

# LIVESTOCK PRODUCTION AND MARKETING IN THE ENTENTE STATES OF WEST AFRICA: SUMMARY REPORT



**Kenneth H. Shapiro, ed.**

Submitted by  
CENTER FOR RESEARCH ON ECONOMIC DEVELOPMENT UNIVERSITY OF MICHIGAN

Financed by  
UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

March 1979

PN-AAJ-217

**LIVESTOCK PRODUCTION AND MARKETING  
IN THE ENTENTE STATES OF WEST AFRICA:  
SUMMARY REPORT**

**Kenneth H. Shapiro, ed.**

**Center for Research on Economic Development  
University of Michigan**

**United States Agency for International Development  
Contract No. AID/afr-c-1169**

## FOREWORD

In response to the Sahelian drought of the early 1970s, the U.S. Agency for International Development stood ready to offer significant funding for a variety of development programs. However, by early 1975 several individuals at AID concluded that in at least one critical sphere, livestock development, there was insufficient information on the very types of programs most often proposed for funding. For example, mixed livestock/crop farming was put forth as a key element of the so-called stratification strategy, but there had never been a full-cycle farm management study in any of the areas under consideration. Similarly, while regulation and even replacement of the private livestock trade was actively discussed, there had been no detailed study of market structure, conduct, and performance.

To help fill these knowledge gaps, USAID commissioned the University of Michigan's Center for Research on Economic Development to carry out four field studies of livestock production and marketing, and to undertake a review of the literature and available data. That work resulted in four monographs reporting on the field research, six working papers, and the present volume. This volume presents summaries of the four monographs as well as an overview drawing on the literature and the six working papers.

A project such as this, extending over three years and covering several African countries, obviously requires the assistance of many individuals. In Africa the work was facilitated by numerous government agencies and officials listed in detail in the four research monographs. At USAID the project was coordinated by the Bureau of Africa's Office of Development Resources where Princeton Lyman, John Blumgart, and Jim Graham were all very helpful.

At the Center for Research on Economic Development administrative and analytical support were forthcoming from many individuals. Judy Brooks played a critical role in initial organization of the African field research and in developing accounting and administrative procedures. As work progressed Aimee Ergas and then Beth Fredrickson assumed administrative responsibilities. In addition Ergas compiled the annotated bibliography found in this volume while Fredrickson undertook most of the editing of the project output. The skill, patience, and good humor of these three

individuals were invaluable to the successful completion of such a large, multifaceted project. A great deal of assistance was also forthcoming from the CRED support staff including Sherry Cogswell, Jane McCormick, and Jayne Owen.

Also at CRED Robert Pogson had a major role in early development of the project. Elliot Berg's considerable experience in West Africa helped shape the general focus of the study. He, Robert Pogson, and Charles Steedman shared some of the burdens of directing the early phases of the project and helped guide the work along appropriate paths. Theirs was a major contribution to both substance and administration. Donald Ferguson also played an important role in the early phases of the project. Edgar Ariza-Niño, Richard Porter, and Henri Josserand provided critical reviews of various aspects of the study.

The formidable tasks of organizing vast quantities of data into computer files and overseeing a wide range of computer work were handled with great skill by Blair Davies. Much of the statistical analysis was facilitated by graduate student research assistants including Bijan Amini, Harry Broadman, Richard Braudo, Sung Jin Chung, David Fasenfest, and Alan Pitts.

The full set of documents resulting from this study is as follows:

- K. Shapiro, ed., Livestock Production and Marketing in the Entente States of West Africa: Summary Report. (This volume contains an overview by Shapiro plus separate summaries of each author's monograph.)
- A. Ergas, ed., Livestock Production and Marketing in the Entente States of West Africa: Annotated Bibliography. (Included as part of the summary report.)

MONOGRAPHS:

- Delgado, C., Livestock versus Foodgrain Production in Southeast Upper Volta: A Resource Allocation Analysis.
- Staatz, J., The Economics of Cattle and Meat Marketing in Ivory Coast.
- Eddy, E., Labor and Land Use on Mixed Farms in the Pastoral Zone of Niger.
- Herman, L., The Livestock and Meat Marketing System in Upper Volta: An Evaluation of Economic Efficiency.

WORKING PAPERS:

- 1. Ferguson, D., A Conceptual Framework for the Evaluation of Livestock Production Development Projects and Programs in Sub-Saharan West Africa.



2. Wardle, C., Promoting Cattle Fattening Amongst Peasants in Niger.
3. Swift, J., West African Pastoral Production Systems.
4. Sleeper, J., An Economic Analysis of the Role of Ox-Plowing and Cattle-Feeding in the Stratification of West African Livestock Production.
5. DeBoer, A. J., The Short Run and Long Run Position of Australian Beef Supplies and the Competitiveness of Australian Beef in International Trade.
6. Porter, R., The Uses of Economic Models in Analysis of the Cattle Sector.

These documents are available from the United States Agency for International Development, Bureau for Africa, Office of Development Resources (AFR/DR), New State Department Building, Washington, D.C. Some may be available from the Center for Research on Economic Development. The monographs and the summary report are also available in French.

Ann Arbor, Michigan  
March, 1979

Kenneth Shapiro  
Project Director

SUMMARY REPORT

TABLE OF CONTENTS

		<u>Page</u>
FOREWORD		
<u>Chapter</u>		
1	THE LIVESTOCK ECONOMIES OF WEST AFRICA: AN OVERVIEW by Kenneth H. Shapiro . . . . .	4
2	AN INVESTIGATION OF THE LACK OF MIXED FARMING IN THE WEST AFRICAN SAVANNAH: A FARMING SYSTEMS APPROACH by Christopher L. Delgado . . . . .	70
3	THE ECONOMICS OF CATTLE AND MEAT MARKETING IN IVORY COAST A SUMMARY by John Staatz . . . . .	144
4	THE LIVESTOCK AND MEAT MARKETING SYSTEM IN UPPER VOLTA: SUMMARY OF AN EVALUATION OF ECONOMIC EFFICIENCY by Larry Herman . . . . .	232
5	PROSPECTS FOR THE DEVELOPMENT OF CATTLE PRODUCTION ON MIXED FARMS IN THE PASTORAL ZONE OF NIGER: A SUMMARY by Edward D. Eddy, III . . . . .	328
6	LIVESTOCK PRODUCTION AND MARKETING IN THE ENTENTE STATES OF WEST AFRICA: ANNOTATED BIBLIOGRAPHY by Aimée Ergas . . . . .	438

CHAPTER 1

THE LIVESTOCK ECONOMIES OF CENTRAL WEST AFRICA:  
AN OVERVIEW

by Kenneth H. Shapiro

TABLE OF CONTENTS

	<u>Page</u>
<u>LIST OF TABLES</u> . . . . .	3
<u>THE SETTING</u>	4
The Geographic Focus . . . . .	5
The Place of Livestock in West African Economies . . . . .	7
The Place of Animal Products in West African Diets . . . . .	7
Location of Production and Consumption . . . . .	10
Location of Production . . . . .	10
Location of Consumption . . . . .	10
Overview of Livestock Production . . . . .	11
Herd Composition . . . . .	11
Offtake . . . . .	12
Transhumance . . . . .	12
Herd Dynamics . . . . .	14
Overview of Livestock Marketing . . . . .	16
Organization of the Trade . . . . .	16
Transportation . . . . .	18
<u>DEVELOPMENT ISSUES</u>	19
Stratification of Animal Production . . . . .	20
Herd Composition . . . . .	21
Price Structure . . . . .	22
Raising Cattle from Age Two to Six . . . . .	24
Fattening . . . . .	28
Size of the Beef Market . . . . .	30
Market Flexibility . . . . .	31
The Role of Livestock in Pastoral Societies . . . . .	31
Production of Animal Products . . . . .	32
Contributions to Crop Production . . . . .	36
Financial Services . . . . .	42
Culture Maintenance . . . . .	44
Market Performance . . . . .	49
Functions of Landlords . . . . .	49
Landlords' Revenues . . . . .	52
Competition among Landlords . . . . .	54
Competition among Butchers and Traders . . . . .	55

	<u>Page</u>
Demand for Sahelian Beef . . . . .	55
Consumer Behavior . . . . .	56
Non-African Competition . . . . .	57
<u>SUMMARY</u> . . . . .	60
<u>LIST OF REFERENCES</u> . . . . .	62

CHAPTER 1 - LIST OF TABLES

<u>Table</u>		<u>Page</u>
1	Climatic Zones of Tropical West Africa . . . . .	6
2	The Place of Livestock in Sahelian Economies . . . . .	8
3	Herd Dynamics . . . . .	15
4.	Labor Inputs in Tropical Savanna Crops with Hoe Cultivation and Ox-Plough Cultivation . . . . .	27

## CHAPTER 1

### THE LIVESTOCK ECONOMIES OF CENTRAL WEST AFRICA AN OVERVIEW

by

Kenneth H. Shapiro

This introductory chapter presents a broad view of livestock production and marketing in the central portion of sub-Saharan West Africa. In so doing, this chapter is intended to highlight key development issues for the livestock sector and also to provide a general framework for the more detailed analyses of specific topics contained in Chapters Two through Five. Those chapters are based on four full-year field studies which are reported more fully in separate monographs. This introduction draws on those four studies as well as reviews of the literature and analysis of secondary data, much of which is also reported in separate working papers.

The first section of the chapter presents the setting of this research by delineating the geographic area studied, analyzing the importance of livestock to the national economies, and introducing the major features of the livestock economy. The main body of the chapter then focuses on the following four broad issues that are of major importance for development of the livestock sector: 1) stratification of animal production; 2) the role of livestock in pastoral societies; 3) the efficiency of livestock markets; and 4) the demand for Sahelian beef.

#### THE SETTING

The livestock sector in West Africa, as compared to livestock in many other parts of the world, is distinguished by strong international linkages in production and in marketing, by significant contributions to national economies, and by extreme vulnerability to the vicissitudes of weather. These distinguishing characteristics are brought out below in a discussion of the geographic and economic setting within which the subsequent analysis should be viewed.

## The Geographic Focus

The West African countries between the Mauritania-Liberia axis in the west and Chad-Cameroon in the east contain over 800 million hectares and cover climatic zones ranging from very high-rainfall forests in the south to minimal-rainfall Sahelian and desert regions in the north (see Table 1). The wetter southern zones are important crop-producing areas but, because of trypanosomiasis and tick-borne diseases, there is little livestock production. In contrast, livestock assume a much greater importance in the drier, tsetse-free northern zones where crop production is difficult and much of the land is best suited to grazing.

The southern areas, however, have higher incomes and account for the majority of West African meat consumption. Thus there is a major international trade in livestock. In addition, the seasonal northward advance and subsequent retreat of the rains leads herdsmen to cross and recross national boundaries in the search for good pastures. Therefore, because of trade flows and herd movements one must focus on a large, multi-country region to investigate the livestock economies of the area.

The primary focus of this study is the group of five member nations of the Conseil de l'Entente: Benin, Ivory Coast, Niger, Togo, Upper Volta. Within that group, most work (including four field studies) was devoted to the major producing nations, Niger and Upper Volta, and the major consuming nation, Ivory Coast. The study area also extends beyond the Entente States to include Mali, which is a major livestock supplier of the Ivory Coast; Nigeria, which is a major customer of Niger; and, to a lesser extent, Ghana, which has been a major customer for Upper Volta. This group of Entente States and its neighbors accounts for more than two-thirds of the West African cattle herd and more than two-thirds of beef consumption.

TABLE 1  
CLIMATIC ZONES OF TROPICAL WEST AFRICA<sup>a</sup>

<u>Zones</u>	<u>Rainfall (mm)</u>	<u>Percent of Total Area</u>
Forest & Forest Savannah	1,750 and above	12%
Guinsan	1,000 - 1,750	18
Sudanian	600 - 1,000	17
Sahel	250 - 600	20
Sub-Sahara	200 - 250	11
Sahara	200 and less	22

SOURCE: Adapted from Klaus Meyn, "A Proposed Livestock Development Strategy for West Africa," Washington, D.C.: World Bank, October 1977.

<sup>a</sup>The countries included are Cameroon, Chad, Benin, Equatorial Guinea, Gambia, Ghana, Guinea, Guinea Bissau, Ivory Coast, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo, Upper Volta.



### The Place of Livestock in West African Economies

As is true in most developing nations, agriculture in West Africa makes a major contribution to gross national product, foreign exchange earnings, and tax revenues. What is unusual in this area is that in five nations the livestock sector is of major importance. As shown in Table 2, for selected years between 1971 and 1975 livestock contributed about 10 percent or more of gross domestic product in the five surplus livestock-producing nations -- Chad, Mali, Mauritania, Niger, Upper Volta. Livestock's contribution was as high as 31 percent in Mali in 1972. For all five countries the contribution was higher before the drought than after it.

The livestock sector is also a major contributor to foreign exchange earnings in four of the five countries. (Mauritania's iron exports make livestock's relative contribution much less important.) In Upper Volta livestock accounted for more than half the value of exports in 1968 and was still as high as 40 percent in 1975 after the drought. Finally, livestock make a significant contribution to the national budgets. In Mali and Upper Volta about 10 percent of predrought tax revenues came from livestock but only 2 to 3 percent of budget expenditures were allocated to livestock.<sup>1</sup>

### The Place of Animal Products in West African Diets

As is true throughout the developing world, animal products play a relatively minor role in most West African diets. In 1974 all animal products provided about 15 percent of the total 50 grams of daily per capita protein intake in the eighteen West African countries under consideration. This may be compared to about 18 percent of the average 52-

---

<sup>1</sup>As a result of the drought both nations suspended the tax on live animals owned by residents and this loss of revenue was made up by grants from the Fonds Europeen de Développement (FED).

TABLE 2

THE PLACE OF LIVESTOCK IN SAHELIAN ECONOMIES

	Gross Domestic Product Livestock as % of Total		Recorded Exports Livestock as % of Total		Tax Revenues Percent from Livestock	Budget Expenditures Percent to Livestock Sector	
Chad	17.6 <sup>a/</sup> (1971)	11.9 <sup>a/</sup> (1975)	17.6 <sup>c/</sup> (1972)	19.9 <sup>c/</sup> (1974)			
Mali	17.0 <sup>a/</sup> (1972)	15.8 <sup>a/</sup> (1975)	25.9 <sup>c/</sup> (1972)	19.6 <sup>c/</sup> (1974)	7.0 <sup>a, f/</sup> (1972)	3.0 <sup>a/</sup> (1972)	3.1 <sup>a/</sup> (1974)
Mauritania	25.8 <sup>b/</sup> (1971)	14.9 <sup>b/</sup> (1973)	3.3 <sup>b, d/</sup> (1972)				
Niger	18.5 <sup>a/</sup> (1971)	11.4 <sup>a/</sup> (1975)	16.0 <sup>c/</sup> [22.3] (1972)	10.1 <sup>c/</sup> 21.0 (1975)	10.0 <sup>a, f/</sup> (1969/70)	2.0 <sup>a/</sup> (1969/70)	2.2 <sup>a/</sup> (1974/75)
Upper Volta	10.5 <sup>a/</sup> (1972)	6.0 <sup>a/</sup> (1976)	54.5 <sup>c/</sup> (1968)	40.1 <sup>c/</sup> (1975)			

SOURCES: a/ World Bank working documents

b/ Elliot Berg (1975). "Recent Economic Evolution of the Sahel," Ann Arbor: Center for Research on Economic Development.

c/ United Nations. Yearbook of International Trade Statistics. (Sum of categories 001 + 01 + 21 - 61 11 divided by "all commodity" exports.)

d/ Live animals only.

e/ W. Beazer and D. Stryker. "Financing Recurrent Government Expenditures for Livestock Development in Mali," Report to the Government of Mali, USAID Contract No. 688-203-1.

f/ Tax revenues from the livestock sector dropped sharply after 1973 when direct taxes on animals owned were suspended. However, this revenue loss was compensated by grants from the European Development Fund.

gram total for all developing Africa and 21 percent of the 54-gram total for all developing nations (UN, FAO, 1977).

The West African averages above are somewhat misleading because the large population and consumption of Nigeria strongly pull down the figures. In Nigeria animal products contribute only 9 1/2 percent of all protein and the total is 46.3 grams. In contrast, daily protein intake in Ivory Coast, Ghana, Senegal, and Mauritania is above the average.

By far the two most important types of animal products are meat and offals (3.6 grams of protein per day in 1974) and fish and seafood (2.7 grams) which together account for 84 percent of all animal protein intake. The remainder is from milk and eggs. This varies from area to area within West Africa. In the north among Sahelian pastoralists milk is the most important animal product.

Within the broad category of meat and offals, beef is by far the most important item. For example, the 1972-74 average figures for Ivory Coast show that about 60 percent of all meat and offals consumed is from cattle, while no other species provides more than 15 percent. In Nigeria 3.3 kilograms of beef and cattle offals are consumed per capita each year, and no other species provides more than 2 kilograms. This breakdown also varies by location. Beef is by far the most important item in urban areas, but this is not generally true in rural areas. Furthermore, since rural areas are likely to be under-reported in these statistics, small stock are probably more important than indicated.

The impact of good rains in the 1960s followed by drought in the early 1970s is revealed by an increased intake of all protein and of animal protein between 1961/63 and 1968, but then a decline in both between 1968 and 1974. The decline in animal protein was somewhat mitigated by the rise in fish and seafood consumption. Protein intake from all meat and offals rose from 4.2 to 4.5 grams per capita per day between 1961/63 and 1968, but then fell by 20 percent to 3.6 grams. In contrast, protein intake from fish and seafood remained at 2.2 grams between 1961/63 and 1968 but then rose by 27 percent to 2.7 grams in 1974. Thus the 1972/74 FAO estimates show yearly consumption of almost 800,000 kilograms of fish and seafood, and almost 1,200,000 kilograms of meat

and offals of which about 540,000 kilograms are from cattle.

