - livestock design team for activities to be undertaken within the defined project area south of Bakel, Senegal. The report was undertaken as phase I of the project and includes description of the area, husbandry patterns and problems extension program to be undertaken but lacks an implementation plan and clear statement of purpose, goals and objectives. Proposes livestock/range interventions in an area containing 6,500 annual units and 87,000 ha to be divided into eight management units.

Cooper, H. W., 1974. "Range Management Sector DAP/CWA (Mauritania, Mali and Senegal - Primarily)." Mimeo 38 pp, December 1, 1974. Field report of member of DAP Team (Livestock), October - November, 1974. (Michigan)

Côte-D'Ivoire, Ministère de la Production Animale, 1974. "Amélioration des circuits commerciaux, aménagement des pistes à bétail et des postes d'entrée dans le Nord de la Côte-D'Ivoire," Requête de Financement auprès du Conseil de l'Entente, Novembre, 1974. Prospectus for loan to improve two trade routes for cattle entering from Mali and associated control posts, holding grounds, watering points. The posts would double as ports of entry for seasonally transhumant herds of cattle from Mali. Grazing reserves would also potentially be used for holding grounds for trade cattle. A well presented document, includes maps and blueprints but financial analysis weak and no management plan for resources. (REDSO)

Côte-D'Ivoire, Ministère de la Production Animale, 1974. Elevage Transhumant Peul, Importation et Commercialisation, Dossier D'Etude et Document de Travail, November, 1974. Report prepared by BNETD. Study requested following problems created by influx of migratory pastoralists into Ivory Coast during the 1973/74 drought period.

Côte-D'Ivoire, Ministère de l'Economie et des Finances, et Ministère de la Production Animale, 1973. Stratégie du Développement de l'Elevage (rapport dirigé par J. Desplechin, October, 1973).

Dahomey, Ministère du Développement Rural et de la Coopération, 1971. Opération de Développement Intégré du Borgou Division Animation Coopération (C.D.R.), B.P. 145, Parakou, Dahomey. Vol 1, Compte Rendu de l'Exécution Technique Campagne 1970-1971 Opération Intégrée du Borgou (May, 1971, 138 pp.); Vol 2, Campagne 1972-73 (Parakou, Dahomey, 1971). (Purdue)

Dahomey. Ministère du Développement Rural et de l'Action Coopérative Direction Générale de l'Action Rurale CARDER de l'ATACORA, 1974. Projet d'Action Intensive de Développement Rural de la Province de l'Atacora, Vol 1, le Cadre Général du Projet - 1976-1980, Vol 2, Le Teneur du Projet, 1976-1980. Natongou, Dahomey, June, 1974 (Purdue), CARDER - Centre D'Action Régional de Développement Rural. History, 1969 FED credit - ODAA Opération de Développement Agricole de

l'Atacora replaced former agriculture service. ODAA to be replaced by a CARDER as in other provinces. The projected activities of the CARDER will include cooperative marketing of most products including cattle. Contains detailed estimates of current and projected production.

- Dahomey, Ministère du Développement Rural de la Province de l'Atacora, 1974. Projet d'Action Intensive de Développement Rural de la Province de l'Atacora, 1976-1980. (Direction Générale de l'Action Rurale CARDER de l'Atacora, June, 1974). (Purdue)
- Dalby, D. and R. J. Harrison Church Eds., 1973. Drought in Africa (Univ. of London, Center for African Studies, 1973).
- Dean, D. and D. Johnson. Beef Cattle Production on the Adamaoua Plateau (U. S. Peace Corps in Cooperation with the United Republic of Cameroon, Ministry of Elevage, 1972). Contains census data drawn from sample survey of 64,000 cattle presented at vaccination centers and in smaller surveys in bush to check validity of main sample. Distinguishes between herds of sedentary pastoralists and sedentary livestock producers.
- E. C. deCarvalho. "'Traditional' and 'Modern' Patterns of Cattle Raising in Southwestern Angola: A Critical Evaluation of Change from Pastoralism to Ranching," J. Devel. Areas, January, 1974, Vol 8, No. 2, pp. 199-226. Although not concerned with West Africa, author presents excellent detailed analysis of traditional pastoralism vs modern ranching schemes in Angola. The author concludes that for the sake of development, attempts should be made to improve the present pastoral system - which already functions well in many respects - rather than replace it with another.
- Deshler, W., 1963. "Cattle in Africa: Distribution, Types, and Problems," Geographical Review, V. 53, No. 1, 1963, pp. 52-58. Large population map (Pl. 1 in pocket), Africa: Distribution of Cattle, with two smaller maps, Types of Cattle in Africa, and Sources of Data. Distribution map based on dry season census, from mostly local sources for West Africa, scale à 1:10,000,000. Sources of data by country also listed. General review of cultural factors in distribution, and general problems.
- Deriviako, J., 1973. "Importance of the Draft Agreements on Fiscal and Customs Coordination, Vocational Regulation and Price - Restructuring for the Future of the Livestock Economic Community," IDET/CEGOS, December, 1973. Mimeo 30 pp + annexes. (Purdue)
- de St. Croix, F. W., 1945. The Fulani of Northern Nigeria (Lagos Government Printer, 1945).
- DeWit, G. M. and H. Ochs, 1972. "Livestock Development in West Africa," IBRD, Permanent Mission for West Africa, Abidjan, November, 1972, mimeo.

- Djiga, A., 1969. Bilan des données actuelles en vue d'une meilleure exploitation des pâturages naturels de Haute-Volta, (Ecole Nationale Vétérinaire, Maison Alfort, France, 1969). Thesis No. 2, 129 pp. illus. (USDA)
- Downs, R. E., and S. P. Reyna, 1976. "Socio-Economic Report on the 10th Region of Mauritania" Dept. of Soc. and Anthropology, Univ. of New Hampshire, February, 1976. Mimeo 102 pp. One of a series of consultant studies in support of the development of a "livestock" project in the 10th Region of Senegal. Ethnographic survey of the Sarakolle and Maure communities, their organization and economic activities, focusing on agriculture and livestock. They conclude that as grass is considered by the community to be a free good, organization of grazing will be difficult.
- Drarassouba, V. C., 1968. L'Evolution des Structures Agricoles du Sénégal (Editions Cujas, Paris, 1968). Includes discussion of Agrican land tenure in a Frankophone country under the influence of French legal codes. (Purdue)
- Dregne, H. E., Ed., 1970. Arid Lands in Transition, AAAS Pub. No. 90, Washington, D. C., 1970.
- Doutressoulle, G., 1948. L'élevage au Soudan Français (Algiers, 1948). Remains as the classic description of breed types and productive potential of West African livestock in French speaking Africa. (USDA)
- Dupire, Marguerite, Peuls Nomades; Etude Descriptive des Wodaabe du Sahel Nigérien. Paris: Institut d'Ethnologie, Musée de l'Homme, 1962, 336 pp. This book concerns the Peuls of Niger, and is a landmark ethnography in the field. Describes both nomadic (Bororo) and sedentary agricultural pastoralist groups. Study similar to that of Stenning and Hopen in Northern Nigeria.
- Dupire, M., 1963. "The Position of Women in a Pastoral Society (Wodaabe)," in Women of Tropical Africa, D. Paulme, ed., Berkeley Univ. of Cal. Press, pp. 47-92.
- Dupont de Dinechin, B. et al., 1970. "Données actuelles sur l'association de l'Agriculture et de l'élevage en Haute-Volta," Marches Agr. Thop. 29:22-23 Jan/Mar 1970.
- Elliot, H. J. C., 1974. Animation Rurale and Encadrement Technique in the Ivory Coast. (Univ. of Michigan, CRED, Discussion Paper 40, September, 1974). Excellent discussion of the various approaches to expanding agricultural production in Ivory Coast, their advantages and disadvantages related to effectiveness, cost, farm family motivation and political acceptability.
- ENTENTE, Fonds de Garantie, 1973. "Note sur le Transport Des Viandes Par Chemin De Fer Entre La Haute-Volta et La Côte-D'Ivoire" (FAC, SEDES,

Fonds de Garantie des Etats de l'Entente, Octobre, 1973). Pp. 44.
Annex. (Perdue)

- Ferguson, D. S., 1967. The Nigerian Beef Industry, (Cornell Int. Agric. Dev. Bul. No. 9, Ithaca, 1967). Describes the livestock cattle and meat industry in Nigeria and the historical development through 1965. First effort to justify conflicting estimates of cattle numbers, production consumption and trade cattle movements on a national basis for Nigeria.
- Ferguson, D. S. and T. T. Poleman. Modernizing African Animal Production: The Uganda Tick Control Project, Cornell Univ. Int. Agric. Dev. Mimeo No. 42, 1974. Economic and technical analysis of a national campaign to control ticks and tick borne disease including estimates of probable changes in productivity, production, net income and foreign exchange. The experience suggests that producers can be organized into larger cooperative groups based upon disease control, an activity they perceive to be in their economic interest.
- Ferguson, D. S., 1973. "A Selected Bibliography of Cameroon Agricultural Development," Dept. of Rural Econ., National Advanced School of Agriculture, Yaounde, Cameroon, 1973. List of 137 references related to rural development in Cameroon.
- Ferguson, D. S., 1973. "The Potential for the Stratification of the Cattle Industry in Cameroon and Central Africa," Colloque sur l'Embouche Intensive des Bovins en Pays Tropicaux, Dakar, Senegal Decembre 3-7, 1973. (IEMVT, 1974) Describes potential for growing out and feeding of cattle from the Adamaoua Plateau before final marketing. Concludes that feeding is possible using molasses as the energy concentrate and should become economically attractive at projected price levels.
- Ferguson, D. S., 1973. "Toward an Agricultural Sector Analysis of Savannah West Africa, Comments on a Research Proposal," 1973. Mimeo 12 pp. Critique of research proposed by AFR/DS for consulting firms, 1973. Responded to a request for AID/Yaounde for comments on the proposed program.
- Ferguson, W., 1967. "Maturu Cattle of Western Nigeria," J. W. AFR Sci. Assoc. 12:1, 1967, pp. 29-36. Argues that the small West African dwarf shorthorn cattle are most adapted to humid tropical conditions and will produce more meat per unit area than introduced zebu stock.
- Fisher, John L., 1969. "Development of the Beef Industry in Africa, Improving Technical and Capital Assistance with Proposed Aid Policy Guidelines," October 24, 1969. Mimeo. Discusses factors which contribute to the "success" or "failure" of livestock industry related projects.

- FAO/WHO, 1969. African Trypanosomiasis: Report of a Joint FAO/WHO Expert Committee Geneva 25-30, November, 1968. FAO Agric. Study No. 81, Geneva, 1969. 79 pp. Reviews all aspects of African Trypanosomiasis and makes recommendations on the planning of campaigns, chemotherapy and chemoprophylaxis and methods of vector control.
- FAO, 1974. "La lutte contre la trypanosomose animale, Rapport pour le Gouvernement de la République du Niger," Rome, 1974. 21 pp.; 8 pp. charts. Report prepared by D. Fanelle. (Purdue)
- FAO/UNDP Environmental Program, 1974. Report of an Expert Consultation on the Formation of an International Program on Ecological Management of the Arid and Semi-Arid Rangelands in Africa and the Near East, 27-31 May, 1974, mimeo 68 pp. Important reference for livestock development strategy. The panel, largely composed of working professionals recommends that all governments of the area should adopt a range use policy based on ecological principals and that no range or land use projects be funded prior to issuance of such policy and preparation of plans based on adequate ecological and socio-economic studies.
- FAO, 1974. Amélioration des Conditions de Vie des Nomades dans l'Erhazen (Agadez) Rapport de Mission February 1 - March 23, 1974. Projet UN/OTC: TF 9328, FAO Rome 1974, 20 pp. Report by P. Martiné.
- FAI, 1970. Etudes en vue de la mise en valeur du Dallol Maouri, Niger, Ags: SF/NER 8, Rapport Technique 3, Sociologie, Rome, 1970. Dallol Maouri region located in Dosso area of Southwest Niger. Contains bibliography.
- FAI/PNUD, 1969. Développement de la Production Animale et des ressources en Eaux Dans L'Est du Niger, LA:SF/NER Rapport d'expert-conseil 1, Rome, 1969. Review of an Expert (Economist) of a proposal for a growing out ranch of 100,000 ha. northeast of Zinder and northwest of Gaure. The analysis indicates that provided 2,000 animals could be obtained annually for a two year feeding program and the animals were sold live in Nigeria, revenue would exceed marginal (operating costs) but would not repay invested capital and interest charged on capital of CFA 70 million (\$2.9 million). He concludes that an expansion of the Zinder abbatoir for frozen meat exports by air would not be feasible given low volume and high operation costs in this isolated location. Report by M. G. Fenn.
- FAO, 1970. Etudes en vue du Développement Agricole de la Région de la Kara - Togo, Sociologie, FAO ESR:SF/TOG 8, Rapport Technique 5, Rome, 1970. Report by Suzanne Jean, related to social issues affecting design and implementation of proposed FAO supported activities.
- FAO, 1973. The Sahelian Zone, A Selected Bibliography for the Study of Its Problems (FAO Library Occasional Bibliographies, No. 9, December, 1973.

- FAO, 1974. Report on the Sahelian Zone, A Survey of the Sahelian Zone With a View to Drawing up a Long Term Strategy and a Program for Protection, Restoration and Development. (FAO/SWE/RF 117 Rome, 1974) Head of mission P. Ferver. Excellent survey of problem areas.
- Ford, J., 1971. The Role of Trypanosomiasis in African Ecology (Clarendon Press, Oxford, 1971). Excellent summary of Tsetse species, habitat and habits: Trypanosomias varieties, symptoms, control and fly distribution in Africa.
- Fransen, J. M., R. H. Khouri and R. Milford, 1970. "Dynamics of Livestock Production in Subsahara Africa," IBRD Livestock Development Division, September 21, 1970. Mimeo. Argues that only through revision of land use patterns--grazing reserves and ranches--can current levels of productivity and production be improved.
- Fraser-Darling, F. and M. A. Farvar, 1972. "Ecological Consequences of Sedentarization of Nomads" in, The Careless Technology, ed. by M. Taghi Farvar and J. P. Milton, Garden City, New York, Natural History Press. PP. 671-682.
- French, M. H., 1970. Observations on the Goat (FAO Agric. Studies No. 80, Rome, 1970), 195 pp plus references. Argues that the goat has a useful place in the Sahelian region, is complementary to sheep and cattle, preferring brouse, and is not responsible for the conservation problems attributed to goat production. Provides discussion of goat production and productivity.
- FAC, 1974. Memento de l'Agronome (Technique Rurales en Afrique, 1974), 1560 pp. Technical manual for agronomists in Tropical countries covering most aspects of tropical agricultural production including annual traction. Standard text and extension guide for Francophone countries.
- FED, 1974. Etude sur la Situation Actuelle de l'élevage dans les pays du Sahel et des mesures de Sauvegarde à envisager (Commission des Communautés Européennes de Développement (FED), Février, 1974). Report of a survey team as to immediate and longer term requirements to reduce further losses resulting from the drought and to prepare for rebuilding the industry. Team members, E. Boeckh, O. Bremond, R. Dumas, J. K. Huhn, and R. Compere.
- FED, 1974. "Study of the Actual Situation of Livestock Breeding in the Countries of the Sahel and Preventive Measures to be considered," February, 1974, 293 pp. English translation for USAID of FED study.
- Gallais, Jean, 1967. Le Delta Intérieur du Niger; Etude de Géographie Régionale, Dakar: IFAN, 1967, 2 vol., 625 p. Monumental study of the human and physical geography of the region, including its economic, social, political, and cultural aspects. Indispensable reading for any study related to the Interior Delta. Describes seasonal grazing patterns.

- George, M., 1965. La Culture Attelée et la Modernisation Rurale dans le Nord Cameroun (Bureau pour le Développement de la Production Agricole, Operation No. 25-05-64, 31 Mar 1965).
- GEOTECHNIP, 1970. "Notice a la Cante Des Potentiels Pastoraux Dans Un Secteur du Sud Tamesna (Niger)," Fevrier, 1970. Test zone stereoscopic mosaic with criteria for interpretation. Zone subdivided into 23 major units depending on surface structure and morphology in relation to vegetation and biomass carrying capacity. Includes only part of Sud Tamesna department included in BRGM and IEMVT studies of the zone. Would be invaluable for establishing ground truth in remote sensing activities in the Sahel.
- Gidel, R., 1972. "Etude sur la Composition Moyenne de troupeaux de Bovins de Haute-Volta et de Côte-d'Ivoire en Fonction de l'âge et du sexe," Rev. Elevage Med. Vet., Pays Trop., 25(4):543-555, 1972. Survey conducted as part of Brucellosis incidence study in cattle and people. Notes basic similarity in age sex composition of herds in all areas of the two countries. (See 106).
- Gidel, R., et al., 1974. "La brucellose en Afrique occidentale et son incidence sur la santé publique, Résultats de dix enquêtes épidémiologiques effectuées en Côte-d'Ivoire, Haute-Volta et Niger de 1970 à 1973," Rev. Elev. Med. Vet. Paysitrop., 1974, Vol. 27, No. 4, pp. 403-418. (OCCGE, Centre Muraz, Bobo Dioulasso, 1970-3). Authors made ten investigations in Ivory Coast, Upper Volta, and Niger (in 4 distinct zones: Sahel, Pereginean, Savannah Guinean, and Forest) to study epidemiology of human and animal brucellosis. Disease was more prevalent among cattle, and prevalence increased as one moved south (6%+ in northern cattle 51%+ in southern cattle). Among humans prevalence tended to be lower in the south (except for herders and their families in non-pastoral zones) and higher in the north (despite lower prevalence in animals). This is probably so because of the pastoral life in the north where milk--raw or curdled--is important dietary staple. There were significant differences between ethnic groups.
- Granier, P., 1975. "Effets de la mise en defense de la végétation en zone Sahélienne," Journées Techniques Production Animale, Compte Rendu Technique, 15-17 Septembre, IEMVT, 1975. Research report, annual IEMVT technicians conference. Describes the effect of exclosures and fire control on the recovery of vegetation in the Sahelian Zone of Niger. Exclosures resulted in the rapid recovery of perennial grass cover and surviving trees and shrubs. Tree/Shrub seedling establishment was inhibited by shading of dominant grasses and by rodent damage.
- Hammond, P. B., 1966. Yatenga: Technology in the Culture of a West African Kingdom (New York, Free Press, 1966). Anthropological Study of the Mossi plateau in Upper Volta.

- Haute-Volta, Ministère du Plan, 1975. Du Développement Rural, du Tourisme et de l'Environnement, L'Élevage en Haute-Volta analyse et Propositions D'Orientation (étude par Ministère du Coopération (FAC) SEDES et Caisse Centrale de Coopération Economique, SEDES, Paris, Mar 1975). 80 pp. Team members: R. Bailhache (CCE), P. La-Chaux (FAC), J. Tye (SEDES). Excellent summary of the existing and proposed livestock development program in Upper Volta. Includes lists of studies being conducted and all existing and proposed projects and source of finance if funded. In general the analysis strongly supports concept of the Upper Volta village livestock project and the need for additional socio-economic studies as part of project design-implementation.
- Hecht, Kurt, Consultants, 1974. "A Nomadic Grazing System Within the Modern Realities of Niger," Discussion Paper D 116, 28 August 1974. Proposal to Africare/Niger suggesting the development of extension outreach centers in the pastoral zone of Niger which would provide basic inputs and government services. (AID/W).
- Helman, Howard B., 1972. Cattle Production in West Africa: No Easy Answers for the New Enthusiasts, November 1972, mimeo., 36 pp. + attachments. Thoughtful review of many of the problems of livestock development in West Africa. The author was attached to the USAID office in Abidjan where he was deeply involved during 1971-73 in efforts to develop a livestock program in Mali.
- HMSO, 1957. The Indigenous Cattle of the British Dependent Territories in Africa (Colonial Advisory Council of Agriculture, Animal Health and Forestry Publication No. 5, London, 1957). Contains descriptions of common breed types in English speaking countries including estimates of population and productivity. Discusses probable origins of breed types, and trypanotolerance among cattle.
- Henry, R., and I. Licht, 1971. "Livestock Production and Marketing Plan for the Lake Chad Basin," Animal Husbandry, POL 17/S-1, L.C.B.C., Fort-Lamy, May, 1971, mimeo.
- Herbert, R. J., 1974. "The Reproductive History of Cows Slaughtered in North-West Nigeria as Indicated by Examination of their Ovaries," Trop. Anim. Health Prod. Vol. 6(4), 223-229, Nov. 1974. Of 43 cows examined, 27 or 63% had active graafian follicles and/or corpus lutea while only 27% were sexually inactive. 84% had had at least one calf with an average of 3.4 calves per cow. Analysis suggested infertile heifers culled quickly but animals having over two calves were retained in expectation of further calves.
- Hopen, C. E., 1958. The Pastoral Fulbe Family in Gwanda (Oxford Press, London, 1958). 165 pp. Ethnographic survey of largely sedentarized Fulani families in Sokoto Province of Northern Nigeria.

- Horowitz, M., 1972. "Ethnic boundary maintenance among pastoralists and farmers in western Sudan (Niger)," Journal of Asian and African Studies, Vol 1, pp. 105-114, 1972.
- Horowitz, M., 1972. "Human Implications of Ecological Change in the Sahel" in AID, Development and Management of the Steppe and Brush-Grass Savanna Zone Immediately South of the Sahara, AID In-House Report, October, 1972. Argues that major problem of studies made in the Sahelian Zone is the difficulty in seeing the region as a complex ecosystem with plants, animals and humans tied together in a web of energy flow and conversion. Argues that various niches-camel, bovine, ovine and caprine pastoralism, cereal husbandry and fishing are identified with particular ethnic groups. Therefore, understanding these interrelationships critical to change programs.
- Hudson, J.R., 1971. Contagious Bovine Pleuropneumonia (FAO Agric Study No. 86. FAO Rome, 1971. 120 pp. A detailed study of a disease which is a menace to cattle in a belt across central Africa.
- IEMVT, 1963. Etude des Pâturages naturels sahéliens ranch Nord - Sanam, République du Niger (Etude Agrostologique No. 5 Maison - Alfort, 1963). Agrostology study for Ekrafane Ranch prepared by B. Peyre de Fabreques. 1:100,000.
- IEMVT, 1965. Etude des Pâturages naturels sahéliens de la Région Nord Gouré, République du Niger. (Etude Agrostologique No. 10, Maison - Alfort, 1965). Agrostology study by B. Peyre de Fabreques. Location approx. 14°N., 11°E. 1:100,000.
- IEMVT, 1967. Etude agrostologique des pâturages de la zone nomade de Zinder, Etude Agrostologique No. 17, Maison - Alfort, 1967. Agrostology study by B. Peyre de Fabreques. Approx. location - 14°40' - 15°20'N; 9°20' - 10°40'E.
- IEMVT, 1969. Projet de mise en valeur du Dallol Maouri - Etude des pâturages naturels, Maison - Alfort, 1969. Study of natural pasture conditions, Gaya Arrondissement of South Western Niger. Approx. location 13°N, 3°30'E. (Not seen.) 1:400,000.
- IEMVT, 1971. Evolution des Pâturages Naturels Sahéliens du Sud Tamesna, Etude Agrostologique (IEMVT, Laboratoire National de l'Élevage et de Recherches Vétérinaires, Niamey, December, 1971, 133 pp. plus Annex.
- IEMVT, 1971. Pâturages Naturels Sahéliens du Sud Tamesna, République du Niger, Etude Agrostologique No. 28, IEMVT and Laboratoire National de l'Élevage et de Recherches Vétérinaires Niamey, Décembre, 1971. 133 pp. Map 1:500,000. Agrostology - B. Peyre de Fabreques and G. Goudet; Nutritional value of forage species - R. Riviere; Plant ecology - J. Lebrun.