### Location of Production and Consumption

The sharp climatic differences between the Sahel and the West African coast, as well as considerable international differences in wealth, give rise to production being concentrated in the relatively poor, dry Sahelian regions and consumption being concentrated in the richer, wetter coastal regions.

Location of Production. -- There are approximately 30 million head of cattle in West Africa. About one-third are in the Sahelian zone, a little over one-half are in the Sudanian zone, and about one-tenth are in the Guinean zone. With regard to seasonal movement, there is a similar breakdown. About one-third of the animals are involved in long transhumance, a little more than one-half are involved in short transhumance, and about one-tenth are under sedentary production systems (SEDES, 1975). The match between location and movement is indicative of the types of production in each zone.

Nigeria has the largest cattle herd, with over 8 million head. Mali is next with over 5 million, followed by Niger and Chad with 3 to 4 million. Upper Volta, Cameroon, Senegal, and Mauritania have 2 to 3 million, while the coastal countries (except Nigeria and Senegal) each have less than 1 million.

Location of Consumption. -- The five surplus meat producers, Mali, Mauritania, Upper Volta, Niger, and Chad, account for about one-fourth of West African meat consumption while the ten deficit countries account for the remaining three-fourths. In 1970, the largest consumer was Nigeria with about 40 percent, followed by Mali with about 10 percent, and then Senegal, Cameroon, Ivory Coast, and Niger, each with 6 to 7 percent, and the other countries with smaller portions (SEDES, 1975). The distribution of beef consumption alone is very similar to that for all meat, with the surplus nations accounting for one-fourth and with Nigeria accounting

for 40 percent. In contrast to consuming 25 percent of the beef, the five surplus nations provide over 50 percent of the slaughter cattle. This difference in location of production and consumption is the basis of the important long distance livestock trade.

### Overview of Livestock Production

Livestock production in West Africa follows predominantly traditional patterns, with the major modern innovation being in the field of animal health. Herds are maintained largely for milk production and thus are predominantly female, with most males sold by the age of two or three. The extent to which there remain excessive older males is a subject of debate. Approximately 11 to 13 percent of the herd is sold each year, and net annual herd growth is probably around 2 to 3 percent in normal times. A major production management tool is herd movement to obtain water, grazing, and mineral salts. These aspects of production are discussed below.

Herd Composition. -- The age/sex composition of a herd is a major determinant of animal sales, milk production, herd growth, and resistance to drought. In addition, information about herd composition provides insights into the economic and social strategies of pastoralists. Surveys prior to the 1972-73 drought reveal that females accounted for between 60 and 75 percent of the herds in the Sahelian Zone [Coulomb et al., 1971, Coulomb et al., 1972]. The percentage of females rose as a result of the drought partly because most males were very young (less than two years of age), and young animals suffered most in the drought. Also, as herders sold more of their animals in an effort to buy increasingly high priced grain, a greater percentage of males than females probably were sold. Thus five large postdrought surveys show 67, 73, 78, 80, and 81 percent of the animals as female, respectively. Meyn (1977) reports on seven post-drought surveys showing 70 to 86 percent females in the herds.

Among animals over two years of age, the percentage of females is much higher since many young males have already been sold or slaughtered

by the pastoralists. In four postdrought surveys the percentages of males and females, respectively, who were beyond their second birthday were 13/72, 18/64, 15/69, and 18/53. The corresponding figures for animals over three years in the surveys cited by Meyn are 5/56, 8/45, 10/44, 5/79, 12/34, 6/39, and 14/44.

Offtake. -- The number of animals sold and slaughtered each year as a percentage of total herd size is one measure of herd productivity and a possible indication of the scope for increasing productivity. There seems to be a general consensus that just prior to the drought, offtake rates in West African Zebu herds were between 11 and 13 percent [SEDES, 1975; Robinet, 1972; USAID, 1975].<sup>1</sup> The FAO Production Yearbook shows an average 1976 (postdrought) rate of 10.5 percent for the five surplus cattle-producing nations. This may be compared with 1976 rates of 11.3 for all developing Africa, 6.1 for Asia, 15.6 for Latin America, and 30.4 for Australia. While the West African rates are low compared to a modern, extensive system such as Australia's, there is no expectation of significant increase in the foreseeable future.

Some have argued that offtake rose to the 11 to 13 percent level from only 7 percent in the early 1950s as herders responded to price incentives [USAID, 1975, p. D -34]. However, a consistency check of sales data, herd growth rates, and offtake rates indicates that offtake rates probably changed very little between the early 1950s and late 1960s [Shapiro, 1976].

Transhumance. -- In addition to the rate and composition of offtake, the most important management decisions probably relate to providing inputs for the animals. In many areas this involves herd movement. The major objectives of such movement are obtaining feed, obtaining water,

---

<sup>1</sup>Offtake rates for sheep and goats are estimated at 25 to 35 percent [SEDES, 1975 p. XIX].

obtaining mineral salts, avoiding damage to cultivated fields, having access to markets and employment, and reuniting with other groups for social purposes. As mentioned above, SEDES (1975) estimates that about one-third of West African cattle are involved in long transhumance, one-half in short transhumance, and one-tenth are sedentary. Examples of a long and short transhumance are discussed below.

Marianne Rupp (1975) provides a good description of a relatively long transhumance undertaken by some of the Peul based in the Dilly grazing area of Mali's Nara cercle. The entire circuit is about 130 miles, roughly half to the north of the town of Nara during the rainy season and half to the south in the dry season.

The northern movement is primarily to allow the animals to graze in pastures with a high salt content. The herds leave Nara at the start of the rains or at sowing time and move slowly northward toward Nema in Mauritania. After a stay of one to two months, by which time the water pools start drying up, the herds return south fairly quickly.

Following only a brief stay in the home village, the herds continue on south to Banambi, Kolokani and the Baoulé river. This movement is motivated by the need for water and secondarily for grazing lands. Also, at these southern locations the Peul can find employment and markets to sell dairy and craft products and buy grain. Because of these latter opportunities many entire families make the southern trip, in contrast with the northern trip which is made only by a few young male herders.

The Tuareg Imrad Ikoubaraden described by Barral (1967) engage in a series of shorter but more complex movements that are partly determined by the cropping cycle. These Tuareg spend the dry season (December to May) near the wells at Tin Saman in the extreme northeast of Upper Volta, just north of Markoye. When the first rains start in May they move about 15 kilometers south toward Dembam to take advantage of small lakes there. At the end of June<sup>1</sup> they move about 20 kilometers north by

---

<sup>1</sup>The original paper says July, but as the rest of the discussion indicated, this must be a typographic error.

northwest to Zeiné Tondia, where they plant millet.

When the planting is finished they move northwest about 15 kilometers to Tadambés on the Béli river where there is good salt pasture.<sup>1</sup> After half a month, by the start of August, they return to Zenié Tondia to weed the millet and then return about 25 kilometers northwest to In Fagagan, which is also on the Béli and has good salt pasture. In October the Tuareg again move south to Zenié Tondia to harvest the millet. This is at the start of the next dry season, and then they move about 10 kilometers west to the wells at Tin Saman. In contrast with some other groups, the entire family participates in these movements.

Other good descriptions of herd management via movement may be found in Dupire, (1962, a, pp. 62-82) for the Wodaabe Fulani of Niger, and in Van Raay (1975, pp. 106-129) for two Fulani groups in northern Nigeria.

Herd Dynamics. -- The rates of herd growth, fertility and mortality vary over different geographic regions, production systems, and time periods. However, it is possible to draw a very general picture of these factors, especially if one focuses on the predrought period.

Table 3 summarizes data on these technical coefficients from several studies, most of which precede the drought. There seems to be rather close agreement among the studies. The number of live births as a percentage of breeding females is between 60 and 65 percent; first calving usually occurs between the fourth and fifth birthday. Herds were increasing at about 3.0 percent per year. Mortality is very high during the first year (30 to 40 percent) but improves markedly in the second year and more so thereafter.

---

<sup>1</sup>The so-called "salt cure" is taken during the wet season by most groups. Dupire (1962, a, p. 69) notes that cattle cannot assimilate much salt in the dry season, and that the salt pastures need sufficient rainfall before they will provide animals with the needed salts.



TABLE 3  
HERD DYNAMICS

	Sahel Zebu Average, 1970 <sup>a</sup>	Peul of the Niger Delta, Mopti Region of Mali, 1971-1972 <sup>b</sup>	Peul of Seno, Mopti Region Mali, 1971-1972 <sup>b</sup>	Tuareg, Mopti Region, Mali, 1971-1972 <sup>b</sup>	Peul, Niger Pastoral Zone, 1970-1971 <sup>c</sup>	Tuareg, Niger Pastoral Zone, 1970-1971 <sup>c</sup>	Sedentary, Niger Pastoral Zone, 1970-1971 <sup>c</sup>	Sahelian Zebu Herds, Mali, 1971-1972 <sup>d</sup>	L'Ader Douchi-Majya, Niger, 1968 <sup>e</sup>	Sahel Average, 1977 <sup>f</sup>	Sahel ORD, Upper Volta, 1976 <sup>g</sup>	Sahel Zebu Average, 1965 <sup>h</sup>
Fecundity Rate (X) (live-births/breeding females)	60-65	60-65	60-65	57-63	61	60	60	28-42	40-60	50	66	
Age at First Calving (yrs.)	3½ - 4	3½ - 4	4 - 4½	4 - 5	4	5	4	4 - 5	5-6			
Rate of Herd Growth (X)	3			3	4.5		3		3	0	3	
Mortality Rate at age 0-1; Male (X)	37.6	17.8	40.4	34.9	40.0	31.5	30	23-48	35-40	30-40		
Mortality Rate at age 0-1; Female (X)	33.2	19.5	40.5	30.0	40.0	31.5	30		35-40	30-40		
Mortality Rate at age 1-2; Male (X)	5.3	6.0	10.5	12.1	14.9		4.9		5-10			
Mortality Rate at age 1-2; Female (X)	5.3	6.0	10.5	10.1	14.9		4.9		5-10			
Mortality Rate at age 2-3				5.0	10.0		4.9		5			
Mortality Rate at age 3-4				5.0	7.9		2	6 - 8	2 - 5			
Mortality Rate at age 4-5				2.0	10.0		2	6 - 8	2			
Mortality Rate at age 5+				2.0	8.0		2	6 - 8	2			

<sup>a</sup> SEDES, 1975, p. xx

<sup>b</sup> Coulomb, J., et. al., 1972, pp. 96-115

<sup>c</sup> Coulomb, J., et. al., 1971, pp. 88-154

<sup>d</sup> Lacroux, M., J. Samiguet, and J. Tyc., 1965, pp. 23-30. These are theoretical figures that yield a herd structure similar to that observed.

<sup>e</sup> Bonte, P., 1968, p. 27

<sup>f</sup> Meyn, K., 1977. Annex 2, p. 6.

<sup>g</sup> Peretti, M., 1976, Tome I, pp. 11-20. Mortality figures were not observed but were taken from SEDES.

<sup>h</sup> SEDES, 1969, pp. 4, 11.

## Overview of Livestock Marketing

Livestock marketing in West Africa shares many of the characteristics of staple food marketing described by Jones (1972) and others, but also has several unique features. Because a live product is being handled, there is a great deal of variability and risk as to the state of the animal at the end of the marketing chain. Depending on the duration and conditions of transit, the animal may gain or lose weight, may fall ill, or may die. Dealing with a live animal calls for considerable expertise by marketing agents. Long distance traders must be able to judge whether an animal can stand the rigors of a long trip. Traders and butchers must be able to estimate the carcass and offal yields of each animal. The extremely long distances involved imply long turn-around times for traders' capital, serious potential problems of information flow, and problems of trust and contract enforcement. The international nature of the trade gives rise to problems of currency convertibility and to import and export taxes. Many of these issues are treated in the main body of the chapter. The purpose of this section is to provide general background information for livestock marketing in the area.

Organization of the Trade. -- Animals usually enter the marketing chain when herders sell either to traders in a market or to collectors (coxers) in the "bush" near the herder's home. The bush collector may be working independently or he may be employed by a trader attempting to form a herd for relatively long transit to major consuming centers.

In the small collection markets in pastoral areas the herder is likely to deal through an intermediary (often called a dillali in Hausa) who offers the following services: seeking a buyer, negotiating price, providing sellers with reasonable guarantees of a fair price, providing buyers with a guarantee that the animal is healthy and not stolen. The intermediary also provides hospitality for the seller and may lodge him. In return for these services to both buyer and seller, the intermediary is compensated by a fee paid by the buyer and perhaps with gifts from the seller. The amount of this fee varies from place to place and over

time, but is usually in the range of 200 to 500 CFA F per animal.

A seller generally has a long-term relationship with one intermediary based on a common place of birth or some other relationship. Dupire (1965, pp. 112-113) describes the following extremely close relationship between Bororo Fulani and their intermediaries, a relationship that leads one to doubt that herders face significant risks from cheating by intermediaries in collection markets:

This economic role has social aspects, and the particular relationship which joins the Bororo with their dillalai takes the form of a "social contract." Those to whom the Bororo of the Tahoua region turn belong to the category dillalai-mahautaa or middlemen-butchers... Some of these say they are the descendants of captives who belonged to Fulani or Bororo families now in Niger ...

These dillalai-mahautaa, although they are today free, continue to observe towards the descendants of their former masters certain of the obligations under which their ancestors lay ... Among the Bororo, servile relations have become very much lessened in content and have actually been assimilated into a sort of joking relationship (dendiragal). No motive for disagreement, say the dillalai-mahautaa, can arise between them and "their Bororos."

Animals purchased at collection markets are moved south either to regroupment markets, to export markets, or to terminal (final consumption) markets. At the former two types of markets the animals may be resold and become part of a larger herd destined to move to a terminal market. The major terminal markets are at the capital cities of the Sahelian and coastal West African nations, and in a few other large cities.

At the terminal markets traders generally deal through intermediaries to sell their animals to wholesale butchers. Intermediaries here have a greater hospitality function since traders may have come from a long distance and may stay for a week or more. Cohen (1969) points out that in Ibadan the ownership of houses in which to lodge traders was a prerequisite to becoming an intermediary. The aforementioned services of seeking a buyer, negotiating the price, and guaranteeing the animal are also performed by southern intermediaries. In addition, in some markets they play a critical role in guaranteeing the butcher's repayment of credit extended by the trader. Some butchers buy on credit

and repay after sale of the meat and offals. Intermediaries are resident in the market and hence can evaluate the credit-worthiness of butchers. The traders do not reside there and so lack the needed information.

At terminal markets as at collection markets, the intermediaries' fee is usually paid by the buyer and not by the seller, although the latter may give gifts. Hill (1966) notes that in Kumasi the intermediaries made most of their money not from these fees but from commissions paid by local merchants to whom the intermediary had directed the trader, and by trading and other business enterprises. On the other hand, Cohen (1969) did not find this to be the case in Ibadan.

Wholesale butchers who buy from the traders may also operate as retail butchers or they may specialize and sell all their meat to retail butchers. In major markets slaughtering is done at government abattoirs, the use of which is controlled by licenses and fees. Retail meat sales are often concentrated mainly at stalls rented by licensed retailers from the governmental market authority, although retailers may sell to itinerant peddlars of raw and cooked meat.

Transportation. -- The long distances involved in West African livestock trade call for special consideration of transportation. Animals are moved from the Sahel to major consuming centers by trek, by train, by truck, or by some combination of these. For example, cattle might be trekked from Djibo in northern Upper Volta to Ouagadougou, where they would board the train for Bouaké in Ivory Coast. Depending on market conditions they might then be trucked on to Abidjan. The mode of transport and the manner in which different modes are combined depend on relative costs, general and seasonal availability, and market conditions. Kellogg (1971) illustrates the impact of these factors in Nigeria.

In the two largest cattle importing nations, Nigeria and Ivory Coast, trek and train are the dominant modes, with trucks being used primarily for rapid reactions to short-term price movements. From 1973 to 1976 between 17 and 40 percent of officially recorded cattle imports entered Ivory Coast by rail, the remainder by road (almost all trekked rather than trucked) (Staatz, 1979). Total official imports of cattle

ranged from 112,000 to 224,000 during that time. For the period around 1971 Bishop (1972, pp. 9-10) estimates that about 105,000 head of cattle entered the country on foot and 40,000 by rail. However, 20,000 of the trekked animals subsequently boarded the train in northern Ivory Coast for shipment to Abidjan. Kellogg (1971, p. 30) reports official Nigerian statistics showing that between 39 and 55 percent of cattle moving from northern to southern Nigeria between 1952 and 1964 were carried by rail and the remainder primarily by trek. During that period between 267,000 and 397,000 head of cattle moved from north to south each year.

Annual costs and returns to trading depend in part on how many herds a trader can collect and ship south. This in turn depends in part on distances involved and time on various modes of transit. The bulk of the trade starts from between 13<sup>o</sup> and 16<sup>o</sup> north latitude (central Mali, northern Upper Volta, central Niger) and is shipped to between 5<sup>o</sup> and 8<sup>o</sup> north (Abidjan, Accra, Lagos, Ibadan). Transit routes often cover more than 1,500 kilometers from collection market to final consumption market. It may take from two to four months from initial collection of the export herd in the north to final sale in the south. The principal trade flows are between the following pairs of nations: Niger and Nigeria, Chad and Nigeria, Upper Volta and Ivory Coast, Mali and Ivory Coast, and Mauritania and Senegal. Other exporting and importing nations play smaller roles in the overall trade network.