- IEMVT, 1971. Evolution des Pâturages naturels Sahéliens du Sud - Tamesna, République du Niger, (Etude Agrostologique No. 32, Maison - Alfort, 1971). 200 pp. Study by B. Peyre de Fabrique. Covers same location as Etude No. 29 after the 1969 drought year. 1:500,000.
- IEMVT, 1972. Modernisation de la zone pastorale au Niger - Etude agrostologique (Etude Agrostologique No. 33, IEMVT, Paris, Janvier, 1972), 3 307 00, with map of pastoral zone. Scale 1:1,000,000. Pastoral zone represents 235,000 km. Includes glossary, description of geography, physical data including climate, geography, soils and vegetation. Provides description of methodology, classification into major vegetation groups by climatic zone (5) and sub categories (40). Text provides description/lising principal plant communities, typical land use, dry matter yield, estimated carrying capacity. Principal research persons G. Rippstein and B. Peyre de Fabregues.
- IEMVT, 1972. Les Moyens de lutte contre les Trypanosomes et leurs vectors--Control Programs for Trypanosomes and their Vectors (acts du Colloque, Paris, 12-15 March, 1972). Articles in English or French with summaries. Perhaps best up-to-date summary of Africa wide control programs and research in progress.
- IEMVT, 1973. Synthèse des Etudes de la zone de Modernisation Pastorale du Niger - Conditions d'une Protection Sanitaire Permanente du Cheptel. (Maison - Alfort, May, 1973). (J. Coulomb). Current (1971) status of animal disease in the pastoral zone. Documents absence of veterinary infrastructure (posts and permanent vaccination parks) in the pastoral zone. Concludes that no animal production project is conceivable without continued vigilance against communicable diseases and where required, control of internal and external parasites. (Niamey)
- IEMVT, 1973. Synthèse des Etudes de la zone de modernisation Pastorale du Niger, Amélioration de l'Exploitation Pastorale (IEMVT, Maison - Alfort, Mars, 1973). Proposes and describes a "model" use plan for the range resources of the pastoral zone requiring an improved distribution of livestock balanced with the yield of various range sites. Proposed modifications to maintain the production potential and protect against range fires. Report by B. Peyre de Fabregue.
- IEMVT, 1974. Etude Agrostologique des Pâturages du Projet Assale-Serbewel, République du Tchad et République Unie du Cameroun (IEMVT/CBLT, convention No. 90/C/72, Projet No. 259/CD/72/VI/1/15(5), Juillet, 1974, mimeo 143 pp. Study financed for the Lake Chad Basin by FAC. Senior scientist, A. Gaston, Agrostologue. Contains bibliography of IEMVT agrostological studies in West Africa.
- IEMVT/FAC, Laboratoire National de l'Elevage et de Recherches Vétérinaires, 1972. Etude pour la Mise en Valeur du Complex du Sud Tamesna, Economie du Troupeau, January, 1972, 147 pp. Report prepared by J. Coulomb with the collaboration of G. Lamarque. (Purdue)

- IEMVT/FAC, 1972. Projet de Développement de l'Elevage dans la Région de Mopti, Etude du Troupeau, (September, 1972). 181 pp. Report prepared by J. Coulomb, J. Levit, B. Clausner. Translated into English September, 1973. 17 pp. plus annexes. Contains important data on the livestock population of Mopti Region, Mali, based on sample surveys. Annexes include a useful social profile of the Peul and some survey data on livestock marketing in the region.
- IEMVT/SEDES, 1969. Techniques Rurales en Afrique No. 15 le ranching techniques et économie (FAC, Paris, December, 1969). Technical bulletin related to the introduction, evaluation and management of large scale ranches in tropical countries.
- IEMVT/SEDES, 1971. Zone de modernisation pastorale du Niger-Economie du Troupeau. (IEMVT/SEDES, Paris, 1970-1971), 178 pp. Socio-economic study of pastoral zone. Report includes estimates of herd composition by major ethnic group, productivity factors (fertility, mortality, extraction rates), quantitative and qualitative trends in the national herd with and without proposed modifications in land use, herd management, infrastructure, and programs. Study prepared by J. Coulomb.
- IEMVT/SEDES/FAC, 1971. Modernisation Pastorale du Niger, Economie du Troupeau, IEMVT/SEDES/FAC 1970-71, 178 pp. Report prepared by J. Coulomb with the collaboration of G. Lamarque. Contains result of census by age and sex. (Purdue)
- IEMVT/SAEA, 1973. L'Embouche Bovine en Afrique Tropicale et à Madagascar (Collège de Dakar) (Senegal) 4-8 Décembre, 1973, Maison-Alfort, France, 1973. Series of papers on animal fattening.
- IEMVT/SAEA, 1974. Colloque sur l'Embouche Intensive des Bovins en Pays Tropicaux (Acts du Colloque, Dakar 4-8 Décembre, 1973), 327 pp. Illus. Articles in English and French with summaries. Survey of research on intensive feeding of cattle Africa wide.
- IEMVT/OCAM, 1969. Colloque sur l'Elevage (Proceedings OCAM. Ft. Lamy-Tchad, Décembre 8-13, 1969), 950 pp. Papers related to livestock production in French speaking countries of Africa and Malagasy Republic. (Purdue)
- IFAN, Centre de Haute-Volta, "Carte de l'Itinéraire de Transhumance de Quelques Groupes Nomades de l'Oudalan. (Cercle de Dori - Subdivision de l'Oudalan," Centre de IFAN, Ouagadougou, 196 .) Map indicating typical transhumance patterns for representative groups of Tuareg, Bella, and Peul family herds. Transhumance routes rarely exceed 40-50 km often crossing the Malian border. Movements are not random and there are definable areas within which affiliated groups usually confine their seasonal movements.

- INSEE/SEDES, 1966. Etude Démographique et Economique en Milieu Nomade, Démographie, Budgets et Consommation (INSEE/SEDES Paris, 1966). Study of the demographic characteristics. Family budgets and food consumption of Taureg and Fulani families and associated agricultural households in Niger. The study zone located between 4-7° East and 15-17° North Latitude (North of Tahoua). Provides basic baseline data for pastoral zone projects. Conducted in 1963-64 by seven man team. Indicates levels of food grain/milk/meat consumption by ethnic group.
- IBRD, Eastern and Western Agrica Region, 1972. "Status of Livestock Operations," December, 1972, mimeo, 16 pp. Background paper for first Brussels conference of donors for Francophone countries associated with the Common Market, December 6-7, 1972. Lists current (1972) and proposed IBRD/IDA livestock industry related projects in region.
- IBRD, 1974. Appraisal of the Livestock Development Project Cameroon (Report No. 295-CM, March 6, 1974). Description and review of a livestock project in Cameroon which includes three large ranches plus activities in support of small holders in central and western Cameroon. Appraisal team, A. Cole, H. Ochs and C. Wolffeit.
- IBRD, 1974. Appraisal of Livestock Development Project--Nigeria (Report No. 127a - UNI, October 9, 1974). Appraisal team N. A. Worker and T. C. Tsui.
- IBRD, 1974. "Note on problems in livestock development and essential ingredients to solve them," SECM 74-738, October 29, 1974, mimeo. Brief review of the difficulties of planning and implementing livestock development projects financed by IBRD/IDA.
- IBRD, 1974. "Proposal for a Cooperative Effort to Rationalize the Livestock Industries of the Sahel," Washington, 1974. This paper describes a possible action program aimed at rationalizing the livestock industries in the Sahel. The approach proposes a coordinated investment program aimed at reaching one-quarter of the one million pastoral families of the Sahel by semi-intensive range development projects over the next five years. It also proposes creating a "Regional Team of Specialists" to identify and prepare integrated range development projects, and a "Steering Committee on Range Development in the Sahel" to plan and supervise the implementation of this program in close cooperation with six national "Range Development Planning Agencies," No date or author listed.
- IBRD, 1974. Senegal: Tradition, Diversification, and Economic Development (IBRD, Washington, D.C., 1974). 341 pp.
- IBRD, 1974. Chad: Development Potential and Constraints, (IBRD, Washington, D.C., 1974). 133 pp.

- IBRD, Republic of Zambia Agricultural and Rural Sector Survey, Vol. I, Main Report and Maps, Vol. II, III, Annexes 1-19 (Report No. 841a-2a, October 20, 1975). Very detailed report, Annex 15 is the live-stock annex. A world bank daily and ranch project considered a failure because of inadequate ranch management. Maps excellent.
- IBRD/IDA, 1971. Livestock Development Project Mauritania (Report No. PA-102a, October 15, 1971). Provides loan for the purposes of well repair/development, fire break construction and improved animal health programs in the third, fourth and fifth administrative regions of southwestern Mauritania. The concept of the project is that, given that communal grazing systems will continue, "feasible actions to assist the livestock sub-sector are limited to those designed to improve the network of wells, to control animal diseases and to protect rangeland against fire." Implementation has been sporadic and the loan has subsequently renegotiated to provide additional technical assistance for implementation.
- IBRD/IDA, 1971. Economic Position and Prospects of Niger, Main Report (IBRD/IDA Western Africa Dept., Restricted Report No. AW-36a, May 1971).
- IBRD/IDA, 1970. The Economic Development of Upper Volta: Vol I, Main Report--Economic Position and Prospects; Vol II, Agriculture; Vol III, Livestock; Vol IV, Education (Restructured Report No. AID-19a, Nov 27, 1970).
- IBRD/IDA, W. A. Regional Office, 1974. Current Economic Situation and Prospects of Togo (report No. 458a-TO, Dec., 1974). 40 p plus appendices.
- IBRD/IDA, West Africa Regional Office, 1974. Current Economic Situation and Prospects of the Ivory Coast (Report No. 296-IV c, April, 1974).
- IBRD/IDA, 1974. Appraisal of Integrated Rural Development Project Mali (Report No. 340a-MLI, May 13, 1974).
- IBRD/IDA, 1975. Appraisal of a Livestock Development Project Upper Volta (Report No. 674a-UV, May 8, 1975). Appraisal of a livestock development project in the Bobo-Dioulasso and Dedougou ORDs which includes, improved marketing infrastructure, and veterinary services, development of 9 group ranches and training activities.
- IBRD/IDA, 1975. Appraisal of Maradi Rural Development Project, Niger (Report No. 881a-NIR, November 14, 1975). Appraisal of integrated rural development project. Activities supported include feeder roads, rural health, training of project staff and extension agents, financial support for veterinary services, low life small scale pumped irrigation, support for animal traction, improved seeds, vehicle operating costs and technical assistance. Disbursement period three years.

- IBRD/IDA, 1975. Appraisal of a Livestock Project, Mali (Report No. 538a-MLI, January 10, 1975). Appraisal of a Livestock project for the Fifth Region of Mali. The project would seek to develop a more rational use of the land and water resource through a combination of incentives, regulation and education. About 100,000 livestock owning families would be beneficiaries.
- Irvine, F. R., 1970. West African Agriculture, Vol. 2, West African Crops (Oxford, 1970, 3rd Ed.). 272 p.
- Jahnke, H. E., 1972. The Economics of Controlling Tse-Tse Flies and Cattle Trypanosomiasis in Africa, Examined for Uganda (Institut Fur Wirtschafts Forschung, 1972). Economic study of alternative methods used in the control of Trypanosomiasis and Tse-Tse fly focused on Uganda. Available from Research Park, Cornell University, Ithaca, New York, 14853.
- Jahnke, H. E. and H. Ruthenberg, 1973. "Organisational Aspects of Livestock Development in Dry Areas of Africa," Universitat Hohenheim, Stuttgart, 1973, mimeo. Draws on study undertaken by the authors for the World Bank. Argues strongly for the necessity of establishing land tenure as a prerequisite of livestock development in dry areas of Africa.
- Johnson, Douglas L., 1973. "The Response of Pastoral Nomads to Drought in the Absence of Outside Intervention," mimeo report, special Sahelian office, United Nations Secretariat, New York, December, 1973. 23 pp.
- N. R. Joshi, et al., 1958. Types and Breeds of African Cattle (FAO, Rome, 1958). Most recent general survey of African cattle types, their distribution and productivity. Out of print.
- Kahoun, J., 1973. "Slaughter and Carcass Characteristics on Fulani Cattle, Ghana," Acta Univ. Agric., Fac. Agion., Vol. 21(3):579-584, 1973. (USDA). Compares white Fulani and Ndama carcass characteristics.
- Kellogg, Earl D., 1971. A Temporal and Spatial Model to Assist in Evaluating Investments in the Nigerian Beef Distribution System (Ph.D. Dissertation, Michigan State Univ., 1971). Dynamic programming model of the Nigerian Beef Industry.
- Kohler, J. M., 1971. Activitiés Agricoles et Changements sociaux dans l'Ouest - Mossi, (ORSTOM - Ouagadougou, Memoires, No. 46, 1971). 249 p. (USDA).
- Konnenup, N. M., 1966. "The outlook for Animal Agriculture in Africa," Proceedings 15th Annual Meeting Agricultural Research Institute, (National Academy of Sciences, Washington, D. C., October, 1966) pp. 131-146. Well documented brief survey of outlook for livestock development in Africa.

- Lacrouts, M., 1967. Le Commerce du Bétail en Afrique (ITC - UNESCO, Center for Integrated Surveys, 1967). 44 pp (LC).
- Lacrouts, M. "Problème de la Commercialisation du bétail en Afrique," Rev. Elev. Med. Vet. Pays Trop., 1969, Vol 22, no. 1, pp. 127-144. Author treats various aspects of the W. African beef market, with the Sahel zone as the area of production and the Atlantic countries as the consumers. The relations between the production zones and large cities in Cameroon and Madagascar are also mentioned. Concludes the development of beef production must have absolute priority for the future. For this goal, several problems must be resolved: techniques of stock-raising must be improved; quality of the animal and the means of transport to the coast must be ameliorated; modes of commercialization must be improved; the selling market must be rationally organized; and finally, necessary facilities for payment for livestock arriving on the coast must be made available. No bibliography.
- L. L. Larson and U. Ndanko, 1962. "Report on Nine Cattle Fattening Trials in the Provinces of Sokoto, Katsina, Kano, Bauchi, and Bornu" (mimeo, Report No. a-13 to the Ministry of Animal and Forest Resources of the Northern Region, June, 1962). Includes discussion of small farmer annual fattening activities. Trials are unique in that they were modeled after existing small scale feeding activities, using available local construction and feeding materials.
- Lele, U., 1975. The Design of Rural Development, Lessons from Africa (IBRD, African Rural Development Study, Johns Hopkins Press, Baltimore, 1975). Review for the IBRD, of factors contributing to the success or failure of integrated rural development projects in Africa. Includes brief project review IBRD livestock projects in Kenya and Malawi and experience/costs of introducing animal traction in integrated crop production projects.
- Little, A. D., Inc., 1971. Un Programme Global et Integre du Développement de l'Industrie du Cheptel (Rapport pour le Gouvernement de la République du Tchad, Arthur D. Little, Inc., January, 1971). 273 pp. Tables.
- Lyman, P. N., 1974. "Reyna Report on Assale - Serbewel Livestock Project," AID/Afr/DS internal memo to J. Pieleimeyer, September 3, 1974. Expresses concern that the more wealthy persons in the society own cattle, and those with larger herds, most likely to accept and benefit from livestock improvement programs.
- Le Rouvreur, A. Sahariens et Sahéliens du Tchad (Editions Berger - Levrault, Paris, 1962). Ethnography of groups inhabiting the Savanna and Sahelian zones of Tchad.
- Lyon Associates, In., 1973. "Report on Review and Implementation Procedures Entente Fund Livestock Sector and Cereals Sector Loans."

- Contract No. AID-CN-AFR-C-73-25, July 31, 1973. Consultant report requested because of delays and problems caused by both conditions precedent and commodity procurement difficulties.
- Madland, M. P. and M. P. Madland, 1975. "Analysis of the 10th Region Evaluation Study," December, 1975. Report of husband and wife consultant team that resided for a six month period in the 10th Region. Provides description of farming systems and evaluates activities proposed in original AID livestock project proposal.
- Magee, C. and F. H. Mass. "Range Development and Grazing System Plan for the Assale - Serbewel Project Area, Guidelines and Design," Consultants Report to AID Najamina Chad, Dec 11, 1975. Proposes system of controlled grazing districts for the Assale/Serbewel project area. Existing project has focused on improved veterinary health delivery system only. Current rapid cattle population growth non-sustainable and conclude they must be complemented with controlled land use plan.
- Mainet, G. Et G. Nicolas, 1964. La Vallée du Gulbi de Maradi, Enquête Socio-économique (Documents des Etudes Nigériennes No. 16, IFAN-CNRS, 1964), 315 pp. Contains descriptions of the animal husbandry practiced by sedentary Hausa farmers and the interrelationships with non-sedentarized pastoralists.
- Mainet, G., 1965. "L'Elevage dans la région de Maradi," Les Cahiers d'Outre-Mer, Bordeaux, 1965, No. 69: pp. 32-72. A description of semi-nomadic cattle-raising in Niger, the main movements of livestock, and markets. Problems facing any attempt at modernization are discussed.
- Mali, Ministre de la Production, 1974. "Programme Bétail--Viandes, Dossier Principal Plan Quinquennal, 1974-1978," Bamako, June, 1974. Mali livestock sector development plan (AID/Afr/DS).
- Martin, L. R. and R. C. Porter, 1966. "Review of the request by the government of Togo for U. S. assistance," Center for Research on Economic Development, May 20, 1966. Contract No. AID/Afr-225, May 20, 1966. Good review of USAID participation and Togo government policy during period of bi-lateral programs to Togo.
- May, Jacques Meyer, 1968. The Ecology of Malnutrition in the French-Speaking Countries of West Africa and Madagascar: Senegal, Guinea, Ivory Coast, Togo, Dahomey, Cameroon, Niger, Mali, Upper Volta and Madagascar (New York, 1968), 433 pp. General description of agricultural systems and policies and the nutritional status of the population. Assessment of the adequacy of food resources. Although based primarily on secondary sources, this is a useful compilation of information and has scattered data of interest though somewhat out-of-date.

- Matlock, W. G. and E. L. Cockrun, 1974. A Framework for Evaluating Long Term Strategies for the Development of the Sahel-Sudan Region, Vol. II, A Framework for Agricultural Development Planning (MIT Center for Policy Alternatives, Cambridge, December, 1974). 229 pp.
- McDowell, R. E., 1972. The Improvement of Livestock Production in Warm Climates (Freeman Co., San Francisco, 1972). Most complete tropical livestock production, management and programs text by an animal scientist.
- McKelvey, J. J., Jr., 1973. Man Against Tsetse, Struggle for Africa (Ithaca, 1973). History of man's discovery and efforts to control Tsetse flies and Trypanosomiasis in Africa.
- McLeroy, G. B., 1974. "An Overview of Trypano-Tolerant Cattle Development Potentialities within the Main Tsetse Fly Belt," AID/Afr/CWR Tech. Staff Paper, December, 1975. 5 pp plus Map. Reviews the advantages and disadvantages of promoting trypano-tolerant cattle production as compared to Zebu stock in the Sudan Zones. Advantages seen are the greater tolerance of conditions within the humid zone which would allow greater use of the underexploited Guinea Savanna zone in order to supply the increasing demand for beef in West Africa.
- McLeroy, G., 1974. "Development Strategy for the Range Livestock Sector of West Africa Sahel-Sudan-Guinea Zones," Internal memo to David Shear, Afr/CWR, August 14, 1974. Critique to AID/REDSO/WA "Multi Year Sahelian Planning Paper," noting certain inconsistencies and technical and programatic problems of strategy proposals.
- McLeroy, G. B., 1974. Suggested Guidelines for Improving the Livestock Marketing Information Service of Mali, USAID/OMBEVI, Bamako Mali, January, 1974, mimeo. Suggests minimum grades and their definitions and data requirements for monitoring the livestock sector including forms for data collection and summary.
- McLeroy, G. B., 1975. "Baseline Inventory and Assessment of the Livestock Subsector in the Republic of Cameroon, North of Adamoua," Personal Services Contract No. AID/Afr-C-1152, 30 July 1975. Mimeo 59 pp., (preliminary draft). Contains basic description of livestock husbandry in the northern portion of Cameroon including descriptions of ecological types and tribal breeds of cattle, sheep and goats in the area and estimates of productivity.
- McLeroy, G. B. and N. Konnerup, 1969. "Guidelines for Planning AID Assistance Programs in Animal Resource Development for Africa," AID/TAB, November 13, 1969.
- McLoughlin, Peter F. African Food Production Systems (Johns Hopkins Press, Baltimore, 1970). Series of African case studies. Summary of McLoughlin ideas in first and last chapters. Emphasizes need to study systems of production and methods of promoting technological change.

- Moeller, A. N. and F. D. Abercrombie, 1974. "Utilization of Grazing Areas in Sahelian Countries of Africa, An Analysis of Development Costs and Impacts for Alternate Systems of Utilization," AFR/DS/SPAD, March, 1974. Mimeo 19 pp. Includes cost estimates for developing various types of grassland in Sahelian countries on a per unit of available grazing basis. Conclude that investments in higher rainfall Sudanian and Guinea Savanna zones more profitable than those in Sahelian zone.
- Miner, Thomas H. and Associates, Inc., 1967. Preinvestment Study Meat Packing Industry for Entente Guarrantee Fund, AID/Contract # AFR-495, Chicago, November, 1967. 169 pp. The object of the study was to investigate factors pertinent to evaluating the opportunity for U. S. private enterprise investment in Upper Volta and Niger meat marketing. Conclude size of supply and costs would not be attractive to American investors.
- Mittendorf, H. J. and S. G. Wilson, 1960. Livestock and Meat Marketing in Africa, (FAO, Rome, 1960). Classic early general survey (1960) of livestock and meat marketing on a continent wide basis. Established baselines for subsequent FAO production marketing estimates for Africa including prices and inter-country and inter-regional flows.
- Mongodin et R. Rivière, "Valeurs Bromatologiques de 150 aliments de l'Ouest Africain" Revue d'Elevage et de Médecine Vétérinaire des Pays Tropicaux, Vol XVIII, No. 2. contains coefficients of digestibility and energy of 150 feed products available in Africa.
- Monnier, J., "Contribution à l'Etude de la Traction Bovine au Sénégal. Deuxième Partie," Mach. Agr. Top., July - September 1965, no. 11, pp. 15-27. (CEEMAT, Bambey, 1963) Author summarizes his study and makes interpretations. The optimal cultivable amount of land for an average Senegalese family (with three working adults) is from 6.4 to 8.8 hectares, depending on the type of implements used. This amount can reach 13 hectares using two pairs of oxen and the necessary heavy equipment. In the above cases, budgets based on 1963 prices were constructed, and the author found that revenues from utilizing animal traction were superior to actual revenues of the average Senegalese rural family. Tables, bib.
- Monod, T., Ed., 1975. Pastoralism in Tropical Africa, (Oxford University Press, 1975). This is a collection of papers (some in English and some in French) presented to a seminar in Niamey in 1972 with an introduction by the editor.
- Monteil, V., 1959. "The Evolution and Settling of the Nomads of the Sahara," International Social Science Journal, 11(4), 1959, pp. 572-585.