#### DEVELOPMENT ISSUES

Following the 1972/73 Sahelian drought there were numerous recommendations for a major restructuring of livestock production, and for greater regulation or replacement of traditional marketing agents. In addition there were fears that coastal markets might soon provide sharply lower levels of demand for Sahelian beef. These issues are considered here in brief overviews of the following: 1) the stratification strategy for encouraging specialization in different stages of cattle production according to agro-climate zones; 2) the roles of live-

stock in pastoral societies; 3) the functioning and efficiency of traditional marketing agents; and 4) the long-run demand for beef in coastal markets and prospects of non-African beef supplies to those markets.

### Stratification of Animal Production

While numerous specific programs and policies have been formulated for limited aspects of livestock development, one broad strategy for most components of the sector continues to receive the most attention -- stratification.<sup>1</sup> Under this strategy the different stages of producing marketable beef cattle would be concentrated in those areas having a comparative advantage for a particular stage of production by virtue of climate, vegetation, availability of other inputs, positive externalities, and proximity to transport and to consuming centers. Thus, in general terms the northern zones which are relatively disease-free and have relatively large pastoral populations with high levels of animal husbandry skills would concentrate on the difficult stages of pregnancy, birth, and raising calves to the age of about two.

Areas farther south or located near major northern water sources would concentrate on "growing out" or raising animals from the age of two to about six. In these areas the availability of better pasture and more agricultural by-products (stubbles, gleanings) might lead to faster weight gains, and the greater incidence of disease might be less troublesome for the older animals. Where the possibility exists for integrated crop/animal farming this might increase the benefits of intermediate livestock production. Most of the mature "grown-out" animals would be marketed directly. However, some might be moved to those areas close to large consuming centers or close to transport where there is also a good supply of feedstuffs to fatten the animals prior to final marketing.

---

<sup>1</sup>This serves as a useful point of departure because it raises a number of important questions. However, as will be seen, stratification may be possible only on a limited scale.

Three main benefits are hoped for from this strategy. First, incomes are expected to rise in the northern zones, where more males would be sold at younger ages. Specialization in the cow-calf operation is considered more profitable than retaining mature males in excess of those needed for stud. Also, if herd size were decreased in the process there would be less stress on the range, hence a slowing or avoidance of the progressive ecological deterioration that some believe has been occurring.

Proponents of the strategy also hope that incomes will rise in the intermediate growing-out zone. The growing-out operation might represent a profitable addition to crop farming in that area. Where crop/animal integration is possible with traction and manure, the benefits might even be greater. Finally, stratification is expected to lead to greater supplies of beef at reasonable prices. Thus, consumers are also expected to gain from this strategy.

The eventual realization of these benefits hinges on a number of issues, some of which are discussed here. First, will northern pastoralists opt for this change in their lives? This is addressed to some extent in the subsequent discussion of the role of livestock in pastoral societies. Second, how many "excess" mature animals are there now that would be eliminated through earlier sales? Third, how much would the present price structure have to change to stimulate earlier sales? Fourth, how well do livestock operations fit into farming systems in the intermediate zone? Fifth, how profitable are fattening operations? Sixth, what is the size of the market for fattened beef? And Seventh is the marketing system flexible enough to service the new types of trade implicit in stratification?

Herd Composition. -- As discussed in the first part of this paper, Sahelian pastoralists presently follow a strategy of selling most of their male cattle by the age of two or three. That is, Sahelian herds are basically dairy operations. However, the percentage of mature males in the herds may be somewhat in excess of the 4 to 5 percent considered necessary for breeding. The herd composition surveys referenced in the first part of this chapter indicated that as a very rough average, about

10 percent of the Sahelian cattle herds may be males past their third birthday. If this is taken as the potential breeding stock it indicates an excess of about 5 percent of native males. With the Sahelian herd numbering about 10 million, this means there are approximately 500,000 excess mature males. Restructuring Sahelian cattle raising to focus on cow-calf operations would reduce this demand on range resources and either allow more slack between carrying capacity and herd population, or make it possible to increase the population of cows and calves.

Following the initial disposal of excess native males, a smaller number of three-year-olds would then be available for sale each year. The aforementioned studies show that about 3 to 4 percent of the Sahelian herd are males between their third and fourth birthday, i.e. about 350 000 head. As a rough approximation, we may say that 25 to 40 percent of these animals are presently sold within the year, primarily for final consumption. Some of these sold animals presumably could be bought by farmers who would raise them to the age of six. In addition, the offtake rate could be increased to provide more animals for growing-out without decreasing the number of breeding bulls below minimum requirements. Perhaps as a rough figure, 100,000 Sahelian three-year-olds could be available for growing-out each year. This number may be compared with the total of 500,000 West African work oxen estimated by Sleeper in a working paper under this project. Thus, the addition of animals for growing out could be a relatively sizeable increment in the intermediate zone. However, the flow of six-year-olds coming from the growing-out operations would be relatively small compared to the total of about 3 to 4 million cattle marketed each year in West Africa.

Price Structure. -- Some have argued that the relative prices of young and old animals compared to the cost of retaining animals in the herd are such that Sahelian pastoralists find it most profitable to sell animals at age six. Presumably, sales at younger ages, reflected in the herd composition data cited above, are for immediate needs and do not reflect optimal, long-range planning. Once such pressing needs are covered, the herder will choose to sell at age six rather than two or three. Thus, a change in price structure would be needed to induce increased sales of young cattle.



However, data on cattle prices do not completely support such an argument. Seventeen data sets showing the price and age of cattle sold in Niger, Mali, Chad, Upper Volta, and Ivory Coast were analyzed to learn how rapidly price rose as animals grew older. Many of the data sets indicate that beyond age two or three the sale price rose by less than 20 percent for each year of animal growth. Furthermore, a linear equation was often the best fit, and this indicates a declining percentage increase in price.

These price increases must be compared to the cost a herder faces if he keeps an animal one more year. If alternative uses are available for the money represented by an animal, then the opportunity cost of capital is relevant. This is generally assumed to be 20 to 25 percent in West Africa. However, this probably should be deflated for herders in the northern zone who may not have many alternative investment outlets. Another major cost is mortality which, as shown in Table 3 has been variously estimated at 5 to 10 percent for ages two to three, 2 to 8 percent for ages three and four, 2 to 10 percent for ages four to five, and 2 to 8 percent for animals over five. The third cost is labor for care and feeding. Once an animal is over two there are relatively few health problems in the northern zone, and feeding cost per animal is low in sizable herds. Thus the total cost of keeping an animal one additional year is about a 20 percent (of the animal's value) opportunity cost, a 2 to 10 percent mortality risk, and the cost of labor for feeding and care. The sum of these costs may exceed the return for keeping an animal one more year.

Therefore, while the evidence is not clear cut, as must be expected when considering such a large area with spotty, rough data, it is not obvious that the current price structure provides strong incentive for herders to keep animals to the age of six rather than selling at age two or three. For such an incentive to exist, the return for holding an animal one more year (i.e., the price increase over the year) must be greater than the cost of keeping the animal for that year. It is not clear that this is

the case in the Sahel.<sup>1</sup> Thus, we conclude that a major restructuring of prices is not needed. However, marginal changes may be necessary to tip the balance more toward sales of young animals, and such changes should be forthcoming if demand for young cattle increases in the intermediate growing-out zone. The latter issue is considered in the next section.

Raising Cattle from Age Two to Six. -- The intermediate stage of cattle production, growing-out, would be done primarily by crop farmers in wetter areas with good feed resources. A major question concerning this stage is whether the additional land, labor, and capital that would be devoted to cattle will yield more in that activity than in crop production. If this is true now, then one must question why those farmers have not already undertaken more cattle production. If returns to cattle raising are not now greater than returns to crop raising, then one must investigate the prospects for interventions that would increase the former.

Intermediate cattle enterprises usually take one of two forms in traditional West African crop systems. Either cattle are purchased by farmers and entrusted to nearby Fulani for management, or the farmer keeps the cattle on the farm where he benefits from manure and possibly traction and, if there are females, milk. Delgado's analysis in Chapter Two looks at both alternatives in southeast Upper Volta.

Under the entrusting system farmers incur few costs other than the initial purchase and occasional medical expenses. The Fulani are responsible for all maintenance and feeding. The farmer's benefits are the sale price of his animals and any young born to his females. The Fulani gets full use of the milk. Use of manure goes mainly to the Fulani, but this may be changing.

---

<sup>1</sup>Theoretically the relation between costs and returns for keeping animals an additional year would indicate one age at which sale would maximize profits. Obviously, in the Sahel all animals are not sold at the same age. Different ages of sale arise because some male animals are kept for breeding, some become ill and thereby cost more to keep, some animals gain weight more or less rapidly than average and so will bring more or less than the average return one year later, and prices and costs vary over space and time.

Under this entrusting system Delgado found a 19 percent internal rate of return (IRR) on males purchased at age two and sold at age four.<sup>1</sup> The figure was 21 percent for females purchased at age two and sold at age six. Thus investment in a cattle enterprise offers a return in the neighborhood of the generally cited 20 percent opportunity cost of capital for the area.

Delgado also explores the hypothetical case of cattle kept on the farm. (In his research area all farmers entrusted their cattle to Fulani, so experiment station data were used and costs were extrapolated from Fulani activities.) When the benefits of milk and manure were credited to farmers and the costs of maintenance were debited, Delgado found that males held from age two to four had an 8 percent internal rate of return (lower than in the entrusting system) and females held from two to six had a 21 percent IRR (the same as in the entrusting system). But cattle on the farm have the disadvantage of possibly damaging neighbors' fields and of revealing a farmer's wealth. Thus, farmers probably find the entrusting system superior and in fact no cattle are kept on the farm.

Delgado pursues the question one step further by including benefits of animal traction when animals are kept on the farm. This analysis is done with linear programming and reveals that under very favorable assumptions this degree of crop/animal integration would yield net returns only 3 percent greater than the case where animals are entrusted to neighboring Fulani.

Delgado's results are consistent with a system in equilibrium where farmers have allocated each resource so as to equalize its marginal return in different enterprises. The returns possible from entrusting cattle are about the same as returns on other investments. A shift of resources from present crop farming operations to accommodate cattle integrated into the system will not significantly increase net returns. Thus, under present conditions, farmers in areas similar to Delgado's Southeast Upper Volta research site are unlikely to generate large new demand for two-year-old Sahelian cattle.

---

<sup>1</sup>If males are held to age six the IRR falls to 14 percent.

On the face of it Delgado's results appear contrary to the conventional wisdom about mixed farming and also contrary to implications of experiments at nearby research stations. For example, at the Saria, Upper Volta research station of the Institute de Recherches Agronomiques Tropicales et des Cultures Vivrieres (IRAT), experiments showed a large yield increase in sorghum from application of six tons of manure per hectare and also large increases for an additional six tons, and minor increases for subsequent applications (Dinechin, 1969, p. 284). With regard to ox plowing, Charreau (1974, p. 238) reviews experiments that show significant yield increases of 21 to 157 percent on millet, sorghum, maize, rice and cotton in West Africa. These are said to arise because plowing allows better penetration of water into the soil and also better retention of water at root level. Thus, ox plowing may not only decrease labor requirements on some operations; it may also increase yields.

However, as Delgado's analysis shows, these impacts of manure and traction must be considered within the context of the full farming system. For example, the use of oxen for land preparation may ease a labor bottleneck at that time of the year only to create one during subsequent phases of the crop cycle. The higher yields and larger areas possible with manure and traction imply greater labor requirements during weeding and harvesting. Problems arise when these operations are still done by hand. Ruthenberg (1971, p. 71) presents data shown in Table 4 that demonstrate an aspect of this phenomenon. The Senegal groundnut operation shown in the table has both land preparation and weeding done by ox-drawn implements, with a resultant 40 percent decrease in labor time compared to a complete hand-hoe system. In contrast, the Tanzanian cotton enterprise used oxen only for land preparation, resulting in a greater per-acre labor expenditure for weeding, and a total labor increase of 2 percent over a complete hand-hoe system.

In addition to possible problems of incomplete mechanization, there probably are several reasons why mixed farming in Delgado's research site would not be as profitable as research station results imply. First, population density (40 per square kilometer) is relatively high for such a dry area, hence crop land competes with grazing land; there is so much land under crops that risks of damage by cattle are high. Second,

Table 4 — Labor Inputs in Typical Savanna Crops with  
Hoe Cultivation and Ox-Plough Cultivation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	<u>Hoe cultivation</u>					<u>Ox-plough cultivation</u>	
Crop	Groundnut	Millet	Maize	Maize-sorghum	Cotton	Groundnut	Cotton
Location	Kaolack	n.a.	n.a.	Sukumaland	Sukumaland	Kaolack	Sukumaland
Country	Senegal	Upper Volta	Upper Volta	Tanzania	Tanzania	Senegal	Tanzania
Year	1966	n.a.	n.a.	1963	1963	1965	1963
Land preparation and planting (hours ha <sup>-1</sup> )	169	88	152	390	370	136	120
Weeding (hours ha <sup>-1</sup> )	376	180	252	250	430	110	700
Harvesting and preparation for sale (hours ha <sup>-1</sup> )	210	208	64	300	690	210	700
Total (hours ha <sup>-1</sup> )	755	476	468	940	1490	456	1520

Source: Eutheberg, Hans. Farming Systems in the Tropics, London:  
Oxford University Press, 1971; p. 71

the area does not grow a high value cash crop that might show very good returns to manuring. Third, the grain marketing system is not reliable enough to permit farmers to reduce millet production below subsistence needs and concentrate more on cattle with market purchases of grain. In areas without these and other constraints discussed more fully in Delgado's monograph, there may be a greater potential for increasing the growing-out of cattle.

Fattening. -- According to the stratification strategy, a small portion of mature animals would be fattened before final sale. Christopher Wardle's working paper for this research project provides one of the few analyses of fattening operations by West African peasants. Wardle served as technical assistant on a project at Liboré near Niamey in Niger funded by Euro Acord and under direction of the Livestock Department of the Nigerian Ministry of Rural Economy. The project provided credit for cattle purchases and some technical advice. While fattening operations are likely to vary considerably across West Africa according to resource endowments, the Liboré project is instructive because it demonstrates that peasants can profitably fatten cattle in at least some circumstances.

Liboré appears to possess a number of preconditions that bode well for the success of fattening programs. It is only 15 kilometers from Niamey, a major consuming center. The Niger river flows along one edge of the canton of Liboré and provides a good source of forage. An irrigated rice scheme provides agricultural by-products, and a few farmers have already been engaged in fattening.

The main constraint was capital to purchase cattle. The project provided 36,000 CFA F to buy one animal and 4,000 for feedstuffs and medicine. Loan applicants were screened by village chiefs, and each village as a whole was responsible for the borrower's repayments. In the first two years a total of 34,268,000 CFA F was loaned for the purchase of 857 cattle by 591 different farmers.

Participants were required to buy healthy male animals of at least 200 kg, but each farmer was responsible for choosing his own animal and so was responsible for the animals' performance. The option of having the project choose the animal was rejected because if the animal

did not perform well, the farmer could argue that he was not to blame and did not have to repay the loan. In the first year 99.92 percent of the money loaned out had been repaid.

Cattle were fattened for a minimum of three months. This minimum period was stipulated in the contract to ensure proper finishing of the animals and to avoid having peasants sell the animal quickly and then use the money for other purposes. The maximum fattening period was six months, when the loan had to be repaid. The feeding regime varies seasonally. Grass from between millet rows was fed from September to December, Bourgou grass from the edges of the Niger River from December to March, grass from between irrigated rice plots between March and June, and a variety of forage after the rains returned in May/June. Agricultural by-products were also fed: millet bran produced locally by village women; rice bran and cotton seed from nearby mills. Throughout the fattening period the farmers were visited by encadreurs, who offered technical advice.

Performance was satisfactory. Daily weight gains averaged 603, 470, 696 and 475 grams per day for four different groups fattening animals in different seasons. The lowest figure was for animals fattened in the dry season. The next lowest reflects an unsuccessful effort to use an inferior hay. The average net profit from farmers in those four groups was 9465, 9762, 13640 and 9797 CFA F respectively. High profits for the third group may be misleading, because this group was composed of farmers especially selected for good performance in the first period because the project wanted to test the feasibility of fattening in the rainy season. The equivalence of profits for groups one and two in spite of large weight gain differences reflects the increase of price in the dry season to offset the decline in availability of feedstuffs.

The above profit figures are net of all cash costs and 5 to 8 percent interest, but not net of family labor costs. Wardle's rough estimate of labor requirements indicate a daily return of 362 CFA F per man day, which is superior to returns he cites for crop activities examined by other researchers. Thus, it appears that cattle fattening by peasants is a profitable activity under the conditions at Liboré. Furthermore, Wardle

indicates several steps that could be taken to improve the availability of feedstuffs, which should improve profitability still further.

Wardle does raise two cautionary issues. First, loans have been staggered over the year rather than dispersed in one period in order to avoid glutting the market. Evidently the Niamey market for fattened cattle is not very large. Second, experience showed that animals over four years of age had more health problems, took longer to settle in, and had lower weight gains than younger animals. In the second year, few farmers bought animals over four. This has implications for the stratification strategy in which animals are "grown-out" until age six and then sold for consumption or further fattening. Under certain conditions, growing-out and fattening may prove to be mutually exclusive. However, this is far from a firm conclusion, because a six-year-old animal that has spent four years on a farm pulling a plow is much different from one that has always been in a Fulani herd.

Size of the Beef Market. -- The stratification strategy implicitly assumes a large and growing market for Sahelian beef sufficient to offer good prices for increased flows of cattle. A subsequent section addresses in detail the nature of demand for beef and competition for the Sahel from non-African exporters. However, it is worth noting here a few aspects directly relevant to stratification. Operations for "growing out" and for fattening animals will produce higher quality beef than is available from range-fed pastoral animals. Animals from the former two operations will yield tender, fatter beef.