- Montgomery, R., 1975. "Declining Demand for Beef in Abidjan: Little Aid-Cum-Trade for the Sahel," CIRES, University of Abidjan, 1975. Mimeo 32 pp. Argues on the basis of declining consumption in Abidjan that trade in cattle is likely to decline diminishing foreign exchange earnings for Sahelian countries.
- Morris, W. H. M., E. Kiefer and D. T. Kinard. Etude de la Praticabilité d'un Abattoir pour la Ville de Maradi, Republic Du Niger (Center for Tropical Agric., Inst. of Agric. and Food Sci., Univ. of Florida, May, 1972). Concludes that an abattoir for the purpose of exporting carcass meat not feasible because of high equipment maintenance and operation costs. Net export revenues would be greatest from export of live cattle to Nigerian markets.
- Morris, W. H. M., 1975. "Work Sessions on Small Ruminant Production IEMVT/Cooperation, Maison - Alfort, September 15-19, 1975," Agric. Econ. Dept., Purdue University, November 1975. 5 pp. Brief review of findings/recommendations of annual IEMVT/FAC conference which was devoted to sheep and goat production. There are large voids in our knowledge of how managed by pastoralists and sedentary farmers but important lessons from experience often ignored. Projects should be attached to other livestock or development operations for execution.
- Müller, J. O., 1967. Problèmes l'Elevage Contractuel des Bovins par les Pasteurs Fulbé (Peul) en Afrique Occidental - Togo (IFO - Institut Fur Wirtschafts Forschung et Institut Fur Auslandsche Landwirtschaft, Juliet, 1967). Describes contractual relationships between Fulani (Peul) pastoralists and Ewe and other agriculturalists in Togo relative to the development of animal production in the "peasant" milieu.
- Mulligan, H. W. and W. H. Potts eds., 1970. The African Trypanosomiasis (London, 1970). 950 pp. illus., maps. Collection of articles by 27 authors related to tsetse fly species identification, habitat, habits and their control; Trypanosomiasis, varieties, symptoms, control and their distribution in Africa.
- Murdock, G. P., 1959. Africa, Its Peoples and their Cultural History. (New York, 1959). General survey of ethnographic data for Africa. Interesting hypotheses as to the origins of the various groups of Fulfulbe (Fulani) speaking people.
- National Academy of Science, 1972. Soils of the Humid Tropics (Committee on Tropical Soils, NAS, Washington, D. C., 1972). Series of survey articles on fertility and management of tropical soils prepared under an AID grant to the NAS committee on Tropical Soils, Chairman, M. Drosdoff, Cornell Univ.
- National Academy of Sciences, 1974. African Agricultural Research Capabilities (Washington, D. C., 1974). Compiled by the Committee on African Agricultural Research Capabilities of the National Research Council of the National Academy of Sciences under the general

- chairmanship of John J. McKelvey, Jr. Excellent review of the research station network, work in progress and future research requirements for Africa South of the Sahara.
- Nicolaisen, J., 1969. "Nomadism and Stock-Breeding Among the Tuareg," in L. Foldes, Viehwirtschaft and Hirtenkultur, 1969, pp 161-185. Description of eight major political groups of Tuareg (w/map) of the W. Sahara and Northern W. Sudan, with emphasis on certain livestock management techniques (breeding, weaning, milking, herding, etc.) for camels, cattle, sheep, goats, as well as horses, donkeys and dogs. Some mention is made of migration routes and various patterns of consumption of livestock products (e.g. how women milk the cows and make butter, etc.). Author states that the Tuareg cannot live on livestock breeding alone, and that they are rational herdsmen. Vague descriptions of migration patterns.
- Niger, République du, 1972. Les Problèmes d' Abreuvement et le Fonctionnement des stations de Pompage vus par les Éleveurs de l'Arrondissement de Tchîn Tabaraden (Sec. d'Etat a la Presidence, Commissariat General ou Developpement, Service de la Promotion Humane, juillet, 1972). 200 pp. Review of "herder seminar" and the physical, social and environmental problems of nomadic livestock production. An objective was to develop a dialogue between the Services and the natural range lands. Includes summary of owner-defined problems and possible action programs in the sub-desert zone.
- Niger, République du Service de l'Elevage et des Industries Animales, 1972. "Sauvetage des Veaux," calves through purchase of young calves at the beginning of the transhumance period which would not survive transhumance. Calves would be fed milk replacer and eventually be resold to herders at 9-12 months of age or used to stock various government projects. No discussion of necessary purchase or sales infrastructure, management nor budgets. One center funded as part of IDA project.
- Nigeria, N.L.M.A., 1971. "A National Market Cattle Classification and Grading System." Nigerian Livestock and Meat Authority, Kaduna, 1971. 3 pp. Market cattle classification and grading system, results of slaughter cattle classification and grading. (Perdue)
- Nigeria, N.L.M.A., 1971 "Basic Concepts in Producing and Marketing High Grade Slaughter Cattle by Hand Feeding During the Dry Season in Northern Nigeria," N.L.M.A., Kaduna, August, 1971. 13 pp., charts. Report prepared by D. M. Salahu. (Perdue)
- ORSTOM - Ouagadougou, 1974. Introduction à la Géographie des Aires Pastorales Soudaniennes de Haute-Volta (ORSTOM, Centre de Ouagadougou, Haute-Volta, 1974). 82 pp., maps. (Perdue)

- ORSTOM, 1976. Carte P dologique et Reconnaissance de la République du Niger (ORSTOM Paris and Niamey, 1976). Soils map of the "useful" agricultural zones of Niger which excludes the Pastoral Zone (1:500,000). Reconnaissance entitled "Sols et Pedogenese ou Niger Meridional" available for reference only (1400 pgs). Synthesis of 125 pages planned but not currently available. Principal soils scientists, M. Gavaud and R. Boulet (ORSTOM Paris or Niamey).
- Oxby, Clare, 1975. "Pastoral Nomads and Development," International African Institute, 1975. (In English and French.) This is a partly annotated bibliography with an eight page introduction. (About 40 pp.)
- Picardi, A. C., 1974. A Framework for Evaluating Long Term Strategies for the Development of the Sahel - Sudan Region Annex 5, A Systems Analysis of Pastoralism in the West African Sahel (MIT Center for Policy Alternatives, Cambridge, December, 1974). A systems analysis of pastoralism in West Africa utilizing dynamic programming techniques. The model suggests historical interventions increased the magnitude of the drought disaster and implies that periodic crises are inevitable under almost any feasible intervention program without migration.
- Raulin, H., 1965. "Travail et régimes fonciers au Niger," Cahiers de l'ISEA, 1965, No. 166, pp. 119 - 139. Indicates traditional patterns of work may have as much influence on agricultural productivity as systems of customary land tenure.
- Rattray, J. M., 1960. The Grass Cover of Africa (FAO Agric. Studies No. 49, FAO, Rome, 1960). Description by country of the major grass species and biologic associations. Includes excellent map of grass cover of Africa.
- Reyna, S. P., 1974 The Assale - Serbewel Social Economic Study (Report for the Lake Chad Basin Commission, Nd'Jamena, Chad, June 15, 1974). Report of 8 month field survey by a social anthropologist in Assale, Chad and Serbewel, Cameroun. The survey was designed to assist in the implementation of a LCBC livestock project in the two areas by pinpointing possible social constraints to proposed activities and by defining the least socially disruptive program methodology. Contains some baseline productivity and marketing data.
- Reining, P., 1973. "Utilization of ERTS - 1 Imagery in Cultivation and Settlement Site Identification in Upper Volta and Niger," Final Report AID/W Contract No. AID/CM/AFR-C-73-21, November, 1973. Report of field work to test feasibility of using ERTS I imagery to determine settlement patterns and crop yields in Sudan - Sahel countries. If combined with extensive ground truth survey, settlement patterns can be identified but under soils types and cropping patterns in the zone, imagery is of no value in estimating hectarage or yields. Methodology suggested for estimating human carrying capacity.

Revue Trimestrielle D'Information Technique et Economique, Communauté Economique du Bétail et de la Viande, (CEBEV) Ouagadougou, Haute-Volta. Journal publication of the Entente Livestock Community with latest available marketing, and disease situation data and articles of general interest to member and associated states.

Robinet, A. H., 1967. "La Chèvre Rousse de Maradi, Son exploitation et sa place dans l'économie et l'élevage de la République au Niger," Rev. Elev. Med. Vet. Pays Trop, 20 (1) pp. 129 - 186. (IEMVT, Niger) Extensive article covering most aspects of Red Maradi goat husbandry of Niger, as well as goat raising in general in the country. Author reviews the goats' habitat and natural conditions, and some aspects of Niger livestock in general, including technical and administrative organizations. Included is a brief survey of the pathology of the breed; aspects of local management; annual increases in pop., exports of meat, hides and skins; the Maradi in the economy - a typical budget for a herd and comparisons, Bibliography.

Robinet, A. H., 1974. "L'eau et le Développement de l'élevage au Sahel," Dept. de l'Elevage, Secrétariat d'Etat Français aux Affaires Etrangères January, 1974. The direct cause of most drought related losses was starvation and malnutrition not absence of drinking water. The provision of additional water without management of range and earlier marketing would be of no value. Would reserve Pastoral Zone north of 350 mm Isohect exclusively for grazing.

Rupp, Manianne, 1973. "The Men and Their Herds," Preliminary report on the sociology of the Maures, Peul, Guera, Bambara and Somiuke in the Nara-Niono plan in the pilot zone of UNDP Project Mali 523, undated, 1973. Describes the interrelationships between the various ethnic groups in Northwestern Sudano-Sahelian zone of Mali as they relate to cattle production and marketing. The Peul are divided into two groups, the Wolonobe (Mbororo) who are more migratory, are described as haughty by their neighbors and live in temporary shelters and the Rimaibe', their former slaves that now outnumber their former masters, have permanent habitations, transhumane shorter distances and are less dependent on their herds for subsistence food production. The area studied will be included in the Sahel grazing activity of the Mali Livestock Sector Grant.

Ruthenberg, H., 1974. "Artificial Pastures and Their Utilization in the Southern Guinea Savanna and the Derived Savanna of West Africa, Tour d'Horizon of an Agricultural Economist," Stuttgart - Hohenheim, 1974. Mimeo 98 pp.

Sargent, M., 1974. "Institut de Recherches en Agronomie Tropicale (IRAT) Research on Cereal Production Technology in Senegal and Upper Volta," Final Report AID Contract, September 24, 1974. Mimeo 63 pp. Review of IRAT Cereals research including tillage technology and benefits of animal traction.

- Schertz, L.P., 1971. Economics of Protein Improvement Programs in Lower Income Countries. (Foreign Economic Development Report 11, USDA/ERS, AID, July, 1971.) Bulletin 37 pp.
- Schneider, H.K., 1973. "The Subsistence Role of Cattle Among the Pakot and in East Africa," in E. Skinner ed., People and Cultures of Africa (New York, 1973). Discussion of why management decisions are based upon the subsistence role of stock, which determine cultural attitudes in a harsh environment.
- Singleton, C.B., 1976. "Mauritania's Range and Livestock Project: Findings and Recommendations of Field Survey Trip to Selibabi Mauritania," Near East Foundation for AID, January 6, 1976. Mimeo 25 pp. Contains data from Department of Elevage sources. Outlines Mauritanian plans for intervention in livestock production and marketing systems.
- SEAE, 1965. Le Cheptel Bovin du Cameroun, Exploitation, Commercialisation, Perspectives d'Avenir, Deux tomes (Ministère de la Coopération, Mars, 1965). Study by M. Lacrouts and J. Sarniquet.
- SEAE, 1968. "Le Ranching Pôle de Développement du Monde Pastoral Sahélien," Rapport présenté par J. P. Marty et A. A. Robinet, Septembre, 1968. Argues that growing out and fattening ranches are necessary to encourage younger marketing of cattle. (Perdue)
- SEAE, 1973. Etude de l'évolution de l'Emploi et des effets des facteurs de production dans les pays de l'Afrique de l'Ouest, Rapport de Synthèse. (SEAE, Paris, 1973.) 81 pp. (Perdue)
- SEAE, 1973. Bilan et Evaluation de l'Action de l'Encadrement dans les ORD de Ouagadougou, de Koudougou et de Kaga (Haute-Volta) Vol. I, Conclusions d'Ensemble: Bilan et recommandations, Vol. II, Etude Auprès de l'Encadrement (MARCOMER for SEAE, September, 1973). Study of the rural milieu related to extension of farming methods in the three ORD's and implications for training extension agents. Contains detailed descriptions. (Perdue)
- SEAE/CEEMAT, 1972. République du Togo, Etude de l'évolution des Facteurs de production mis en place pendant les 10 dernières années et de leurs effets (SEAE - CEEMAT No. 534/M/72/S, Nov. 28, 1972). Estimation of the quantities of major agricultural inputs currently in use on major crops and projections thru 1973 including fertilizer, insecticide and animal traction equipment. (Perdue)
- SEAE/FAC, 1971. "Introduction to a Concerted Policy on the Development of Animal Production." AID Translation, 1971. Mimeo 10 pp. Author, H. Lepissier, FAC, Dakar.
- SEAE/FAC, 1974. French Aid to the Sahelian Countries Stricken by the Drought - Replenishment of the Herds and Modernization of Animal Production, February, 1974. Mimeo 64 pp. AID Translation summarizing French assistance and at that time view of necessary actions to rebuild herds.

- SEAE/IEMVT, 1970. Manuel sur les Pâturages Tropicaux et les Cultures Fourragères. (Manuels et Précis D'Elevage, No. 4, SEAE/IEMVT, Paris, March 5, 1970)
- SEAE/IEMVT, 1971. Manuel Vétérinaire des Agents Techniques de l'Elevage Tropical (Manuels et Précis D'Elevage No. 5, Paris, 1971).
- SEAE/Tchad, 1967. Exploitation du Cheptel Bovin Au Tchad Tome I, Production, Consommation, Exportation, Tome II Les Marches de la Viande en Afrique Centrale (SEAE/FAC, Paris, 1967). Detailed survey of production and marketing in Chad. Contains no analysis of Nigerian market, assumes entire exports will be directed toward Frankophone countries. Team members: J. Sarniguet, J. P. Marty, R. Arnand.
- SEAE/SEDES, 1973. République de Haute-Volta, Etude de l'Evolution de l'Emploi et des Effets des Facteurs de production mis en place pendant les Dix dernières années. Analyse des Effets des Facteurs de Production Dans Les ORD de Bobo-Dioulasso et de Dedougou. Rapport de Stage ou CPDCET de de Mr. Bergassoli.) (Perdue)
- SATEC, 1973. Projet de Mise en Valeur des Terroirs dans les ORD de Ouagadougou, Koudougou et Kaya, Tome I, Evaluation de la phase experimental de l'Operation Terrors, Tome II Projet de Mise en Valeur Des Terroirs (Société d'AIDE Technique et de Coopération, Juillet, 1973). Development program for three ORDs financed by FAC and carried out by agents of SATEC. (Perdue)

- SEDES, 1960. Les ressources animales de la République du Niger: leur exploitation et perspectives d'avenir. (Paris, SEDES, 1960), 106 pp. Report prepared by M. Lacrouts and J. Tyc. Believed to contain estimates of numbers, herd composition, production and recommended programs including "ranch" development. (Not seen.)
- SEDES, 1965. Région du Korhogo (Côte-d'Ivoire) Tome Agriculture et Elevage. Etude de développement socio-économique, Septembre, 1965.
- SEDES, 1968. Approvisionnement en Viandes de l'Afrique Centre Ouest (Paris: 1968), 3 volumes. The major study of the livestock sector in Ghana, Nigeria, and the Entente countries. Contains abundant information and data on herd size and composition, off-take rates, trade, marketing, slaughter, consumption, prices, costs, regulations, taxes, etc. Projections of future supply and demand. Recommendations for improvements in production, marketing, and distribution.
- SEDES, 1969. Harmonisation des Législations et Actualisation des Coûts de Transport du Commerce du Bétail et de la Viande dans les Etats de l'Entente (Paris: July, 1969) mimeo, 187 pp. + annex. Description of customs regulations, tax systems, commercial legislation, health legislation, and transportation costs for livestock and meat in the Entente countries. Recommendations for the harmonization of legislation, the organization of the commercial sector, including credit, the organization of health control and the improvement of transportation. Basis for Entente protocols.
- SEDES, 1969. Implantation d'un Centre d'Embouche dans la Région de Niono; Etude Economique et Avant-projet Technique, September 1969, mimeo, 103 pp. Investigation of the economic desirability of establishing a feedlot in the Niono area. Considerable data though out-of-date.
- SEDES, 1971. L'Approvisionnement en Viandes de l'Afrique Centrale, Tome I, Analyse de la Situation Actuelle et Projections, 1975-85 (Paris, SEDES, 1971). Report edited by M. Tyc, J. Sarniquet and others.
- SEDES, 1971. L'Approvisionnement en Viandes de l'Afrique Centrale, Tome II, Synthèse Diagnostique et Proposition pour la Région et les Sous-Régions (Paris, SEDES, 1971). Report edited by M. Tyc, J. Sarniquet and others.
- SEDES, 1971. Les prix du bétail et de la viande dans les pays de l'O.E.R.S. (SEDES, Paris, 1971).
- SEDES, 1971. Etude des problèmes posés par la Commercialisation de la Viande de Kaedi, Mauritanie. (SEDES, Paris, 1971).
- SEDES, 1971. Expertise en vue de la mise au point d'un programme d'intervention du II ème F.E.D. dans le domaine de l'Elevage du Dahomey (SEDES, 1971).

- SEDFS, 1972. L'Approvisionnement des Villes dans les Pays Francophones d'Afrique Vol II, Abidjan, Bouaké (Paris, December, 1972). Contains estimates of the volume, source, prices and per capita availability of major commodities including meat and fish. (CRED)
- SEDES, 1972. L'Approvisionnement Des Villes Dans Les Pays Francophones d'Afrique, Enquêtes et Perspectives Vol III, Lomé, Paris, December, 1972.
- SEDES, 1972. L'Approvisionnement Des Villes Dans Les Pays Francophones d'Afrique, Enquêtes et Perspectives, Vol IV, Ouagadougou (Paris, Décembre, 1972). (CRED)
- SEDES, 1972. Etude de Factibilité du projet relatif au développement de l'Elevage - Ghana, Vol 1, Rapport général, Vol 2, Annexes économiques (SEDES, Paris, 1972).
- SEDES, 1973. Approvisionnement en Viandes de l'Afrique de l'Ouest, Tome I, Première Partie, Analyse de la Situation Actuelle, Projections 1975-1985 Dans six Pays de la Région, Rapport Provisoire Février, 1973; Deuxième partie, Etude régionale, Productions Commercialisation, Consommations (Paris, Février, 1973). Study review of production and marketing in Mauritania, Senegal, Gambia, Mali, Sierra Leone, Liberia. Team members included J. Sarniquet, J.E. de Mieulle, P. Blanc supervised by J. Tyc. Study financed by FAC and USAID.
- SEDES, 1973. Approvisionnement en Viandes de l'Afrique de l'Ouest, Tome 2, Analyse de la Situation Actuelle, Projections 1975-1985 Dans Six Pays De La Région (Paris, 1973). (CRED)
- SEDES, 1973. "Projet d'Organisation de l'Embouche Bovine Paysanne Niger," Paris, 1973. Study financed by FED in cooperation with the service de l'Elevage et des Industries Animale.
- SEDES, 1974. Approvisionnement en Viandes de l'Afrique de l'Ouest Synthèse de l'Analyse, des provisions et des propositions de l'Etude. (SEDES/FAC, Paris, 1974.) (CRED)
- SEDES, 1974. Introduction aux coûts Economiques de la production animal, application aux pays Sahéliens Tome 1, Etude Méthodologique (2 ème Ed., Paris, 1974). Methodology for establishing estimates of animal numbers and products and their value in marketing systems. Excellent for essential French vocabulary, marketing and production systems.
- SEDES, 1974. Etude de Factibilité de Deux Projets de Ranchs Nord Dakoro - Nord Gouré et Etude Préliminaire d'un site dans le Département de Dosso; Tome I, Rapport de Synthèse, Paris, 1974. 94 pp. Contains synthese of of technical documents related to these three locations for possible ranch development. North Dakoro was eliminated as a potential site because of "demographic factors." Further dossiers were developed for the North Gouré site but no further studies available for North Dakoro. Report contains descriptions of vegetation, soils, potential range management and fodder production potential).

- SEDES, 1974. Etude de Factibilité de Deux Projets de Ranchs Nord Dakoro - Nord Goure et Etude Préliminaire d'un site dans le Département de Dosso, Tome 3, Rapport Socio-Economique (Paris, April, 1974). Describes socio-economic conditions in the vicinity of the three sites. The ranches would serve as "poles of intervention" for the purpose of extension work with the local livestock owners. Present practices and proposed programs are described.
- SEDES, 1974. Diagnostic et Perspectives sur la Production Animale au Togo (SEDES pour FAO/PNUD, April, 1974). 109 pp. plus annexes. Provides current statistical data on the livestock sector of Togo, describes existing institutional infrastructure, ongoing and proposed development projects including cost estimates and suggests additional programs with necessary government reorganization. Report prepared by J. Sarniquet and P. Legrand.
- SEDES, 1975. Enquêtes et Projets d'Amélioration de l'Élevage des Petits Ruminants (SEDES pour FAC et OMBEVI-IER, Mars, 1975). Report prepared by H. Raymond and R. Dumas (IEMVT) on constraints and data requirements required for development of sheep and goat production in Mali.
- SEDES/FAC, 197?. "Considération sur les Action Menées par les Organismes Régionaux de Développement en Haute-Volta sur les ORD Ouagadougou, Kaya et Koudougou." Report by A.A. Rochez and H. Raymond. Programs for breeding, animal traction, functional literacy and general propositions. (Purdue)
- SEDES/IEMVT, 1974. L'Élevage des Petits Ruminants dans les Circonscriptions de Kaya-Ouahigouya et du Sahel, Haute Volta (Paris, 1974). Report prepared by H. Raymond (SEDES) and R. Dumus (IEMVT). Proposes survey to obtain baseline productivity, disease and parasite data.
- SEDES, République du Mali, Ministère de la Production, 1972. "Projet de Développement de l'Élevage dans la Région de Mopti, Rapport de Synthèse." (SEDES, Paris, Décembre, 1972.) Prefeasibility study IBRD/IDS Livestock Project. Proposes creation of pilot pastoral units, semi-intensive ranches, modern feed lots and program to develop portions of the seasonally flooded interior delta.
- SEDES, République du Mali, Ministère de la Production, 1972. Projet de Développement de l'Élevage dans la Région de Mopti. Annexe A - Aspects Sociologiques des Conditions de l'Élevage en Région de Mopti. (SEDES, Paris, Décembre, 1972.) Prefeasibility study IBRD/IDA Livestock Project. Review of social organization and grazing patterns of pastoral Peuhl. Contains map of 5th region transhumance patterns.