Staatz's study in Ivory Coast reveals that there is some consumer preference for fatter beef. Taurin cattle obtained a 2 to 4 percent premium (per kg carcass weight) over zebus because, so butchers believed, the former provide fatter meat. In addition, the implicit price of the meat in a standard large size pile (100 or 200 CFA F) of meat, bone, fat, and offals is higher than the implicit meat price in small piles (25 or 50 CFA F) because meat in the former is considered more tender. However, Staatz's interviews revealed a distaste for beef with heavy fat layers. Thus, Staatz concluded that consumers prefer meat from animals that may be called well-fleshed but not finished. This



probably means a preference for animals that have been grown-out and for those that are fattened for two to three months, but not those coming from intensive, longer fattening regimes.

The demand for beef and for higher quality beef are both, of course, sensitive to changes in relative prices and consumer incomes. As discussed further below, estimation of demand functions shows that the own-price elasticity<sup>1</sup> of beef is almost -1.0, the cross price elasticity of beef with fish is about .37, and the income elasticity of beef is between .5 and .6. Thus, increases in consumer income should significantly increase per capita demand for beef, but the large price elasticities indicate that demand will fall sharply if prices rise considerably.

Market Flexibility. -- Stratification of cattle production implies changes in the size of trade flows, changes in the types of animals handled, and changes in important sending and receiving points. Some have questioned the ability of the traditional trade to respond to these changes and facilitate the new flows. Predictions of this sort are obviously hazardous. However, Herman's work in Upper Volta revealed that the traditional trade was responsive to another sharp shift in animal flows. In neighboring Niger the government's herd reconstitution program generated strong demand for young animals. Traders responded to this demand and facilitated a major flow of such animals from Upper Volta to Niger.

### The Role of Livestock in Pastoral Societies

The stratification strategy discussed above and most other livestock development policies depend for their success on correct assessments of the incentives to which pastoralists will respond. This in turn calls for

---

<sup>1</sup>Percentage change in quantity demanded divided by the percentage change of the indicated variable, price of beef in this case.

an understanding of the roles that livestock now play in pastoral societies. This section reviews the following four major roles but does not attempt to rank their importance nor develop a general model of herder behavior: 1) production of animal products; 2) production of crops; 3) financial services; 4) culture maintenance.

Production of Animal Products. -- Melville Herskovitz's classic treatise, "The Cattle Complex in East Africa" (1926), describes the manner in which cattle have become the dominant element in the cultures of a number of pastoral peoples. This emphasis on the cultural significance of cattle may have led subsequent observers to downplay or overlook the subsistence roles of cattle.

One of the earliest efforts to redress this often unbalanced perception was Harold Schneider's (1957) article, "The Subsistence Role of Cattle Among the Pakot and In East Africa." Amongst the same peoples for whom Herskovitz described the cultural importance of cattle, Schneider found very important subsistence contributions. For example, among the Pakot he found that: (Schneider, 1957, p. 287)

1. "All cows and goats are milked and the milk is consumed without ritual or other complications."
2. "Another important source of nourishment is the blood of cattle . . ."
3. "Most steers are slaughtered when they reach their prime, while cows are not killed because of their value as productive capital."

One of Schneider's most interesting findings was that even though most cattle are slaughtered in ritual settings, this does not significantly diminish the subsistence value of the meat. First of all, meat from ritual slaughter is totally consumed. Second, there is no piling up of ritual slaughter that might cause some meat to be wasted. Third, slaughter in a ritual setting implies a large group of participants who share the meat, hence, again prevent waste. (Although the Pakot know how to dry meat, they prefer it fresh and they incur some spoilage with drying.) Fourth, there is a taboo against consuming milk and ritually slaughtered meat on the same day, so that consumption of those two foods is spread

over a wider number of people or, via soured milk, over time. Fifth, and perhaps most significant, the scheduling of rituals that call for slaughter seems geared to the community's need for meat. Schneider (1957, p. 289) comments as follows:

The most frequent feast seems to be the one known simply as kerket; this is not required at any special time but is held when there is a need for meat, even though ritual ends are also served by it. The other sapaná-like feasts, such as the funeral, are of relatively rare occurrence. But even these fulfill a subsistence role, for presumably the decision to hold a kerket is conditioned by whether a compulsory feast such as the funeral has recently been held. The attitudes of conservation which accompany kerket are most prominently seen in the fact that it is often initiated by the community which calls upon one of its members to give a steer as an obligation. The person selected may demur on the grounds of placing himself in economic jeopardy, but he must eventually consent in order to maintain his standing in the community. Two feasts never occur on the same day or even on adjoining days, except in unusual circumstances. Finally, the consumption of meat does not conflict with the use of milk, except in the sapaná. Persons who consume ritually slaughtered meat may not take milk on the same day; the milk thus saved is either made available to those who have had no meat, or is eaten sour on the following day.

In addition to just noting that livestock may simultaneously serve subsistence objectives and cultural objectives, it is necessary to examine the subsistence roles of livestock in some detail. The quantity, nutritional value, and seasonality of food produced by animals has a major influence on herd size and structure, demand for nonanimal food, and the pattern of sales of milk and animals. The following discussion examines milk, meat, and food in turn. Much of this is drawn from Dahl and Hjort (1976) who provide a very useful compilation of data from many studies of pastoral groups, with major concentration on the English language literature regarding Africa.

Milk is the most important animal food consumed by most pastoral groups. With supplementary sources of iron and Vitamin C, a family could base most of its diet on milk. Taking representative nutritional yields and requirements, Dahl and Hjort (1976, p. 155) calculate that a family with a 30-year-old father, a pregnant mother of 25, a girl of 15, a boy of 18 and children aged 3 and 8 would require 16.6 kg of

of milk to satisfy their daily need for 13,800 kcal and 318 g of protein. However, the nutritional value of milk and hence the required volume varies according to the breed of cow, the location, and the season. Researchers have reported calorie yields between 633 and 831 kcal per liter of milk from pastoral cows, and protein yields between 3.0 percent and 3.8 percent. (See Deshler, 1965; Widstrand, 1975; Orr and Gilks, 1931; Bartha, 1971.) The seasonal variation is particularly important in the Sahel. Bartha (1971 in Hjort and Dahl, 1976, p. 154) found that fat content, a major determinant of calorie content, was 2.3 to 2.5 percent at the end of the dry season while during the rains it more than doubled to 5 to 7 percent.

Seasonal variation is even more critical to the volume of milk produced. One of the most careful studies is by Van Raay (1975, p. 49) for a sample of 692 Fulani-owned cattle around Zaria in 1970. He measured milk available for human consumption, i.e., milk obtained after the calf's normal suckling. The daily average per lactating cow was 0.77 liters, but the actual output varied from a low of 0.50 in April to a high of 1.07 in September. This variability was not exacerbated by variability in the number of lactating cows. Van Raay (1975, p. 50) found no significant seasonal variation in the percent of a herd in milk.

Other less detailed studies provide a wide range of average figures on milk yield. The World Bank (1975) estimates that Fulani-owned cattle in western Upper Volta yield about 150 kg of milk for human consumption during each lactation. This would be .69 liters per day over a 210-day lactation period. Brémaud and Pagot (1962, p. 318) indicate a yield of 400 to 450 kg over a 210 lactation as a general estimate for Sahelian Zebu. This range of 1.8 to 2.0 liters per day is much higher than the yields indicated by Van Raay and the World Bank. Brémaud and Pagot are not clear as to whether their figures are for total yield or yield available for human consumption. However, Dahl and Hjort (1976, p. 145) seem to believe it is the latter. An even higher figure is provided by Dupire (1962, b, p. 111) who states that Bororo Fulani cows yield slightly over three liters per day over the first six months of the lactation and that during the wet season the yield is even higher, five liters.

Again, it is not clear whether these high figures refer to total production or just the amount available for human consumption. However, Dupire implies it is the latter. High yields were also found by Rada and Neville Dyson-Hudson (1970, p. 113) among the Karimojong in Uganda. Daily milk yields for human consumption varied from 1.0 to 2.2 liters per lactating cow, with an average of 1.6 liters.

The above discussion of milk yields and requirements has implications for herd size and composition. Providing the 16.6 kg (16.1 liters) daily milk requirements for the aforementioned reference family would call for an average of 21 cows in milk over the year, according to Van Raay's data on milk yields. However, during the periods of lowest milk yields, in April, 32 lactating cows would be needed. If, as Van Raay (1975, p. 50) found, about 17 percent of a herd is in milk at one time, the total herd would have to number about 124 head, using the above averages. In the dry season about 188 would be needed. Such large herd sizes are not very common in the Sahel, and this confirms the important place of nonanimal foods in pastoral diets.

Meat and blood are much less important than milk in pastoral diets, but their contribution is still significant. Dahl and Hjort (1976, p. 170) estimate that the meat on a 120-kg bovine carcass yields 283,500 kcal and 17.4 kg of protein. An additional 51,860 kcal and 1.6 kg of protein are provided by the tongue, liver, heart, kidney, suet fat, caul fat, and hump of an animal with liveweight of 250 kg. (Based on Dahl and Hjort, 1976, p. 170.) The above carcass weight and liveweight estimates seem to be appropriate for animals slaughtered in West Africa, although this varies considerably over time and space.

Blood is more important among East African pastoralists than among those in West Africa. Each year an animal may yield six liters of blood (over three bleedings) which provides a total of 1980 kcal and .46 kg protein. (Dahl and Hjort, 1976, p. 174.) Since fertile cows usually are not bled, each herd probably contains fewer than 50 percent bleedable animals. Thus compared to milk and meat, blood is not a major source of calories and protein for pastoralists.

The above discussion of the substance value of animal products should

not be taken to mean that pastoralists consume all the food produced by their herds. The nutritional yields cited represent a potential that the pastoralist family can consume itself, but the animal products may be sold or traded rather than eaten. For example, Dupire (1962, b, p. 46) states that:

Milk products ... are the very basis of the daily economy of the Bororo household, which by the exchange of curdled milk or the sale of butter provides, theoretically, for its food needs ('no butter, no millet,' goes one saying).  
[our translation]

Similarly, a large part of herd offtake is sold rather than slaughtered for pastoralist consumption.

Contributions to Crop Production. -- Livestock contribute to crop output by producing manure, by providing power for cultivation and transportation, by developing and maintaining labor assistance arrangements, and by increasing the profitability of improved fallows. The full extent of these complementarities between livestock and crop enterprises is rarely realized in Africa. In some areas the cost of exploiting these complementarities may be greater than the benefits. (See Delgado, 1978.) However, in other areas the benefits may outweigh the costs, and the combination of livestock and crop enterprises in an integrated system may become more wide-spread with the assistance of extension activities and adaptive technological development.

Manure production by pastoral animals has received little study and the available estimates are quite variable. At the Saria, Upper Volta research station of the Institut de Recherches Agronomiques Tropicales et des Cultures Vivrières (IRAT), the annual production of manure from a pair of zebu steers was approximately 5 metric tons, and the entire herd of 60 animals (composition not stated) provided about 120 metric tons (Dinechin et al., 1969, p. 271). A metric ton of this fresh manure had approximately 222 kg dry matter and contained 20 kg of N, 2.65 kg of  $P_2O_5$ , 11.9 kg of  $K_2O$ , 4.33 kg of CaO, and 3.09 kg of MgO (Dinechin et al., p. 279). The Momento de l'Agromonie of the French Ministère de la Coopération (1974, p. 1003) estimates that an African steer stabled at night will produce 3.2 metric tons of manure per year, of which 750

to 1000 kg would be straw used for litter. A steer under permanent stabling would produce ten metric tons. Presumably, this is the weight of wet and dry matter, but it is still difficult to compare this with the IRAT estimate since IRAT does not indicate stabling conditions nor the contribution of straw litter, if any. Some variation in estimates is to be expected since manure output is dependent upon feed input.

For India, the FAO 1971 Production Yearbook estimates that one cow produces 8.6 metric tons of fresh (wet and dry material) manure each year. However, A. Singh argues that a more realistic figure is 5.5 m.t. (Singh, 1975). One metric ton of this fresh manure is said to contain approximately 180 to 260 kg dry matter.

For Zambia (then Northern Rhodesia) Allan (1965, p. 417) states that available cattle manure is limited to night droppings in the kraal since the animals graze during the day. The quantity of this manure that the farmer actually obtains is probably less than three-quarters of a ton although a few farmers may get nearly two tons. The manure is only slightly augmented with litter.

The yield gains from application of manure have not been studied extensively in Africa. For experimental data to be able to be generalized over time and space the tests would have to include analysis of the manure's composition and they would have to be conducted over a long period of time to determine sensitivity to rainfall, changes of soil ph and organic matter, and other long-term variations. As discussed in the stratification section, one experiment conducted during only one year in Upper Volta shows large yield increases for sorghum for the initial six tons of manure per hectare, and also for the next six tons, but subsequent increases are minor (Dinechin et al., 1969, p. 284). This was at Saria, Upper Volta where the composition of manure was as stated above.

Another factor on which there is little information is the extent to which manure is actually used on crop lands. Allan (1965, p. 417) notes that "improved" Zambian farmers applied not more than three tons per acre every fourth year, although the best farmers may have applied ten to twelve tons. In many areas no manure is transported from kraal to field, but the kraal is moved repeatedly and crops planted on the former sites. Another common system, especially in West Africa, is for animals to be

kept on fields for the specific purpose of depositing their manure. The actual transport of manure by the farm family would entail large labor inputs, especially where animal-drawn carts are not available. However, as Ludwig (1968, p. 120) found on Tanzania's Ukara island, sufficient quantities of manure may be moved with head loads. When the Wakara go to their fields they carry a basket of manure and they return with a basket of harvested crops or forage, achieving an efficient transport system. The average basket weighed 33 pounds and the average daily quantity moved per household was 348 pounds. Ludwig (1968, p. 120) provides the following somewhat confusing conclusion:

...the fields are provided with 4-5 tons per acre per year. This means that each field can be manured every 2-3 years.

The Ukara example is interesting because it demonstrated that head loading can move sufficient quantities of manure, but the high rainfall and high population density of the island probably yield a cost-benefit calculation that differs considerably from what might be found in the Sahel. However, Delgado (1979) found that Fulani in southern Upper Volta were transporting manure from kraals to fields at certain times of the year.

The most common means of applying manure in the Sahel is probably through grazing animals on fields and keeping them there through the night. Dupire (1962, b, p. 29) found the following system among "sedentary" Fulani in Marna, Niger:

Owners of herds have them stationed twice on their fields just before the growing season, changing the site of the kraal nightly; afterwards, they burn the stubble from the preceding year. If possible one proceeds to a third stationing of the herd in the field after the harvest, which barely precedes the departure for transhumance. The fresh dung deposited before sowing is the best. This period of stationing lasts a month in all.

One indication of the high value placed on such manuring is that animals are returned from transhumance to the village just before the rainy season primarily to manure the fields (Dupire, 1962, b, p. 29). An added bonus of this system is that the manure is worked into the soil by the animal's hooves.



In addition to improving their own fields, pastoralists provide manure to others under a variety of arrangements. In the Cercle de Tessaoua in Niger among "semi-nomadic" Fulani, Dupire (1962, b, p. 21) found that animal manure was highly valued and was becoming an object of commerce via transportation on donkeys. A more common exchange arrangement in West Africa is through the "stationing" system similar to that found in Marna.

Hopen (1958, pp. 37-38) describes the exchange arrangement in Northern Nigeria during the dry season as follows:

Early in dabunde the late maturing varieties of corn are completely harvested and again the herds are free to camp on the farmlands which surround the villages. Stubble is often grazed by herds which are on the move to the farm area of the cattle-owner. The dabunde lasts from December until late February or early March. During this period the Fulbe return to their own farm area, going first to the farm-lands of the village and district heads where they corral their cattle for about ten nights. A village or district head may give gifts of kola-nuts to the herd-owners who keep their cattle on his farm-lands, but the herdsmen do not expect further remuneration.

After having manured the farm of the local chief the pastoralists disperse to other farms within the same village area, keeping their cattle on each farm for periods which may vary from three to ten nights. No fixed fee is charged for corralling the cattle on the farm of a peasant farmer. Herd-owners are quite pleased if they receive enough corn for their domestic needs while they are on a farm and they may or may not receive kola-nuts and possibly salt in addition. If any remuneration is paid in cash, the amount is established by bargaining before the herd is moved to the farm. Herd-owners whose cattle are in transit and spend one night on a farm do not receive payment from the farm-owner.

At some stage in the dry season a herdsman will use cattle to manure his own farm if he has one.

The dabunde is a season of progressive decline in the condition of the pastures. As grazing deteriorates pastoralists abandon the possibility of gaining an income from manuring and give priority to seeking out the best pastures.

As Hopen's discussion indicates, stubble grazing is the major part of the remuneration "paid" to have a herd manure a field. This is understandable since these exchanges occur during the dry season when

pastures no longer provide good grazing, thus stubble would be highly valued. More recently in northern Nigeria Van Raay (1975, p. 58) found that the terms of exchange were still similar to those found by Hopen.

Rupp (1975) found a similar arrangement between the Fulani and Bambara south of Dilly in Mali. The Fulani move south from Dilly during the dry season primarily in search of watering places and secondarily, seeking grazing land. They disperse among Bambara villagers with whom they have a good relationship. "For manuring the fields the grazier is given the right of access to water and on rare occasions gifts (millet) by the owner" (Rupp, 1975, p. 50).

Although most sources do not cite the manure/grazing exchange as a major source of pastoralists' income, Dupire (1962, b, p. 7) indicates that it may be important for one group of "nomadic" Fulani, the Jelgobe, in Niger:

In the dry season they obtain millet by trading their milk, or as remuneration for the manure their herds deposit on the fields of the sedentary groups, or by buying it.