- SEDES, République du Mali, Ministère de la Production, 1972. Projet de Développement de l'Elevage dans la Région de Mopti. Annexe B - Résultats de l'Enquête Economique sur le Commerce du Bétail dans la Région de Mopti (SEDES, Paris, Décembre, 1972). Prefeasibility study IBRD/IDA Livestock Project. Includes review of age/sex structure of herds and animals marketed.
- SEDES/Niger, MER, 1973. Projet de Modernisation de l'Elevage en Zone Pastorale (Rapport de Synthèse) (SEDES/Paris, Juillet, 1973). 213 pp. Report summarizing the SEDES/IEMVT/BGRM studies of the pastoral zone. Proposes creation of four sub zones of intensive extension activities (sud Tamesna, In-Gouchoul, Tejika and Kadzel-Manga) for the pilot implementation of recommended programs for the pastoral zone. Zones would include a permanent deep well, small capacity wells, a pastoral (education) unit with specially trained extension workers. Report edited by M.C. Tselikas and M.J. Tyc.
- SEDES et Togo, Ministère de l'Economie Rural, 1973. Les Aspects du Crédit Agricole au Togo (Lomé et Paris, Décembre, 1973). A study of the agricultural credit structure and requirements prepared for the UNDP and the Ministry of Rural Economy.
- SCET, 1972. Projet d'Aménagement des routes et des marchés à Bétail au Togo, Tome I, Rapport Général, Tome II, Dossier de Présentation, (Lomé et Paris, Août, 1972). Feasibility study for the improvement of cattle trails and markets in Togo. Provides data on numbers of cattle using various trade routes. Activities financed under AID/Entente Guarantee Fund Loan, May, 1975. Principal author, A. Arnaud.
- SCET, International, 1972. La Production Animale Voltaïque Perspectives de Développement Tome I 1ère partie, La Situation actuelle de l'Elevage (1969) 2ème partie, Potentialités actions recommandées synthèse économique Tome II Note de Synthèse (SCET-International, 1972). Vol 1, 450 pp., Vol 2, 53 pp., Charts and Maps. Detailed survey of livestock production and marketing as of 1969 including trends (Purdue).
- SCET, International, 1972. Pistes et Marchés du Bétail dans l'Ouest et le Centre-Ouest Niger, Projet d'Equipement, (SCET, Paris, 1972). Advant-project for development/improvement of cattle markets; cattle trails, linking Ekrafane ranch, the Niamey Abattoir and exportation routes to Upper Volta and Dahomey, followed by development of east-west trails linking North Tahaoua department with Niamey and Ekrafane. Describes markets, marketing procedures, taxation, volume (1970) cost estimates. Report prepared by M.M. Fredet and Kassianof, March - April, 1972. Financed by Entente Fund/AID. (Niamey)
- Stenning, D.J., 1959. Savanna Nomads (Oxford, 1959). Ethnographic study of pastoralist Fulani in Bornu Province of Nigeria. Contains good discussion of the history of the Fulani of West Africa and some discussion of management practices - pre-independence period.

- Stenning, D.J., 1960. "Transhumance, Migratory Drift, and Migration," in S. and P. Ottenberg Eds., Cultures and Societies in Africa (Random House, New York, 1960).
- Stryker, J. Dirck, 1973. Livestock Production and Distribution in the Malian Economy, August 1973, mimeo, 50 pp. plus annex tables. Supplementary report to that submitted by the USAID/GOM team in March 1973. Presents and evaluates information and data from a wide range of documentary sources, especially the SEDES study of the OMVS countries, as well as data gathered by the USAID/GOM team to Mali in January/February 1973. Emphasis is on the links between the livestock sector and the rest of the Malian economy and on problems of public policy.
- Texas Tech University, 1974. Ranching/Mixed Agriculture Program in Niger: A Feasibility Study for Africare (Lubbock, Texas, June, 1974). 93 pp. plus 14 annexes. Proposes major ranch development in the pastoral zone of Niger in a site northeast of Gouré. Ranch mixed agricultural scheme would involve 500 families with an initial investment cost of \$12 million or \$24,000 per family. Development team included six professionals from Texas Tech University.
- Touchberry, R.W., 1967. A Study of the N'Fama Cattle at the Musara Animal Husbandry Station, Sierra Leone, Bulletin 724, University of Illinois Experiment Station, April, 1967. Study financed as part of USAID/AFR 293 in cooperation with Njala University College. Gives basic productivity coefficients for cattle born on the station.
- Tourne, A., G. Djungbedja et K. Affognon, 1975. Monographie de la Région Des Savanes au Togo (Version Provisoire, BDPA pour l'Ministère et l'Economie Rural et le PNUD, Lomé et Paris, 1974). Monograph prepared by the rural economy section of the Savanna region development agency which summarizes the agricultural economy of the region including the livestock sector. The objective of the report was to identify possible programs and interventions by the agency in agricultural production and marketing.
- Tremblay, R.H., 1969. Economic Evaluation of the Rinderpest Eradication Campaign in West Africa, USDA/USAID, September, 1969. 16 pp. plus appendices. Concludes Rinderpest eradication an "unqualified" success because value of cattle "saved" exceed the cost. But, eradication was not achieved, and the report assumes no costs result from an expanding cattle population. Unfortunately a very poor evaluation of this major program.
- UNDP, 1972. "Mission Interdisciplinaire, du PNUD en Haute-Volta, Rapports Sectoriels, Développement Rural Intégré," Novembre 4-30, 1972. 39 pp. Program of action for the UNDP, basis of current United Nations activities in Upper Volta.

UNESCO, 1962. Problems of the Arid Zone, Proceedings of the Paris Symposium (UNESCO, Paris, 1962).

UNESCO, 1963. "Nomades et Nomadisme au Sahara," Recherches Sur la Zone Aride, XIX, UNESCO, 1963.

UNESCO, 1975. The Sahel: Ecological Approaches to Land Use, Man and the Biosphere (MAB) Technical Notes, Unesco Press Paris, 1975. Report and documents presented to regional meeting on integrated ecological research and training needs in the Sahelian Region held in Niamey (Niger) 11-15 March, 1974. Contains articles on climate and soils (L. Berry). Remote sensing potential (N.H. Macleod), plant cover and pastures (H. Gillet), pastures and livestock (G. Boudet), Research Trends (Boudet and H. Gillet).

U.K., Min. of Coop. and SCET - International, 1976. "Outline of Water Resources Development in the West African Sahel," mimeo, 93 pp. Provisional working document with preliminary estimates of irrigation potential from the principal aquifers and river systems of the Sahelian countries with and without flow control, under alternative cropping systems. Suggests priorities for scheme and dam construction based upon potential. Double cropping required for feasibility of most schemes.

USDA/IADS, 1966. Recommendations for U.S. Aid in Agricultural Development - Niger (Report to AID by USDA/IADS Team, April/May, 1966. Interesting review of initial AID programs in Niger and projects of other donors that date. The team recommended an expansion of the AID program from four to eighteen technicians principally in extension activities.

USDA-SCS/FAC, 1976. Resource Inventory of North Cameroon, (USDA, Soil Conservation Service, Washington, February, 1976). Land use and land use capability survey of North Cameroon using U.S. approach but drawing heavily on pre-existing soils, vegetation, agrostological data and various socio-economic surveys. Valuable compilation of agronomic, social and economic data for North Cameroon (English and French).

U.S. Department of the Interior Bureau of Land Management, 1967. Land Management Study, Nigeria, (June, 1967). Team members: E.L. Kemmis, C.P. McCrillis, J.M.F. Dubois, H.R. DeLano. Study sponsored by USAID.

Upper Volta, Ministère du Plan, du Développement Rural de l'Environnement et du Tourisme, Direction des Services de l'Elevage et des Industries Animales, 1974. Projet de Centres de Multiplication de Bovins, 1974. 9 pp.

Uzureau, Claude, 1974. "Animal Draft in West Africa," World Crops, Vol 26, No. 3, May - June, 1974, pp. 112-114. Despite the views of other experts, the use of draught animals in the Sudanian savannah zone of West Africa is assuming increasing importance (based on 1972 statistics from Senegal, Mali and Dahomey). Although only a minority of farmers in these areas are concerned, the use of animal traction has become an important part of the government's extension programs. Advantages, on the balance, seem largely in favor of this technique, and it seems worthwhile to encourage use of draught animals in this zone until such time as applied research can come up with some economically viable form of mechanization of benefit to the majority of African farmers.

- Van Binsbergen, H., 1973. Rapport Final de l'Expert en Production Animale, Centre Agricole Polyvalent de Formation de Matourkou, Phase II (FAO/PNUD Projet UPV/68/507, Feurter, 1973).
- Van Dyne, G.M. Long-Term Development Strategies in Relation to Environmental Management in the Sahel, Report for the meeting sponsored by the Panel on Arid Lands of Sub-Saharan Africa sponsored by the U.S. National Academy of Science and the Rockefeller Foundation, Bellagio, Italy, 24-29 October, 1974. 74 pp. Good summary of strategies as outlined in the literature particularly as it relates to livestock development. He notes the predominance of literature in this area and apparent donor interest in this subject. Proposes a "Sahel Institute," a "think tank" to consider the major problems and advocates systems analysis as a method of conceptualizing the complex problems of the zone.
- van Raay, J.G.T., et al., 1971. "The Importance of Crop Residues as Fodder: A Resource Analysis in Katsina Province, Nigeria," Samaru Research Bulletin No. 139, 1971, Institute for Agricultural Research, Samaru, Zaria, Nigeria, 7 pp. Authors survey the main crops of the Dutsinma-Safana area of the Katsina Province, and record yields, weights and edible residues; mean protein content of crop residues; and number of grazing days on crop residues (millet, guineacron, cotton, groundnuts, cowpeas and cassava). Authors discuss the traditional use of crop residues and certain aspects of Fulani-Haussa relations.
- Grazing in the area is satisfactory until February because of the quantity and quality of crop residues. It is only thereafter that fodder becomes increasingly scarce, but even so, the good condition of the livestock that grazed the farms ensures that widespread starvation is rare. Concludes that the ability of livestock to survive the dry season is greatly facilitated by grazing crop residues and without it mortality among cattle would be considerably higher.
- Walter, H., 1964. "Productivity of Vegetation in Arid Countries, the Savannah Problem and Bush Encroachment After Overgrazing," in The Ecology of Man in the Tropical Environment. Proceedings and papers of the North Technical Meeting of the International Union for the Conservation of Nature and Natural Resources, Morges, Switzerland, 1964.
- Wright, W.H., 1973. "A Resume of Some Human and Animal Diseases of West and Central Africa," Resume for AID Technical/Health (TA/H), September 28, 1973. Mimeo 70 pp. plus appendix tables. Summary of occurrence, pathology, treatment and control of commonly occurring human and animal diseases in West and Central Africa. Valuable summary of sleeping sickness (trypanosomiasis) and diseases transmitted from animal to man.

- WIP, 1973. Elaboration d'un Dossier d'Exécution Concernant Quatre Opérations dans le Domaine de l'Élevage au Dahomey, Tome I, Zootechnie - Parasitologie; Amélioration de la Productivité Numérique du troupeau et embouche paysanne dans la région d'élevage du Borgou; Ranch d'Embouche de la Okpara; Élevage Sous palmeraie (WIP, 1973). (Purdue)
- Whyte, R.O., 1962. "The Myth of Tropical Grasslands," Tropical Agriculture, 39:1, 1962. The great potentialities of tropical and subtropical grasslands are still largely a myth and the cultivated fodder crops and artificial pastures of the temperate latitudes will continue to provide the greater part of the world's output of livestock products.