Polly Hill (1972, p. 287) seems to believe the manuring may be a significant source of income for pastoralists in northern Nigeria, even though her respondents indicated otherwise:

When enquiries were made during the farming-season, the payment to the pastoral Fulani who bring their herds to manure the farms in the dry season was always put at £1 a month for 30 cattle -- surely an absurdly low figure, whatever quantity of grain etc. is also given? Although the position is clearly competitive, with the richer farmers attracting most of the herds, the owners of farms near wells and grazing grounds are also well situated.

The quantity of manure deposited under these arrangements is obviously quite variable. Hill (1972, p. 288) cites Meek's (1925, p. 128) estimate that thirty cattle would adequately manure 2 1/2 acres in one month. Van Raay (1975, pp. 58-59) took a random sample of fields on twelve farms in Katsina Province, Nigeria and came up with widely varying estimates of the quantity of manure deposited. A major source of variation was the difference between fields that were merely grazed during the day (70-400 kg manure per hectare) and fields that were grazed during the day

but also had the animals coralled on them at night (2100-6200 kg manure per hectare). The variation within each category was due primarily to length of stay

Traction power for cultivation and hauling are probably less important than is the use of manure. One reason may be the often cited need to have ox-drawn weeding and not just land preparation in order to have large labor reductions. In the section on stratification data are presented that illustrate this problem.

Hill (1972, p. 193) states that in northern Nigeria the lack of ox-drawn technology for the first groundnut weeding is unfortunate, but ox-plowing is still extremely important in Katsina and Kano province. This seems to be due to large land owners who cannot find a readily available source of hired labor. Ownership of a plow may also be for the purpose of running a plow-hire service as well as plowing the owner's land. This seems to be the case in Maradi, Niger (G. Nicolas et al., 1968) as well as in Batagawara, Nigeria (Hill, 1972, p. 309). Thus, purchase of a plow may not be related to size of the owner's land holding.

Farther north, among the Fulani and Tuareg of Niger, the sources emphasize traction power for hauling goods and people, and for raising water from wells rather than for plowing. See Dupire (1962, a, pp. 91, 92, 94, 95, 110) and F. Nicolas (1950, pp. 132-133).

Agricultural labor on pastoralists' farms may be provided by individuals who are linked to the herder in a variety of relationships based on loans or gifts of animals. The provision of this labor is part of a broader set of obligations that generally help to bind people together and add coherence to the society. Schneider (1957, p. 285) describes this aspect of the relationship among the Pakot of Kenya:

An important use of cows, then, is to secure rights in persons in whom there are no rights per se; steers are also used in this manner to secure obligations. Cooperation in such subsistence acts as housebuilding, herding, cultivation (especially irrigation) . . .

These relationships are discussed further in the subsequent section on culture maintenance.

Improved fallows are generally not an immediate prospect in most African mixed farming systems. However, in parts of North Africa, the reintroduction of a native legume, medicago or medic, provides an example of what may be possible. In Algeria medics could be grown on 2.5 million hectares of annual fallow and thereby place \$45 million worth of nitrogen in the soil annually, double wheat yields, and allow twice as many livestock to be fed (Berth, 1975, p. 2). The presence of animals in such a crop/fallow system may be critical to the profitability of the improved fallow, thus to the increase in crop production.

Financial Services. -- Livestock serve pastoralists as investment goods which have the following desirable characteristics:

- (a) easy convertibility to cash;
- (b) service as a medium of exchange;
- (c) options for decreasing risk;
- (d) portability; and
- (e) a moderate rate of return.

Among the Fulani and Tuareg of West Africa, the sale of livestock seems to be by far the most important source of cash income. This is shown clearly in a study of 4,990 pastoralist households surveyed in 1963/64 in northeast Niger (Ganon, 1966, p. 157, p. 165).<sup>1</sup> Livestock sales account for 97.1 percent of cash income among the Fulani sample and 89.0 percent among the Tuareg sample. Cattle made up the great majority of the Fulani sales whereas only 33 percent of the value of Tuareg sales was from cattle, 27 percent from goats and sheep, and 40 percent from camels (Ganon, 1966, p. 157, p. 166). Although livestock sales are of paramount importance for cash income, the aforementioned study showed that the value of milk consumed by the families from their own

---

<sup>1</sup> Twenty-seven percent of the Fulani and 48 percent of the Tuareg households are engaged in some crop cultivation.

herds was as great as the value received from animal sales. Eddy (1979) found a similar rough equivalence of the value of meat and milk north of Tahoua, Niger.

Livestock not only are sold for cash but also are exchanged for a wide variety of goods, services, and obligations. Schneider (1968, p. 434) argues that in some pastoral societies animals may be considered as money:

Turu livestock may be considered money because animals are standards of value, media of exchange and stores of value. Livestock are normally used for purchasing goods priced in terms of them, and they are the supreme stores of value, the end of all economic pursuits. Thus, however strange a form of money they may appear to be, they are functionally equivalent to money as defined by economists.

As found in the above Niger study, livestock may be traded **directly** for grain. Different animals may also be traded against each other. Among the Turu of East Africa, Schneider (1968, p. 427) found a standard exchange ratio of three head of small stock (goats or sheep) for one young bull or steer, and five head of small stock for a heifer. A specialized form of exchange arises among the Turu when a herder needs a steer (for sacrificial slaughter, for example) but **does** not have one. If he has several cows he may exchange one cow for one steer under a *tilla* arrangement. The recipient of the cow has **full** use of the milk but cannot kill or sell the cow and must return a certain number of calves to the original owner (Schneider, 1957, p. 284). Thus, in this case livestock are a rather remarkable investment in that they can be partially liquidated but still yield a return.

The most obvious means of decreasing risk in a herding enterprise is to disperse the animals to several different areas. Gallais (1967, p. 133) describes such an arrangement among Fulani in Mali:

. . . the *diom-diaudi* disperse in a very widespread fashion a large portion of their animals in the herds of friends. This practice is a mutual assurance against misfortune. If a Peul's herd is decimated by an epidemic, worn out by thirst or hunger, or raided, those of neighbors might have been spared. The animals **con-** fided to them permit the restoration of the weakened herd.

Dupire (1962, b, pp. 43-44) speaks of a broader set of risk-diminishing arrangements among the Fulani of Niger:

. . . institutionalized forms of exchange of goods and services among the nomadic Bororo, which all give the pastoralist . . . multiple chances of warding off the factors of insecurity of his occupation: pre-inheritance; gifts and counter-gifts of meat, milk, and other objects; loans of reproductive heifers under very advantageous conditions, of travelling bulls, of lactating cows, . . . thanks to those reciprocal relations the poor or unlucky nomad comes to feed his family, form his herd, or reconstitute his herd.

Within his own herd a pastoralist can also minimize risk by increasing the number of older animals. These animals have presumably acquired immunity to a variety of ailments that might kill younger animals.

The rate of return on a herder's investment may be taken roughly as the offtake rate plus milk production plus net herd growth minus operating (herding, watering, etc.) costs. Estimates of offtake vary from about 7 percent to 12 percent or 14 percent. As shown above, the value of milk production may be as great as the value of animal sales. Net herd growth may be around 2 percent over offtake. Thus gross returns may be between 16 and 30 percent.<sup>1</sup> Deducting the cost of maintaining the herd lowers net return. Delgado (1979) calculated the net internal rate of return for a male bovine kept on a Voltaic farm as 8 percent and for a female as 21 percent. This is with high labor costs to maintain the animals.

Culture Maintenance. -- In addition to the roles livestock play in production and exchange, they are often also very important as a medium through which cultural values are maintained.<sup>2</sup> Livestock serve this function through their role in bridewealth payments, gifts, bequests, ceremonial sacrifice, and generating networks of personal (kin and nonkin)

---

<sup>1</sup>These figures naturally vary with variations in price and herd structure.

<sup>2</sup>Patterns of production and exchange may also serve to reinforce cultural values. However, in this section we focus on the manner in which livestock further culture maintenance in noneconomic arenas.

relationships. To the extent that herders desire to reserve animals for these basically noneconomic roles, those herders will require greater economic incentives to alter their rate or pattern of offtake.

Bridewealth in the form of livestock is very common among African pastoralists. The need to reserve animals for future bride-wealth payments is revealed quite clearly by Stenning and Hopen among the Fulani of northern Nigeria. Stenning (1959, p. 112) found that at the time of a boy's circumcision (7-10 yrs.) certain of his father's animals are set aside for his future use:

The sibling group of the boy's father -- his paternal uncles and aunts -- seek to betroth him at any time after his circumcision at the age of seven to ten. It is at this time that the boy's services to the herd begin to be no longer negligible, and his interests in it are now furthered by his father. "When he has been circumcised, you take your son into the cattle corral, show him the beasts ear-marked for him at his name-giving, and again ear-mark for him what further heifers you are able, so that when he marries he may have their increase."

Animals are not, literally, ear-marked for this purpose, but the term adequately suggests the nature of this event.

When the boy's interests in the herd have been thus enhanced, the future provision of the complementary services of a wife are thought upon - "There is the herd - the milkmaid is to follow" - and the preliminaries to betrothal are set forward.

Hopen (1958, pp. 119-120) notes that early ear-marking of animals for a son's bridewealth serves the additional purposes of maintaining good father-son relations and helping to insure continued herding services by the son:

Now herd-owners, having once been youths themselves are well aware of the fact that the only really effective way in which to forestall frustration in a son is to make it clear to him that cattle are available for his marriage. This being so it is clear that the father-son conflict is least acute when there are enough cattle for the needs of the son when the time comes for him to marry. If a man is not able to marry at approximately the same time as his age-fellows he will feel inferior in their company and, owing to the progressive reduction of their community

of interests, he cannot fully enjoy their companionship. A man who is old enough to be married, but who is as yet unmarried, is further frustrated since, in his view his future is being jeopardized; late marriage means small families and delay in gaining a self-sufficient household.

When a son is old enough to get married, or is approaching that age, the tension between him and his father is, potentially, at its greatest. This tension centers about the family herd, for now a son begins to compete with his father for the use of cattle, and ultimately it is the supply of cattle which places a limit on the number of women married by the men of a family.

The number and types of animals offered as bridewealth differ over time and among different groups. For Fulani in Mali during the mid-1960s Gallais (1967, p. 133) states that two years before the marriage a young man presents his in-laws with two milking cows to support his fiancée, and at the marriage gives his wife a group of heifers ( un lot de génisses ). Dupire (1962, a, p. 97) speaks of the bride's family choosing three animals for the bridewealth (sa daaki) from the herds of the bridegroom's father and paternal uncles. For three different Tuareg groups in Niger in the 1940s F. Nicolas (1950, p. 216) lists the following bridewealth: 1) four or five camels for the Imâjer'en group, 2) ten to twenty goats or sheep or two cattle, or ten goats and one pack ox for the Eklan; and 3) four or five cattle for the Inesleman.

For Fulani in northern Nigeria during the 1950s, Hopen (1958, pp. 84-95) notes that the value of bridewealth was rising. Marriage of a virgin calls for the groom's family to sacrifice a young bull. The only animal transferred was a heifer, whose offspring and milk would then belong to the wife. There was also a cash payment ranging from £2 to £12, the latter amount being the value of some bulls. These figures are for desirable brides; less desirable brides would get lower payments, and lower payments were also common among poor people. Stenning (1959, pp. 113-121) also writes of only one heifer being transferred among northern Nigerian Fulani, but he states that a total of four bulls are sacrificed on various preliminary occasions. After the birth of the first child two more bulls are slaughtered by the new husband's family and they give the new wife a pack ox. Dupire (1962, b, p. 35) and F. Nicolas (1950, pp. 217-218) also speak of



various sacrifices before and after marriage. Additional transfers of animals are noted by Stenning (1959, p. 121) who states that after the first child is born the new wife attaches to her herd any calves belonging to her husband's cattle and the calves given by the husband's maternal and paternal grandfathers to the first born.

Gifts and bequests of cattle to sons are closely linked to sons' marriages and probably represent a greater transfer of animals than does bridewealth. In addition to the animals given the bride and slaughtered at the time of marriage, as discussed above, a father must provide his son with sufficient animals to start and maintain a new household. Hopen (1958, p. 139) found that the sum of such gifts to sons generally exhausts the father's holdings so that in old age he is dependent on his children and has few if any animals to bequeath upon his death.

Whatever principle of inheritance is applied in practice, only a small proportion of cattle are transmitted by inheritance in each generation. A man, as we have seen, gives cattle to his sons successively as they marry and, if he lives until all his sons have married, he will spend his last years as their dependent. On his death he will have no cattle to pass on to them. If a large herd is inherited it generally means that the late owner had only very young sons or no sons at all. The more usual pattern is that when a man dies he leaves no cattle or only a few beasts. Some informants hold that in order to reduce the number of cattle passed in inheritance a proportion of herd-owners accelerate (in comparison with the past) the distribution of their cattle among their sons and by doing so three things are accomplished:

1. The necessity of paying death duty in the court is avoided.
2. The likelihood of daughters receiving a large share in a court settlement is eliminated.
3. The possibility of disputes among the sons (which are regarded as likely if there is an estate) is avoided.

Dupire (1962, b, p. 17) also writes of this custom of "pre-inheritance" found among the Fulani of Niger whereby the sons obtain nearly their full share of the father's herd before the latter's death. Not only the father but other close paternal relatives as well are under a moral obligation to give a young man animals with which to start his own herd

(Dupire, 1962, a, pp. 122-123). These gifts begin flowing when the child is about seven years old and starts wearing leather trousers as a sign of his hard work and obedience (Ibid., pp. 83-84). However, Gallais (1967, p. 132) notes that at the time of baptism, one week after birth, the father and maternal uncle establish a herd for the young son. The son's mother also given him a "pre-inheritance" from her personal herd (Dupire 1962, a, pp. 118-119).

Networks of social relationships are formed and maintained through various gifts and loans of animals. Gallais (1967, p. 133) makes this point quite strongly for Fulani in Mali:

Social ties are expressed by animal transactions. All the mythical alliances, the dendirâgal which unite the Peul clans or tribes, are based on gifts or loans of animals. The primordial significance of these gifts is understandable. The herder's life depends on a herd which brutal epidemics and other catastrophes can reduce to a few animals. The survival of the group depends on ties of solidarity. Old alliances are nourished and enriched by these alternating gifts . . .

Occasional loans and the delegation of animals to other herds express ties of kinship, real or fictive, of clientele, of protection, which unite Peul families. Each Peul is thus at the center of a system of relations founded on cattle, and social rank is appraised in terms of the extent of this bovine network.

Dupire (1962, a, p. 138) writes in a similar vein about nanga-nai loans that reinforce kinship ties and create new reciprocal obligations among the Peul in Niger.

Ceremonial sacrifices of animals provide vivid reaffirmations of cultural values. Slaughters at marriage and at the birth and naming of children, as discussed above, seem to be most common. Without intending to downplay the importance of these slaughters for culture maintenance, we should recall the subsistence value they provide. Echoing Schneider's discussion for East Africa there is the following comment by Dupire (1962, a, p. 62) about slaughters by Fulani in Niger:

During roughly two months -- at the time of gatherings in the wet valleys -- the meat feasts follow one another in a rhythm such that the conservation of rations permits almost daily meat consumption . . . (Our translation).

## Market Performance

The studies by Herman and Staatz under this project represent pioneering efforts to evaluate the performance of West African cattle marketing systems. Their data on traders' margins, market shares, and similar issues provide some of the first documentation on the efficiency of these markets. The broad context for reviewing their results is provided in the introductory section on marketing in the first part of this paper. As pointed out there, a key element in those market systems is the landlord who serves as an intermediary between buyers and sellers. Because of their key role and because they have frequently been denounced as superfluous parasites serving no function, it may be useful to provide a detailed description of the role of landlords before proceeding to the results of Herman's and Staatz's studies.

Functions of Landlords. -- The need for landlords arises because of the very long distances involved in the cattle trade and the problems that these distances imply with regard to information, contacts between different ethnic groups, trust (credit worthiness, breach of contract), and dealing across national boundaries.

Although the precise set of landlords' functions may vary from time to time and place to place, the following activities are commonly cited in the literature: 1) housing and feeding the cattle trader (seller); 2) getting the seller the best deal possible; 3) arranging the details of the sale; 4) guaranteeing the health and ownership of the animals; 5) guaranteeing the buyer's credit; 6) storing the seller's cash; 7) guiding the seller through various aspects of international commerce; 8) guiding the seller to local services and merchants.

The first of the functions, housing and feeding traders who have arrived from a distant point in the north, may be the key to all other activities by landlords in many northern consuming centers. Cohen (1969, p. 71) states that, "housing is the most important capital asset of a business landlord." He must not only house the incoming trader, but also the large number of assistants (and their families) who help him in business. Furthermore, houses are the main measure of credit worthiness,

indicating that a landlord can guarantee a buyer's credit. Finally, ownership of housing indicated a settled, reputable community member in whom buyer and seller can have faith. In the Sabo Quarter of Ibadan, the home of most Haussas and all cattle landlords, the thirty cattle, kola, and transport landlords owned fifty-one houses for putting up visiting traders (about one-tenth of the Quarter's housing); and of the twelve cattle landlords one had six houses for traders, one had four, two had two, and eight had one each (Cohen, 1969, p. 72).

In northern markets in the supplying areas the landlord may not house and feed the seller, especially if the seller is a local cattle owner living within a one day round trip distance from the market. In some southern markets as well the housing function may not be present (see Staatz, 1979). Whether or not landlords house traders, they universally serve as brokers attempting to get the seller the best deal possible. Sellers often come from a far distance (especially to the southern markets), so frequently lack the information needed to bargain effectively for the best possible price. Thus, in addition to handling the mechanics of a sale, a landlord serves the more important function of having good, current information on market conditions and using this information for his seller's advantage. Information is a critical variable in any marketing situation, and long distance traders in areas with weak communication and little government market reporting have special needs. The high demand for information in the long distance trade may be a major raison d'être for landlords. However, as is discussed in the section on costs and returns, while the incoming seller demands the information, it is the resident buyer who pays the landlord's commission.

In northern supply markets the landlord also provides the buyer with important information. The landlord guarantees that the animal is in good health and that it has not been stolen but does in fact belong to the seller. By the time animals reach more southerly consuming markets they have changed hands several times, so the landlord cannot and does not guarantee ownership; nor does he guarantee the animals' health.

In some markets one of the landlord's most important functions is guaranteeing credit to cattle buyers. The importance of credit and

of landlords' role in it varies among markets and over time. During Cohen's study in Ibadan in the early 1960s a large percentage of sales were on credit, and landlords guaranteed that credit. In contrast, Hill (1966, p. 12) found that credit had become less important in Kumasi in 1964 and others besides landlords were extending credit. Staatz (1979) found that credit was not so important in Bouaké and Abidjan as it once was.

In Ibadan Cohen (1969, pp. 74, 80-81) found that butchers purchasing animals could do so on credit of up to £1000 with repayment due in two to four weeks.<sup>1</sup> Landlords guaranteed the butcher's credit worthiness and made good to the seller in case of default. (Although sometimes the seller accepted less than full value.) Thus, although sellers incurred the cost of waiting, landlords incurred the risk. The landlords were able to reduce that latter cost to levels much lower than those that would obtain if sellers from far northern areas had to withstand the risk. This is because landlords are resident in the market and so know the credit rating of the butchers. Furthermore, to keep that information as current and accurate as possible, landlords and their employees frequently exchange information about butchers.

Exchange of information on credit ratings is facilitated when the landlords and their aides all speak the same language and have other bonds that encourage trust and a full exchange of information. Thus the Hausa monopoly on the landlord profession in Ibadan improves the flow of information and thereby lowers the risk component of the cost of credit. For example, a landlord may not wish to inform other landlords that a butcher has defaulted because that butcher may then not be able to get anymore credit from other landlords and thus may not be able to make good his defaulted loan. However, the common ethnic and religious bonds of the Hausa landlords and their common acceptance of rule by the Hausa

---

<sup>1</sup>Usually no explicit interest is charged for the credit, but sales on credit are often at a higher price than comparable cash sales.

chief of their quarter would tend to minimize such distortions in the flow of information.

Thus, ethnic monopolies in trading are useful not only in vertically integrating trading agents<sup>1</sup> up and down the marketing chain, but also in horizontally integrating agents at the same level in the chain. The benefits of such integration are decreased trading costs made possible by a greater trust and flow of information among marketing agents. However, this integration may give rise to monopolistic and monopsonistic tendencies that increase the price spread between producer and consumer. This is discussed in a subsequent section.

In addition to the above activities directly concerned with selling animals, landlords in the south also provide sellers with a variety of other services. They often store the large amounts of cash that sellers may have with them or may acquire. Landlords also provide information other than cattle prices. Sellers may need considerable help with licensing procedures, foreign exchange controls, animal health documentation, and the like. Sellers also may want information about local goods and services they wish to purchase, and the landlord often helps out. In fact, according to Polly Hill, these latter two services may be important sources of landlords' revenues,

Landlords' Revenues.-- As compensation for arranging a sale of cattle landlords receive a commission (often called lada) from the buyer, even though most of the landlord's services benefit the seller.<sup>2</sup> In the early 1960s an Ibadan butcher had to pay a 13 shilling commission on every animal he purchased (Cohen, 1969, p. 124). Three shillings of this went to the

---

<sup>1</sup>Traders' desires to deal with landlords they know and trust is shown by the fact that they not only deal with fellow Haussas, but that they prefer dealing with fellow Haussas who have kinship ties in the trader's home area.

<sup>2</sup>The Yoruba living in and around Ibadan are quite aware of this seeming inconsistency, and the Yoruba butchers were moved to formal protest of British colonial authorities. The Yoruba discontent is even stronger since Haussa have monopolized the kola landlord profession and charge the Yoruba producer/sellers a commission on sales made to Haussa buyers down from the North. (See, Cohen, 1969.) This may be another effect of an ethnic monopoly.

landlord's employee who actually arranged the sale, two shillings went to the seller as compensation for waiting for payment, one shilling was distributed among the landlord's clerk and herd boys, and seven shillings were retained by the landlord.<sup>1</sup>

Polly Hill (1966, p. 6) argues that the commission is not the only source of landlords' revenues, and may not be the most important. In Kumasi in 1964 landlords received 5 shillings per animal, providing a yearly average total of £400, far less than needed to support the level of living Hill observed. In fact, Hill (1966, pp. 7-9) notes that landlords derive revenues from a host of other sources, including the following:

1. Commission from local merchants to whom the landlord has directed the northern cattle merchant. Transport landlords in lorry parks are an important example of such local merchants.
2. Hidden commission from buyers with whom the landlord has a close relationship and for whom the landlord secretly helps get a good deal.
3. Cheating the seller by telling him his animals sold at a lower price than was actually the case, and keeping the difference.
4. Payment for directly helping buyers with matters such as arranging transport north, obtaining licenses, and so forth.
5. Profit from the long distance trade that some landlords pursue.
6. Profit from the local dealing (buying animals for resale) that some landlords pursue.
7. A portion of the tips that northern merchants pay to servants in the landlord's house.

In contrast to the above contentions by Hill, Cohen is either silent about such other sources of landlords' revenues or he downplays their

---

<sup>1</sup> Commission received by the seller and landlord are forms of interest on credit, but the landlord receives his commission even for cash sales. It is not clear whether the total commission paid by the buyer is reduced for cash sales.

importance. For example, while noting that during his study two landlords pursued long distance trading, Cohen (1969, p. 77) states that this is difficult and uncommon. Northern merchants will have less trust in a landlord who competes with them in cattle selling and is preoccupied with that second career. Also, it is difficult to engage in long distance trading on less than a full-time basis because of the information and animal gathering networks that must be maintained in the north.

Perhaps these other revenue sources were more important in Kumasi than in Ibadan, because the landlords' traditional functions had become less important in Kumasi. This was because strangers had entered the market in force to buy for re-export to the south. Since Kumasi landlords could not develop credit rating information on these strangers, one traditional function was diminished. Also, Kumasi butchers had become relatively prosperous and were able to do more purchasing for cash than for credit (Hill, 1966, p. 12).

Competition Among Landlords.-- Landlords prosper by handling a large volume of cattle for a large number of sellers. Thus the main arena of competition is the effort to attract sellers, either new sellers coming to the market for the first time or return sellers who had been dealing with other intermediaries. However, Cohen (1969, pp. 93, 94) notes that competition for the new sellers is more intense because landlords must maintain good relations with each other to facilitate the flow of information. In fact, one form of competition is suppression of information about bad credit risks so that other landlords may have difficulty if loaning to a bad risk (Cohen, 1969, p. 82).

Since the landlord's commission is fixed, the main modes of competition would seem to be hospitality and ability to get a quick sale at a good price. Striving for a good price may lead to efforts to reduce total sales in the market, but Staatz observed no collusion by landlords to do this in over a year's observation at Bouaké and Abidjan. In addition, he did not find high concentration among the landlords. In Abidjan, the eight largest landlords handled an average of 37.1 percent of sales between December 1976 and June 1977, while in Bouaké the largest eight handled 63.5 percent between September 1976 and June 1977.



Competition Among Butchers and Traders. -- The effectiveness of competition among these two groups of marketing agents is best measured by the relative profitability of their enterprises. That is, if their businesses yield a return of capital greater than that available in other comparable fields, then the conclusion may be drawn that competition in the livestock trade is not very strong. If, on the other hand, rates of return are comparable, this implies that traders do not get excess profits and that consumers and producers are being served as well as possible, given the prevailing technologies.

In Abidjan and Bouaké during 1976/77 Staatz found that rates of return to capital of butchers and traders were comparable to the 20 percent returns commonly assumed for this area. They were slightly higher for Abidjan traders, probably reflecting a premium for the high risk involved in that trade. Thus, among the three major groups of agents, landlords, traders, and butchers, there is no evidence of inefficiency or exploitive practices that would justify major efforts at regulating or reorganizing livestock marketing.

#### Demand for Sahelian Beef

As shown in the first part of this chapter, livestock exports are of major importance to the Sahelian economies. Thus, there was considerable concern in the mid-1970s when doubts were raised about the future strength of demand for Sahelian beef by the main importing nations on the coast. The doubts focused on two issues: 1) consumer preferences for beef, especially in the face of relative increases in staple food prices and relative decreases in fish prices (see Montgomery, 1975); and 2) the ability of Sahelian beef to compete with cheap non-African beef. While both issues are of legitimate concern, it does appear that neither is likely to cause a damaging decline in demand for Sahelian beef. The following analyses indicate that demand probably will continue to rise as a result of increases in population and income, and that strong price competition from non-African beef following 1974 was largely the result of transient phenomena in the world beef market coinciding with the Sahelian drought.

Consumer Behavior. -- The growth of demand for any food may be represented simply as follows:

$$d = p + (n)(i)$$

where  $d$  = percentage change in quantity demanded;

$p$  = percentage change in population;

$n$  = income elasticity of demand or the percentage change in quantity demanded per the percentage change in real income; and

$i$  = percentage change in real income.

This representation ignores changes in relative prices of other commodities which may cause slower or greater increases in the growth of demand. However, this formulation is a useful starting point and, as will be seen, it does cover the most important factors that are at work.

In order to examine the relative importance of various factors affecting consumer behavior, an analysis was conducted of Abidjan's historical pattern of beef consumption, beef prices, other food prices, population, and income. Regressions were estimated to determine how demand for beef was affected by changes in income, and by changes in the price of beef, fish, chicken, grain, and tubers. The results conform to similar studies of luxury foods in showing a high own-price elasticity near  $-1.0$ , a moderate cross price elasticity with fish near  $.38$ , and a strong income elasticity of about  $.55$ . While multicollinearity gave rise to significance problems for several variables, the least significant coefficients were for chicken, grain, and tubers.

Given the roughness of the estimates, there is little justification to consider more than just the rough orders of magnitude of the figures. This will suffice for the present purposes. The above equation for growth in beef demand can now be filled in. Abidjan's population has grown at a rate of 2 to 3 percent per year between the late 1950s and early 1970s. Real per capita income has grown at an average annual rate of between 5 and 6.5 percent per year over the same time period. From our estimates and from other studies of similar goods in similar areas, the income elasticity of demand can be taken as about  $.55$ .

If we take  $p = 2.5$ ,  $i = 5.7$  and  $n = .55$ , our formula shows beef demand growing at about 5.6 percent per year. The stimulus for this growth in demand comes about equally from population growth and from increased purchases per capita as income rises. As mentioned, this ignores the impact of price changes which will be considered below. However, at this point it is worth comparing this figure of 5.6 percent growth in demand to estimates of the growth of Sahelian cattle herds. Most such estimates are around 3 percent per year or lower.

The above rough estimate of growth in beef demand must be qualified by consideration of price effects. According to our regression estimates, a 1 percent rise in real beef prices (i.e., prices deflated by the consumer price index) would cause a 1 percent decline in quantity demanded. A 1 percent decline in real fish prices would cause about a .38 percent decline in the quantity of beef demanded.

Thus, if the relative price of fish fell 10 percent in one year this would reduce the projected increases of beef demand to 2.8 percent in that year. However, is it likely that fish prices would continue such sizable declines relative to all other prices for any length of time? Probably not. An even stronger impact would be felt if beef prices rose, but we would expect this to generate a self-correcting mechanism that would lead to a relative decline in beef prices. In sum, while price changes may affect demand, their impact is likely to be transient, while in contrast, the underlying forces of population growth and income growth represent a relatively steady, long-run source of rising demand for beef.

Non-African Competition.-- In 1974/75 imports of non-African beef into several West African coastal nations increased significantly and caused concern that Sahelian exporters would lose their major markets. For example, Ivory Coast imports of non-African beef rose from 142 tons in 1974 to 15,532 tons in 1976. However, there is considerable evidence that the stimuli for such large non-African imports were transient phenomena, specifically the Sahelian drought which lowered the supply of Sahelian export cattle after 1973, and the glut of export beef on the

world market starting in 1974/75. Thus, initial concerns about the long-run loss of markets for Sahelian cattle may have been exaggerated. But whenever a major exporter becomes a significant supplier to any country there are likely to be some long-lasting effects. Trade channels are developed; it becomes easier to do business, and so there is a likelihood of increased trade for sometime after the initial stimuli have passed. Also, non-African suppliers will now be more sensitive to opportunities in West Africa so there are likely to be more frequent increases from these sources as relative market conditions vary.

The major stimulus for increased sales to West Africa from non-African exporters, primarily Argentina, was the large glut of export beef in the world just at the time when Sahelian supplies had been diminished by the drought. The world glut was brought about by several factors that accentuated the common "cobweb" type cycle of surplus and scarcity in the beef industry. Basically, there was strong demand and good producing conditions in the 1960s and early 1970s which led to large increases in herds. This was followed by a rapid downturn of demand and the sudden onset of very bad producing conditions which led to rapid liquidation of herds and subsequent excess beef supplies by the mid-1970s. These changes are discussed in detail below.

Through most of the 1960s and into the early 1970s, beef producers faced rising consumer demand fueled by rapidly rising incomes. For example, between 1962 and 1973 Japanese real gross national product grew at annual rates of between 5 and 14 percent. Other industrial countries registered less spectacular, but steady, strong, gains over the same period. These increases led to greater demand for beef and shortages of supply by 1970-1972. These shortages in turn led to large price increases in 1971 through 1973/74. For example, the price index of Argentine corned beef stayed between .50 and .55 between 1965 and 1970 but then jumped to .83, .88, 1.10 and 1.51 in 1971 through 1974, respectively. The Argentine frozen beef price index rose from the 60s to 70s in most of the mid-1960s to 1.03 in 1971, 1.33 in 1972, 1.83 in 1973 and 2.16 in 1974 (IMF, 1978, p. 57).

These higher beef prices led to a new expansionary phase of the cattle inventory cycle in 1971-72, but then conditions changed. Starting

in 1972-73 grain prices began rising rapidly, making cattle feed more expensive and also raising the opportunity cost of grazing land. By the end of 1973 the world economy started slowing down and oil prices rose rapidly, leading to slower growth in consumer income and a slackening of demand for beef. For example, the period of rapid Japanese economic growth was followed by a decline of 1.2 percent in real GNP between 1973 and 1974. By 1975 real GNP was only 1.3 percent above the 1973 level. In the United States real GNP declined in both 1974 and 1975. These declines in income led to lower beef demand and resultant price declines. The Argentine frozen beef price index fell from 151 to 100 between 1974 and 1975, and then to 99 in 1975. The Argentine corned beef price index fell from 216 in 1974 to 100 and 106 in 1975 and 1976, respectively (IMF, 1978, p. 57). Thus, by 1974-75 the major producing nations were faced with sharply higher herd inventories, higher costs, and lower prices. Since the cattle producer reacts to lower prices and higher costs by decreasing the age of slaughter,<sup>1</sup> the short-run response to lower prices was a further increase in production (slaughter). This added more impetus to the fall in prices.

The exporters' problems were exacerbated by the increase of domestic supply in major importing nations during this period. The United States and the European Economic Community (EEC) both have sizable beef herds which undergo cycles similar to those in exporting nations. Herd inventories also grew in these areas in the late 1960s and early 1970s and, with the subsequent decline of prices, slaughter also increased significantly. Thus, these major importers had much higher levels of domestic supply, and important constituents who increased their opposition to beef imports. The results were restrictions on such imports. For example, by 1977 United States meat imports were sharply curtailed under voluntary restraint agreements negotiated with major suppliers subject to the Meat Import Law (USDA, 1976 and 1977).

---

<sup>1</sup>This phenomenon conforms to the economic theory of profit maximization from a piece of capital that is to be converted into final output, such as cattle into beef.

In sum, by 1975 the major meat exporters were faced with the problem of severe oversupply and hence were forced to seek nontraditional markets. Australia increased its efforts to export to the USSR, Eastern Europe, the Middle East, and Mainland Asia. Argentina turned, among other places, to Africa. This happened just when Sahelian cattle exports were down because of the drought. Thus, Argentina filled a gap in West African beef supplies. The opening of major trade channels is likely to mean some continuing greater competition for Sahelian beef in coastal markets. However, the major stimuli for large non-African exports to West Africa seem to be transient, and thus the threat to Sahelian exports is probably less than it may have appeared initially.

#### SUMMARY

After the 1972/1973 Sahelian drought there was considerable discussion of the need for major changes in West African livestock production and marketing in response to new ecological and economic conditions. This brief overview indicates that in several key respects such major changes are either unnecessary or unlikely.

Examination of the prospects for stratification of production shows that marginal changes may be possible, but a major restructuring of the industry is unlikely. This conclusion is strengthened by a review of the role of livestock in pastoral economies. At present the Sahelian cattle herds do not contain large excesses of mature males whose removal in a stratification program would reduce grazing pressures on the range by more than about 5 percent. Furthermore, there may be an increase of cow/calf units counterbalancing any reduction in mature males. Under present conditions, a maximum of about 100,000 additional three-year-old males might become available for integration into farming units for a four-year growing out period. This may add considerably to the stock of work oxen in West Africa but it would represent a very small addition to the total number of animals marketed in the region. Furthermore, the full potential impact of additional work oxen may not be realized because farmers in many areas may not find it profitable to shift to an ox-plough farming system. Finally, because pastoralists raise cattle for

a number of objectives in addition to cash sales, they may not supply the maximum number of three-year-olds possible.