ADDENDA

- AID, 1976. Proposal for a Long Term Comprehensive Development Program for the Sahel, Part I, Major Findings and Programs, (Report to the United States Congress, April, 1976).
- AID, 1976a. Proposal for a Long Term Comprehensive Development Program for the Sahel, Part II, Technical Background Papers, (Report to the United States Congress, July, 1976).
- AID/Afr, 1974c. Mali: Mali Livestock Project, Program Proposal (PP), 1974. Grant in support of livestock production by sedentary farmers, and commercial scale cattle feeding by private persons and a para-statal company. Also includes a livestock credit fund, equipment and supplies and participant training.
- AID/Afr, 1976. "Upper Volta Village Livestock, Project Proposal," February, 1976. The purpose of Phase I is to determine improved livestock production capabilities in selected villages of three ORDs of eastern Upper Volta -- Kaya, Koupela and Eastern (Fada) which can then be extended on a more general scale in ecologically similar localities in subsequent phases.
- AID/Afr, 1976a. Africa Regional - Entente Livestock II, AID/DLC/D-2155, March, 1976. Project proposal and review of the 2nd Entente Fund Livestock Loan/Grant to assist the countries of the Entente states (Ivory Coast, Togo, Dahomey, Upper Volta and Niger) to develop the livestock sector. Includes review of the first loan sub-projects and an indicative listing of projects proposed for funding by member states. An annex volume includes livestock sector analyses for Ivory Coast (prepared by W. Morris) and Togo (prepared by D.S. Ferguson).
- AID/TAB, 1975. Bibliography of the Soils of the Tropics, Vol I, Tropics in General and Africa (Tech. Ser. Bull. No. 17, AID/TAB, Washington, D.C., June, 1975).
- Afrique Agriculture No. 4, December, 1975. Entire issue devoted to animal production and industry in Africa with country articles and articles by leading authorities.
- Baier, S. and D.J. King, 1976. "Drought and the Development of Sahelian Economies: A Case Study of Hausa - Tuareg Interdependence" Land Tenure Center, University of Wisconsin, 1976. Reviews evolution of warrior Tuareg and sedentary farmer relationships from that of lord-vassal during the pre-colonial period to that of interdependent trade in the present era.

- Boudet, G., A. Bourgeot, J. Coulomb, D.S. Ferguson and F. Bandemaele, "Sur l'Etude des Possibilités sur la Gestion du Bétail et des Terrains de Parcours pour Combattre la Désertification dans les Régions Sudano-Sahélien, Une Synthèse des Réflexions et des Conclusions du Groupe de Travail," UNEP (SCLAR), Nairobi, 1976. Provisional report of the SOLAR working group for a trans-national project to facilitate the ecological management of rangelands in the arid zones of West Africa.
- BDPA/IEMVT, 1965. Bilan des expériences de culture attelée en Afrique occidentale d'expression française, Guinée exceptée. (Paris, BDPA/IEMVT: mimeogr.; 1965), 3 tomes. Report by Casse, Dumes and Garm.
- Carter, M.G. and G.B. McLeroy, Range Management and Livestock Industry in the Chad Basin, August, 1968 (USDA/USAID report prepared for the Chad Basin Commission, Fort-Lamy). This extensive report involves the countries of Cameroon, Chad, Niger and Nigeria, and covers the traditional and modern marketing and production situation for the area, and describes future demand, transportation, physical environment, cattle resources, stock raisers, carcass quality, research and education requirements. The authors describe problems and make both short- and long-term recommendations for marketing, production, research and education. Tables show cattle exploitation and offtake by country for 1968 and projected exploitation for 1973. Appendices include: area maps of rainfall, vegetative climatic zones, tribal distribution, stock corridors, main cattle routes, crop adaptation, distribution of breeds, and abattoirs; land area and human/livestock density estimates; bibliography; specific breed characteristics; and the organization articles for the Commission.
- Centre National de Recherches Agronomiques (CNRA) de Bambey, 1971. Cinquantenaire C.N.R.A. 50th anniversary pamphlet, Bambey, Senegal, 1971. Concludes that the integration of livestock and crop production pioneered by Bambey agronomic research center would appear to provide the way of the future to better utilize agricultural by-products and to increase the income of small farmers. (USDA)
- deWilde, J.C., et al., 1967. Experiences with Agricultural Development in Tropical Africa, Vol. 1, The Synthesis, Vol. 2, The Case Studies, (Johns Hopkins Press, Baltimore, 1967). Remains the best overall discussion of the constraints to and opportunities for agricultural development in tropical Africa with case studies drawn from Kenya, Mali, Chad, Upper Volta, Ivory Coast and Tanzania. Of particular interest are indirect comparisons between the government extension services approach in Kenya and Tanzania versus the development society approach in Mali, Chad, Upper Volta and Ivory Coast. Good review of animal traction programs.

- De Young, M. "Some Notes on the Economics of the Beef Industry in the West African Subregion," Agricultural Economic Bulletin for Africa, No. 10, July, 1968, pp. 49-60.
- Ferguson, D.S. and F. Vandermaele, 1976. "Study of Livestock Production in Arid Regions SOLAR - West African Sudano - Sahelian Countries," Feasibility Study for UN Environmental Program, Conference on Desertification, September, 1976.
- Harrison-Church, R.J., 1966. West Africa - A Study of the Environment and of It (6th Edition, London, 1966). Remains a valuable survey of geography and land use for West Africa from Senegambia thru Nigeria. Includes country summaries.
- Heady, Harold F., 1960. Range Management in East Africa. (Kenya Department of Agriculture and East African Agriculture and Forestry Research Organization, Government Printers, Nairobi, Kenya) 125 pp. plus maps.
- Institute of International Agriculture (IIA), 1969. Agricultural Mechanization in Equatorial Africa. (Research Report No. 6, Michigan State University, December 31, 1969). About 600 pp. Review programs, equipment and success factors related to mechanization through improved hand-held equipment, animal and power implements. Includes extensive bibliography.
- IEMVT, 1976. "Projets d'aménagement et d'intervention dans quatre zones de modernisation pastorale au Niger." IEMVT; 1976 (en cours d'élaboration). Report by J. Coulomb and M. Quesnel.
- IBRD/IDA, 1974. Appraisal of Livestock Development Project, Nigeria (Report No. 12f a - UNI, October 9, 1974). A project to establish or improve seven breeding or fattening ranches, to develop a credit scheme and to assist 1,500 herdsman and their families to become established on properly equipped and staffed grazing reserves totaling 1,600 sq. mi. Value of loan, \$21 million. Appraisal mission composed of Messrs. Worker, Tsui, Cockcroft, Blanc, de Smidt and Hopen.
- IBRD/IDA, W.A. Regional Office, 1974. Current Economic Situation and Prospects of Togo (Report No. 458a-TO, Dec., 1974). 40 pp. plus appendices.
- Joyce, S.J. and F. Bendot, 1976. Elements for a Bibliography of the Sahel Drought (Organization for Economic Cooperation and Development (OECD), Paris, 1976). 122 pp. Over 650 items listed.

- Kissinger, H.A., 1976. "Speech - U.S. Proposal for Sahel Development," Dakar, Senegal, May 1, 1976. Proposes an international consortium to undertake a systematic and comprehensive attack on the Sahel's development problems under the auspices of the club des Amis du Sahel.
- Lepissier, H., 1971. General Technical Report on the STRC Joing Campaign (JP13) Against Rinderpest in Central and West Africa, 1961-1969, (OAU/STRC, Lagos, Nigeria, 1971), 201 pp. (LC).
- MacLeod, N.H., 1974. "Use of ERTS Imagery and Other Space Data for Rehabilitation and Development Programs in West Africa." COS PAR Seminar on Space Application of Direct Interest to Developing Countries (San Jose dos Campos, Brazil, June 21, 1974).
- National Academy of Science, National Research Council. Agricultural Research Priorities for Economic Development in Africa, the Abidjan Conference, 1968 (NAS/NRC, Washington, D.C., 1968). Vol I: Report of the Conference. Vol II: Contributed Papers; Soil and Water Management; Crop Production and Protection. Vol III: Contributed Papers; Animal Production and Health; Economics; Farming Systems; Education, Research and Institutions. Report of the conference, principal speakers and 105 contributed papers, some with references. Remains an excellent summary of research priorities, programs and problems all aspects of agricultural development.
- Neville-Rolfe, E., 1969. A Selective Annotated Reading List of Reports and Studies Concerning 40 African Countries During the Period 1960-1969. (Univ. of Oxford, Agric. Econ. Res. Inst., 1969).
- SEAE/IEMVT, 1975. "Manuel sur les pâturages tropicaux et les cultures fourragères (2ème édition)." Ministère de la Coopération - IEMVT: 1975, 235 pp., 157 ref., 21 tab., 15 fig., 8 pl., 28 ph., 6 c.
- SEAE/SEDES, 1975. Recueil Statistique de la Production Animale (Editions du Ministère de la Coopération, 1975). 1,201 pp. Statistical Atlas of animal industry in 24 African countries covered by SEDES studies. Includes all countries of West and Central Africa except Guinea and Guinea Biseau.
- S.C.E.T. Inter., 1973. "Programme d'hydraulique au Sahel, Rép. le Haute-Volta: hydrogéologie, géographie humaine, inventaire des points d'eau, liste programme avec fiches individuelles." Paris, 1973, 3 t: 210 pp., 132 pp., 308 pp. Cartes de pâturages, ressources hydrauliques, zones pastorales, andodromes, programme: 12 coup. a 1/2000 000.
- Stryker, J.D., 1975. "The Marketing of Malian Cattle," Tufts University, October 15, 1975, mimeo, 30 pp. Reviews existing data on the marketing of cattle from Mali based upon secondary data and the author's visit to Mali in 1973 as part of an AID project identification team.

- Uganda, Ministry of Animal Industry, Game and Fisheries, Report of the Committee on the Marketing of Livestock, Meat, Fish and Their Products in Uganda (Entebbe, 1969). Contains detailed analysis of the reasons for the failure of an export oriented abattoir constructed at a cost of \$7 million. The abattoir never was opened.
- U.S. Geological Survey, 1975. Applications of ERTS Products in Range and Water Management Problems, Sahelian Zone, Mali, Upper Volta and Niger, Washington, D.C., 1975. Possibly the best example of the uses of ERTS in interpreting natural formations, surface and sub-surface water resources, extent of deforestation around villages and the like in the Sahel. Six representative frames in the three target countries with interpretive overlays and discussion. (AID/W)
- Vandermaele, F.P., 1976. "Rationalizing Animal Production: Utilization of Humanly Non-Edible Feed Stuffs," UNDP, 1976, mimeo., 13 pp.
- Warren, A. and J.K. Maizels, 1976. Ecological Change and Desertification. (Univ. College, London, 1976) (Draft). Discussion paper for UNEP Conference on Desertification in Arid Zones.
- Weber, F.R., 1976. "The Role of Forests in Sahelian Rehabilitation Efforts." Report to USAID on CILSS/UNSO/FAO Consultation, April 20 - May 1, Dakar, Senegal, 1976.
- Wills, J.B., 1960. "Contributions to a Bibliography of Animal Husbandry in West Africa," Ghana Journal of Agricultural Science (2), 127-141, 1969. Annotated bibliography containing 115 items related to cattle, sheep, goat and poultry husbandry. Categories include general animal husbandry, animal nutrition, grassland husbandry and grazing, and animal health (including Trypanosomiasis).