Following the drought there was an increase in criticism of the traditional livestock marketing system and there were fears that coastal markets would be lost to Sahelian exporters. Analysis of both issues indicates that there is probably less basis for concern than has previously been voiced. Traditional marketing agents seem to perform reasonably well given the available physical infrastructure. The intermediaries or landlords who often are cited as nonproductive do in fact serve very important functions regarding security of contract, information flow, and credit. Traders and butchers receive a return on their capital comparable to that available in other similar ventures. The system as a whole has shown considerable flexibility in responding to different demand signals from herd reconstitution programs in Niger and greater consumption needs in Nigeria.

While non-African suppliers took a much stronger position in coastal markets immediately after the drought, that change in market shares seems to have been the result primarily of transient factors. At the time there was a glut of export beef on the world market, and there was a drought-induced scarcity of Sahelian beef available for coastal markets. Thus, while the effects of the greater non-African supplies may last for some time, the relative importance of those exports should decline. Furthermore, growth of population and income in the coastal nations should provide a satisfactory long-run increase in demand for Sahelian cattle.

Although this brief general overview indicates that major changes are unlikely or unnecessary in several key parts of the West African livestock sector, this does not mean there is no scope for useful interventions. Detailed examination of specific components of the sector, as was done in the four field studies, reveals considerable scope for improvements. Programs to realize many of these improvements would benefit from external assistance. Recommendations for such interventions are discussed in the following four chapters which report on the detailed field studies undertaken in Niger, Upper Volta, and Ivory Coast between 1975 and 1977.

LIST OF REFERENCES

- Allan, William. The African Husbandman. New York: Barnes & Noble, Inc., 1965.
- Barral, Henri. "Les Populations d'Éleveurs et les Problèmes Pastoraux dans le Nord-Est de la Haute-Volta,". In Cahiers ORSTOM, pp. 1-30. Volume IV, Série Sciences Humaines, 1967.
- Bartha, R. Studien zur Tragen der Zeburinderzucht inden tropen, Munich: IFO-Institute, 1971.
- Berth, A. "The Return of Medic," CIMMYT Today, 1975, 3:1-16.
- Bishop, Dwight R. "Livestock and Meat Marketing Patterns and Costs in the Entente and Adjoining Countries." Report to the Economic Community for Livestock and Meat. Report prepared for the Council of the Entente, Ouagadougou, September, 1972.
- Bonte, Pierre. "L'Élevage et le Commerce du Bétail dans l'Ade Douchi-Majya." In Études Nigériennes, no. 23. Paris: I.F.A.N., 1968.
- Brémaud, O. and Pagot, J. "Grazing Lands, Nomadism and Transhumance in the Sahel." In Problems of the Arid Zone, pp. 311-324. Vol. XVIII: Arid Zone Research. Paris: UNESCO, 1962.
- Charreau, Claude. Sollu of Tropical Dry and Dry-Wet Climatic Areas of West Africa and Their Use and Management. Ithaca, New York: Cornell University Department of Agronomy, (mimeograph), 1974.
- Cohen, Abner. Custom and Politics in Urban Africa: A Study of Hausa Migrants in Yoruba Towns. Berkeley: University of California Press, 1969.
- Coulomb, J., et al. "Zone de Modernisation Pastorale de Niger: Economie du Tropeau." Paris: SEDES and IEMVT pour le Ministère de l'Économie Rural, Niger, 1971.
- Coulomb, J., et al. "Projet de Développement de l'Élevage dans la Région Mopti; République du Mali." Paris: Institut d'Élevage et de Médecine Vétérinaire de Pays Tropicaux and République du Mali, Ministère de la Production, 1972.
- Dahl, Gudrun and Hjort, Anders. Having Herds: Pastoral Herd Growth and Household Economy. Stockholm, 1976.
- Delgado, Christopher. Livestock versus Foodgrain Production in South-east Upper Volta: A Resource Allocation Analysis. Ann Arbor: Center for Research on Economic Development, University of Michigan, and USAID, 1979.



- Deshler, W.W. "Native Cattle Keeping in Eastern Africa." In Anthony Leeds and Andrew P. Vayda (eds.), Man, Culture, and Animals, pp. 152-168. Washington D.C.: American Association for the Advancement of Science, 1965.
- Dinechin, B., C. Malcoiffe, J. Hayes. "Données Actuelles sur l'Association de l'Agriculture et de l'Élevage en Haute-Volta," in L'Institut d'Élevage et de Médecine Vétérinaire des Pays Tropicaux (ed.). Colloque sur l'Élevage, Fort Lamy, Tchad, December, 1969, pp. 268-286.
- Dupire, Marguerite. "Facteurs Humains de l'Économie Pastorale." Études Nigériennes. Niamey: Centre Nigérien des Recherches en Sciences Humaines, 1962.
- Dupire, Marguerite. (a) "Peuls Nomades: Étude descriptive des Wodaabe du Sahel Nigérien." In Travaux et Mémoires de l'Institut d'Ethnologie, Vol. LXIV. Paris: Université de Paris, 1962.
- Dupire, Marguerite. (b) "The Fulani: Peripheral Markets of a Pastoral People." In P. Bohannan and G. Dalton, ed., Markets in Africa, pp. 93-129. Garden City, New York: Anchor Books, 1965.
- Dyson-Hudson, N. and R. "The Food Production System of a Semi-Nomadic Society, The Karimojong, Uganda," in P. McLoughlin (ed.), African Food Production Systems, Cases and Theory, Baltimore: The Johns Hopkins Press, 1970.
- Eddy, Edward D. Labour and Land Use on Mixed Farms in the Pastoral Zone of Niger. Ann Arbor: Center for Research on Economic Development, University of Michigan and USAID, 1979.
- FAO 1971 Production Yearbook.
- Gallais, J. Le Delta Intérieur du Niger: Étude de Géographie Régionale, Tome 1. In Mémoires de l'Institut Fondamental d'Afrique Noire, no. 79. Ifan-Dakar: Université de Dakar, 1967.
- Canon, F. et. al. Étude Démographique et Économique en Milieu Nomade. Paris: SEDES, République Française Ministère de la Coopération, 1966.
- Herakovitz, M. "The Cattle Complex in East Africa," American Anthropologist, 1926, 28: 230-272, 361-380, 494-528, 633-664.
- Hill, Polly. "Landlords and Brokers." In H. Ord, C. Fyfe, and D. McMaster (eds.), Markets and Marketing in West Africa, pp. 1-14. Proceedings of a Seminar held at the Centre of African Studies, University of Edinburgh, April, 1966.
- Hill, Polly. Rural Hausa: A Village and a Setting. Cambridge University Press, 1977.
- Hopen, C. Edward. The Pastoral Fulbe Family in Gwandu. London: Oxford University Press, 1958.

- International Monetary Fund. International Financial Statistics. May, 1978
- Jones, William O. Marketing Staple Food Crops in Tropical Africa. Ithaca, New York: Cornell University Press, 1972.
- Kellogg, Earl D. "A Temporal and Spatial Model to Assist in Evaluating Investments in the Nigerian Beef Distribution System." Ph.D. dissertation; Michigan State University, 1971.
- Lacrouts, M., Sarniquet, J., and Tye, J. "Exploitation du Cheptel Bovin au Mali." Paris: République Française. Secrétariat d'Etat aux Affaires Etrangères chargé de la Coopération and République du Mali, Ministère du Développement, 1965.
- Ludwig, Heinz-Dieter. "Permanent Farming on Ukara: The Impact of Land Shortage on Husbandry Practices." In Hans Ruthenberg (ed.) Smallholder Farming and Smallholder Development in Tanzania, African Studies #24. Munich: Ifo-Institut für Wirtschaftsforschung, 1968.
- Meek, John James. "Simulation of the Cattle-Calves Sub-sector in a Developed Economy with Special Reference to the Canadian Cattle Herd." Ph.D. dissertation. Michigan State University, 1975.
- Meyn, Klaus. "A Proposed Livestock Development Strategy for West Africa." Washington, D.C.: World Bank, mimeograph, 1977.
- Ministère de la Coopération, France. Momento de l'Agronomie, Paris, 1974.
- Montgomery, Roger. "Baisse de la Consommation de Viande de Boeuf a Abidjan: Raisons Economiques." In Cahiers Ivoiriens de Recherche Economique et Sociale, nos. 7-8, 1975.
- Nicolas, Francis. Tameana: Les bouleversements de l'Est ou Touareg "kel Dinik". Paris: Imprimerie Nationale, 1950.
- Nicolas, G., et. al. "Problèmes Posés par l'Introduction de Techniques Agricoles Modernes au Sein d'une Société Africaine: Vallée de Maradi, Niger." University of Bordeaux. 1968. (mimeograph).
- Orr, J. & Gilks, J. "Studies of Nutrition: The Physique and Health of Two African Tribes." Privy Medical Research Council Special Report Series, no. 155, London, 1911.
- Peretti, M. Projet Mine en Place de l'Ord du Sahel, Tome 1: Situation Actuelle de l'Ord. Ouagadougou: Ministère du Développement Rural, Direction des Services de l'Elevage et des Industries Animales, 1976.
- Robinet, A. B. Le Développement de la Production Animale en Haute-Volta. New York: United Nations Development Program, mimeograph, 1972.
- Rupp, Marianne. "Anthropology of the Maures, Peul, Guera, Bambara, and Soninke in the Nara-Niono Plain." Washington, D.C.: UNDP Project-521, unofficial translation by U.S. Department of State, mimeograph, 1975.

- Ruthenberg, Hans. Farming Systems in the Tropics, London: Oxford University Press, 1971.
- Schneider, Harold. "Economies of East African Aboriginal Societies." In E. LeClair and H. Schneider (eds.). Economic Anthropology: Readings in Theory and Analysis. New York: Holt, Rinehart, & Winston, Inc., 1968.
- Schneider, Harold. "The Subsistence Role of Cattle Among the Pakot and in East Africa." In American Anthropologist, vol. 59, pp. 278-300, 1957.
- SEDES. Approvisionnement en Viandes de l'Afrique Centre-Ouest. Paris, 1969.
- SEDES. Recueil Statistique de la Production Animale. Paris: Republique Francaise, Ministère de la Cooperation, 1975.
- Shapiro, Kenneth. "Livestock Marketing in the Entente States of West Africa." Preliminary report to USAID, mimeograph, 1976.
- Singh, A. "Use of Organic Materials and Green Manure as Fertilizers in Developing Countries" in FAO, Organic Materials as Fertilizers, Rome: U.N., 1975.
- Sleeper, J., An Economic Analysis of the Role of Ox-Plowing and Cattle-Feeding in the Stratification of West African Livestock Production. Ann Arbor: Center for Research on Economic Development, University of Michigan, and USAID, 1979.
- Staatz, John. The Economics of Cattle and Meat Marketing in Ivory Coast. Ann Arbor: Center for Research on Economic Development, University of Michigan, and USAID, 1979.
- Stenning, Derrick J. Savannah Nomads: A Study of the Wodaabe Pastoral Fulani of Western Bornu Province, Northern Region, Nigeria. Published for the International African Institute by Oxford University Press, 1959.
- UN, FAO. Provisional Food Balance Sheets, 1972-74, Averages. Rome; UN 1977.
- USAID. Development Assistance Program: Central West Africa Region, Volumes 1-3. Washington D.C.: U.S. Government Printing Office, March, 1975.
- U.S. Department of Agriculture, Foreign Agricultural Service. Foreign Agriculture Circular: Livestock and Meat. Washington, D.C., April, 1976 and April, 1977.
- Van Raay, H.G.T. Rural Planning in a Savannah Region. Rotterdam: Rotterdam University Press, 1975.
- Wardle, G. Promoting Cattle Fattening Amongst Peasants in Niger. Ann Arbor: Center for Research on Economic Development, University of Michigan, and USAID, 1979.
- Widstrand, C. On Pakot Group Ranches, Kapenguria, 1972 (mimeo).

CHAPTER 2

AN INVESTIGATION OF THE LACK OF MIXED FARMING  
IN THE WEST AFRICAN SAVANNAH:  
A FARMING SYSTEMS APPROACH

by Christopher L. Delgado

TABLE OF CONTENTS

	<u>Page</u>
LIST OF TABLES . . . . .	68
LIST OF ILLUSTRATIONS . . . . .	69
<u>THE ARGUMENTS FOR MIXED FARMING, THE PROBLEM, AND THE SYSTEMS APPROACH</u>	70
Introduction . . . . .	70
The Key Role of Southern Livestock in the National Devel- opment Strategy . . . . .	71
Projected Benefits of Mixed Farming for the Smallholder . . . . .	73
The Problem with the Mixed Farming Model at the Household Level . . . . .	75
The Farming Systems Approach and Data Collection . . . . .	78
<u>LABOR USE BY SAMPLE FARMS</u>	81
Rationale for a Detailed Analysis of Labor Allocation . . . . .	81
The Division of Labor and the Lack of Hired Help . . . . .	81
The Agricultural Calendar and Labor Use by Major Sector of Activity . . . . .	82
Labor Use by Major Agricultural Operation . . . . .	84
Household Labor Allocation to Crops . . . . .	87
Household Labor Allocation to Livestock . . . . .	89
Labor Requirements for Cattle and the Conflict between Crops and Livestock . . . . .	91
<u>LAND, CAPITAL, AND FARM OUTPUT</u>	94
Farm Land Holdings . . . . .	94
Farm Land Allocation . . . . .	95
Farm Access to Capital and the Livestock Investment Option . . . . .	96
Farm Livestock Ownership . . . . .	99
The Measurement and Evaluation of Farm Agricultural Output . . . . .	101

	<u>Page</u>
<u>THE FARM PRODUCTION MODELS</u>	105
Objective and Requirements of the Modeling Exercise . . . . .	105
Structure of the Basic Agricultural Production Model . . . . .	105
Activities, Resource Supplies, and Input Requirements. . . . .	110
Adding Animal Traction to the Basic Model. . . . .	114
 <u>RESULTS AND CONCLUSIONS</u>	 121
Optimal Farm Production Strategies Under Different Assumptions. . . . .	121
Sensitivity Analysis and the Opportunity Cost of Resources. . . . .	124
Trade-Offs in Production Between Cattle and Food Grains. . . . .	128
Critical Assumptions and Applicability of the Results to Other Areas . . . . .	129
 <u>POLICY RECOMMENDATIONS</u>	 131
Principal Policy Recommendations for Livestock Inten- sification in the Research Area. . . . .	131
Policy Recommendations for Livestock Inten- sification in Areas Similar to Tenkodogo without a Cattle Entrusting Option . . . . .	132
 <u>LIST OF REFERENCES</u> . . . . .	 137

CHAPTER 2 - LIST OF TABLES

<u>Table</u>		<u>Page</u>
1	Calendar of the 1976-77 Agricultural Year (Divided into Fortnights). . . . .	83
2	Mean Total Household Hours Per Hectare of Each Crop Category. . . . .	88
3	Mean Household Area and Number of Fields Cultivated on Each Type of Land . . . . .	95
4	Mean Household Land Area and Percentage of Farm- land Allocated to Each Crop Category . . . . .	96
5	Summary of Bisa Sample Household Livestock Holdings (N=30) . . . . .	100
6	Age Structure of the Bisa Sample Cattle Herd . . . . .	100
7	Computation of the Revenue From One Hectare of Each Crop Enterprise . . . . .	102
8	Tenkodogo Farm Linear Program Model I. . . . .	109
9	Key to Labels in the Basic Tableau . . . . .	111
10	The I.R.A.T. Animal Traction Yield Multipliers in the Context of the Basic Model. . . . .	117
11	The I.R.A.T. Animal Traction Labor Multipliers in the Context of the Basic Model. . . . .	119
12	Tenkodogo Farm Linear Program Model II . . . . .	120
13	Summary of the Optimal Solutions to the Farm Production Models Under Different Assump- tions (With and Without the Option of Animal Traction). . . . .	122
14	Dual Variable Values in the Optimal Solutions to Various Models (Interpreted as the Oppor- tunity Cost in CFA of One Unit of a Scarce Resource). . . . .	127

CHAPTER 2 - LIST OF ILLUSTRATIONS

<u>Figure</u>		<u>Page</u>
1	Mean Total Household Labor Hours Each Fort- night by Category of Work for the Entire Sample. . . . .	85
2	Mean Household Hours Allocated to Each Major Agricultural Operation, by Fortnight. . . . .	86
3(a)	Mean Household Labor Inputs Per Animal to Large and Small Stock . . . . .	90
3(b)	Mean Household Labor Inputs for Typical Herd Sizes . . . . .	90
4	Mean Household Hours Allocated to Crop and Livestock Activities Over Time (Crops are Per Hectare Totals) . . . . .	92

## CHAPTER 2

### AN INVESTIGATION OF THE LACK OF MIXED FARMING IN THE WEST AFRICAN SAVANNAH: A FARMING SYSTEMS APPROACH

by Christopher L. Delgado

#### THE ARGUMENTS FOR MIXED FARMING, THE PROBLEM, AND THE SYSTEMS APPROACH

##### Introduction

This study examines the reluctance of peasant farming groups in southeastern Upper Volta to keep cattle on their farms, despite the many benefits from mixed farming. The issue is of crucial importance to West African development planning; sedentary livestock production in the more humid areas of Sahelian countries offers opportunities both for the further expansion of the national output of cattle and hope for salvaging an agricultural system with declining yields. The problem arises, however, that farmers have been reluctant to maintain cattle on the farm in many of the areas for which planners have advocated this practice.

The explanation often advanced by expatriate agricultural advisors with respect to this reluctance for mixed farming is that "non-economic factors" operate to create a division of labor between herdsmen and crop cultivators. The examination of the profitability of on-farm cattle is often limited to a simple comparison of the cash costs of maintaining cattle versus the cash benefits. There is virtually no consideration of the adjustments of the farming system required in order to include the new activity. The implicit assumption appears to be that the extra non-cash resources required to look after the animals, principally household labor, can be obtained without reducing the production of any other item.

This paper presents a case study of an area in Upper Volta where farmers do not engage in mixed farming, despite a government and donor agency orientation in favor of this activity. It will adopt a systems approach to these questions, which involves ascertaining the overall adjustments of resource use and output required to permit the entry of a new activity. This permits an evaluation of the relative profitability of the new production strategy as a whole. The model used to investigate these issues examines the "general equilibrium" of the entire farm production system as opposed to the "partial equilibrium" of the cattle enterprise in isolation. More specifically, a preliminary hypothesis is elaborated to the effect



that labor conflicts between crops and livestock during peak agricultural periods make keeping cattle on the farm less profitable than entrusting them to herders and concentrating farm labor resources in crop production. This theory is tested using data from a farm management survey conducted by the author in two villages near Tenkodogo, in the southeastern region of the country.

The remaining portions of this section explore the key role of southern livestock in the national development strategy, the benefits projected for mixed farming, and the issues involved in deriving a satisfactory explanation to the problem of why virtually no sedentary farmers maintain cattle on their land holdings. The next section examines the farm management survey data on labor availability and allocation within the sample, with a view to establishing the basic data for the modeling exercise. The use of land and capital, the extent of cattle ownership, and the evaluation of farm output in the research area are then dealt with. The next section concerns the construction of an appropriate model and presents the proposed vehicle for testing the major hypothesis. A summary of results obtained from different versions of the basic model precedes the analysis of the opportunity cost of scarce resources under different assumptions. The paper concludes with a brief discussion of desirable policy actions relevant to the intensification of livestock production in the southern areas of the country.

### The Key Role of Southern Livestock in the National Development Strategy

The following assessment by a major international donor agency in the West African Sahel succinctly portrays the crucial development role played by livestock activities in the Voltaic economy (USAID, 1975, p. D-34):

The livestock sector in Upper Volta as in other West African countries serves a number of vital functions. It provides subsistence for a large number of pastoral and sedentary producers and a surplus of meat and milk for urban populations. It is a valuable source of foreign exchange not only from the export of meat, but also animal by-products, particularly hides and skins [and animal manure] for crop producers who tend livestock or make their fields available to the animals of migratory herders. It is a way to help to maintain soil fertility and to improve soil structure. Ownership of cattle and other livestock is an investment and form of savings for pastoral and sedentary producers that assures survival in times of

stress, satisfies social obligations, and adds to social status. In normal times, national livestock production activity represents a considerable source of revenue to the government through direct taxation.

Historically, policy makers have focused attention on stockraising in the northern, or Sahelian, part of the country. However, the severe drought in the Sahel during the early 1970s served to underscore the fragile ecology of the area as a cattle producing region. Tyč (1975, p. 10) estimates that the herd in the northern (Sahelian) part of Upper Volta decreased by 32 percent between 1969 and 1974. He estimates that the herd in central and southern Upper Volta increased by 10.4 and 15.9 percent, respectively, during the same period. This leads to an assessment for the end of 1974 of 408,000 head of cattle in the Sahelian north and 2,132,000 head in the center and south of the country. Thus, one-sixth of the Voltaic herd was to be found in the north at the end of the drought, while the rest were in the center and south, with over a quarter specifically in the south.

These findings have led some observers to conclude that the growth in herd size and increases in slaughter rates that occurred during the fifties and sixties were a temporary phenomenon, due to above average rainfall in that period (USAID, 1975, p. D-34). During years of low or average rainfall, in this view, the northern pastoral system cannot be relied upon to produce further sustained growth in animal production, along with the attendant development linkages specified above. As a consequence, analysts have turned to the relatively more humid savannah area of the country in search of a location for increased livestock production. In this context, one of the foremost observers of Voltaic livestock production activities has concluded: "The development of animal production should be sought essentially through a better integration of stockraising into agriculture."<sup>1</sup>

Since the report containing this quotation was issued (May 1975), Voltaic animal production policy has emphasized increased activities in

---

<sup>1</sup>Tyč (1975) p. 14, my translation of: "Le développement de la production animale doit être recherché essentiellement par une meilleure intégration de l'élevage dans l'agriculture."

southern areas (GOUV, MDR, 1976). Major initiatives envisioned on the production side have been improved veterinary services, state feedlots, and small-scale on-farm fattening operations. There has also been renewed discussion of a "stratification" strategy of the type proposed for Cameroon in Ferguson (1973). Tyē (1975, p. 57) proposed that the southern farmer should purchase a northern-born bullock at eighteen months, graze it for extra weight for one year, and then use it for three years for animal traction, prior to selling it for the beef market. This strategy leaves an important livestock breeding role for the north, while removing a key stage in the livestock production chain from the vicissitudes of Sahelian weather.

#### Projected Benefits of Mixed Farming for the Smallholder

The most often cited advantages of keeping cattle on smallholder farms are: the use of manure as fertilizer on crops, a source of milk for sale and better nutrition, better surveillance of household animals relative to entrusting cattle to outside herdsman, the extra weight gains from the use of crop by-products as forage, and a source of power for animal traction. These will be briefly explored below. Each of these benefits would be lost if household animals are entrusted to semi-sedentary Fulaani herdsmen who live outside the village. The discussions of mixed farming that cite these advantages all seem to ignore the non-cash cost of resources used to maintain the stock.

The literature strongly supports the view that cattle manure boosts the yields of grain, legumes, and cash crops (McCalla, 1975; Dupont de Dinechin et al., 1969; Guinard, 1967). Experiment station research has shown that the addition of a dozen metric tons of cattle waste to an hectare of previously unfertilized sorghum field can provoke yield increases of the order of 300 percent (Dupont de Dinechin et al., 1969). This is clearly a crucial issue, since an agricultural sector amendment for Upper Volta by USAID attributes three out of four major food production problems in the area to the generally low productivity of the Voltaic farming system (USAID, 1975, p. D-13). "Population pressures leading to serious overexploitation of land resources and deteriorating soil productivity in some areas" are

singled out as crucial problems facing the food crop subsector (Ibid.).

The advantage of a daily source of fresh milk cannot be ignored in the context of a population with a high percentage of children whose diets are protein deficient. Without refrigeration it is difficult to depend upon local markets for dairy products. Furthermore, at 25 CFA per liter for milk, the ownership of a lactating cow implies a nonnegligible amount of purchasing power.<sup>1</sup>

One possible advantage of maintaining household cattle on the farm is better surveillance and care for the animals. This minimizes the danger of theft by herdsmen or the neglect of young stock by not allowing the calves enough milk. The argument is that no one cares more about the animal than the owner.

Another benefit occasionally projected for mixed farming is that animals can be fed a more nutritious diet, using crop by-products in addition to range grazing. Animals kept on the farm would have access to feedstuffs that would not be available to them if they were kept outside the village by the Fulani. The extra weight gains attributable to an improved diet are at issue, since the owner of an animal benefits from the normal weight gain over time, whether the animal is entrusted to a herdsman or not.

Finally, the most controversial advantage of keeping cattle on the farm is the possibility that this introduces for animal traction cultivation. The evidence available thus far is inconclusive. On the one hand, experiment station personnel enthusiastically recommend ox plowing as a means of increasing both yields and the area cultivated (Dupont de Dinechin et al., 1969). On the other hand, there are the disappointing results of a "pilot farm" project in the 1950s and a major initiative to introduce donkey traction to the central part of the country in the 1960s. The first experiment ended after three years, when "the majority of the 500 or so farms thus established (with traction and other farm equipment) had

---

<sup>1</sup>Following Delgado (1979, p. 165), a mixed zebu-N'dama cow is assumed to produce 150 kg of saleable milk each lactation, with a market value of 3,750 CFA or \$16.30 at \$1 = 230 CFA. This can be compared to an estimated annual cash income for a rural household in the research area of roughly 47,000 CFA in 1976, or \$200 (Ibid. p. 200).

reverted to the traditional pattern." (De Wilde et al., 1967, II, p. 373). The second experiment, which involved thousands of Mossi farmers during the sixties, appears to have failed through the inability of the agriculturalists to repay the funds used for the purchase of the equipment (Mesnil, 1970, VIII). This was interpreted at the time as the result of the use of the equipment on millet and peanuts, rather than on cotton (Ibid.).

It is noteworthy that the nine-volume study analyzing the lessons of the failure of animal traction on the Mossi Plateau (Mesnil, 1970) fails to consider the opportunity cost of the labor resources required to maintain the animals or use these techniques effectively. Rather, the analysis of the animal traction problem, like the discussion of the other benefits to mixed farming, compares the direct production benefits of enterprises to the cash cost of purchased inputs. The implicit assumption is that any extra labor required to implement these activities is free, in the sense that work input can be increased throughout the year without decreasing any of the other farm outputs. This assumption appears to result from the observation of underemployed labor on farms during a large part of the year.

#### The Problem With the Mixed Farming Model at the Household Level

In light of the many benefits attributed to mixed farming, it is curious that practically no predominantly farming-oriented ethnic groups in Upper Volta keep cattle (Jeune Afrique, 1975, p. 34). Instances of peasant-owned cattle are common, although they are almost always entrusted to semi-sedentary herdsman of the Fulani ethnic group.<sup>1</sup> The consensus among expatriate advisors and many Voltaic officials appears to be that "psychological" reasons prevent the dominant farming groups from integrating cattle with crop growing. Examples of this form of argument would

---

<sup>1</sup>The term "peasant" is used interchangeably with "farmer." The former term accurately describes the position of most Voltaic smallholder agriculturalists, in terms of relations with traditional authorities and labor-intensive methods of cultivation. The Fulani, on the other hand, are uniformly designated as "herdsman," even though they frequently cultivate substantial areas of crops, in addition to their livestock activities. Details of the cattle-entrusting relationship may be found in Delgado (1977).

be that farmers are afraid of large stock, unwilling to live with them in bush areas, or not sufficiently confident of their knowledge of how to care for them. On the other hand, the major hypothesis to be explored in this paper is that the high opportunity cost of labor at certain peak periods, coupled with a lack of easily available forage and a desire for on-farm self-sufficiency in food grain production, can offer an "economic" explanation of why peasants like to own cattle, but not to look after them.

The existence of seasonal peaks of labor use in African agricultural systems with one rainy season is well known (Cleave, 1974, pp. 39-41; De Wilde, 1976, p. 23). Lahuec (1970, pp. 74-75) has documented these for central-eastern Upper Volta. Some evidence exists that it is the shortage of labor during one or two critical periods which determines the amount of the harvest (De Wilde (I), 1967, pp. 71-77). The implication is that labor available at certain critical times is a scarce resource, the allocation of which helps to determine the pattern of outputs of the farming system.

To the extent that this is the case, the labor required to feed and water livestock during these periods of peak labor use is a resource taken away from other activities, and is thus associated with a fall in the production of the other farm outputs. This is especially true where the timing of agricultural operations must be rigidly adhered to, allowing little substitutability between labor inputs in different periods (De Wilde, 1967, I, p. 84; Ruthenberg, 1976, p. 80; Delgado, 1979, p. 104).

In Upper Volta, approximately three-quarters of the area cultivated is under millet and sorghum, the principal food staple in the country (RHV-IRAT, 1972). Given the predominance of millet and sorghum in farm output, it is likely that labor removed from the pool of available resources at peak weeding and harvesting periods will decrease the amount of food grains produced. This is especially true if the type of labor required for stock work during the rainy season is fully transferable to crop work, as is true for young adult labor. Other results indicate that this may be the case (Delgado: 1977, pp. 60-65; 1979, pp. 125-128). To the extent that this is true, keeping livestock on the farm has an opportunity cost in terms of food grain. If stock are range-fed on free land outside the village, the opportunity cost is measured through the reallocation of labor from food grains to herding. If the animals are fed with produced forage,

then the opportunity cost is calculated by taking both labor and land into account. A supplementary cost of maintaining cattle in the village during the cropping season is the risk of crop damage by the animals.

Farmers in the Savannah may be quite reluctant to incur a high new cost in terms of foregone food grain production. Hunter (1966, p. 33) presents chilling evidence of chronic seasonal famine in Nangedi, on the Ghana-Upper Volta frontier:

In June, at the time of the second measurements with some 3 to 4 weeks of hunger to face, levels of nutrition had greatly deteriorated: 88% of the community was underweight ... 23% of the men and 36% of the women were "seriously" to "very seriously" underweight.

Within this context, there is little margin for miscalculating the ability of next year's market to supply staple grains for family nutrition, given the penalty of being wrong. The position of much of peasant Savannah agriculture at the margin of subsistence helps to explain the conventional wisdom concerning planting decisions in West Africa, to the effect that the farmer wishes to be assured of self-sufficiency in food grains, even in the event of below-average rainfall.

In sum, the feasibility of the intensification of livestock production by sedentary farmers hinges not only upon the projected benefits, but also upon the possible opportunity costs in terms of other farm products, principally foregone food grains. If this opportunity cost is prohibitive, or if farmers are unwilling to rely upon the market to supply their food, then attention must be paid to the food grain production system before cattle production can be increased. In this event, policy makers will need to modify the farming system itself, in order to permit the entry of a new activity. A paradoxical result would then emerge to the effect that an improvement in the output of food grains per labor hour expended during peak periods would be the best way of encouraging a long-term expansion of sedentary livestock production.

### The Farming Systems Approach and Data Collection

An adequate test of the hypothesis elaborated in the previous section requires a conceptual framework for the simultaneous consideration of resource inputs and the optimal value of an overall farm output composed of many different products. A linear programming model of a typical peasant farm in southeastern Upper Volta was designed to shed light on these issues. This methodology is appropriate for identifying the production strategy that maximizes farm income under different assumptions. It serves to identify critical resource constraints and calculates the opportunity cost of inputs that are fully used in the optimal solution to the model. Furthermore, this procedure has the overriding advantage of being easy to use, since its application to agricultural production problems is well established and computer routines are available (Beneke and Winterboer, 1973).

The problem with the linear programming approach is that the value of results depends to a high degree upon the accuracy and detail of the underlying data. This requirement indicates the need for a systematic and detailed method of data collection extending over at least one calendar year. In this vein, the author designed and implemented a farm management survey in southeastern Upper Volta, of the type advocated by De Wilde (1967, I) and Ruthenberg (1976), and performed by Collinson (1972), Norman (1973<sub>b</sub>), and Shapiro (1973).

The environs of Tenkodogo in the central southeastern portion of the country were chosen as the research zone. The town is 180 kilometers from the capital by a new paved road. Mixed farming is both technologically feasible and encouraged by the Voltaic government, although the practice was virtually non-existent in the area as of 1977. It is in the middle of the region proposed by USAID for sedentary livestock intensification (Upper Volta Village Livestock Development Project). The dry season usually lasts from mid-October to mid-May, with an average of 950 millimeters of rain during a five-month wet season. The principal crops are millet, sorghum, cowpeas and peanuts. Small stands of rice and cassava are also frequently cultivated on bottom land. Soils in much of the research area are poor, with often less than a foot of sandy topsoil covering an impermeable lateritic crust. After the rainy season, abundant grass cover is available,



including much-sought-after fodders such as Andropogon guyanus (Benoit, 1974, pp. 20-23). Grasses rarely grow over one meter high, and large areas are consumed by brush fires each dry season. Mango and shea nut trees are found in abundance.

The density of the cattle population in the research zone is estimated at 9 head/km<sup>2</sup>, compared to a national average of 9.5 head/km<sup>2</sup>. (Delgado, 1979, p. 25). Tenkodogo is just inside the climatic belt subject to trypanosomiasis. The cattle kept are of mixed breed, with the smaller trypano-tolerant races well represented. A majority of the inhabitants of the area derive their cash incomes from crop sales rather than from livestock, even if the latter is defined to include poultry (ORSTOM, 1975, II(3), Figures 17 and 18). On most counts, the environmental characteristics of the research zone are representative of much of the West African savannah.

The specific research site is composed of the cantons of Oueguedo and Loanga, whose main villages, ten kilometers apart, define the base of a triangle with Tenkodogo proper at the apex, eight and five kilometers away from the villages. The town of Tenkodogo is an administrative center, with approximately eight thousand inhabitants. The population density of the immediate research area is roughly 40 inhabitants/km<sup>2</sup>, or twice the national average. In this respect, the research site is not representative of the savannah as a whole at the present time. With rapid African population on arable land, however, the region does illustrate the problems that most areas nearby will soon have to face.

The inhabitants of the village of Oueguedo are almost exclusively from the Mossi ethnic group, which accounts for half of the population of Upper Volta. The people of Loanga are from the ethnically-distinct Bisa group. Apart from cultural differences, the two villages are very similar with respect to their environmental characteristics. Semi-sedentary Fulani pastoralists live on the outskirts of both hamlets, close to bush areas. While the rural Mossi and Bisa are primarily smallholder peasant-farmers, the Fulani are the predominant herding group in West Africa.

A sample of thirty households was randomly selected within each village. After the elimination of unrepresentative cases and the results from an enumerator who proved to be unreliable, the final sample included 26 Mossi and 15 Bisa households.<sup>1</sup> Each farm was visited twice a week from May 1976 until May 1977. The prime example of data collected during these visits consists of all the labor hours devoted by each household member to each task, each day, throughout the year. This includes labor by visitors, neighbors, and paid workers. The 750 fields cultivated by sample members were also measured, and 170 yield plots were kept. Livestock and capital good inventories and field histories were also collected. A concomitant five-month, six-visit survey of twenty Fulani households living near Oueguedo provided information on herd sizes, herd composition, and animal husbandry practices.<sup>2</sup> The massive amount of data accumulated by the surveys were synthesized by computer and analyzed in detail in chapters four through seven of Delgado (1979). The highlights will be briefly presented in the next two sections before proceeding to the consideration of the basic farm production model from the data.

---

<sup>1</sup>The village chiefs were judged to be unrepresentative cases, but were interviewed along with the other sample members for reasons of protocol. The details of household definition, sample selection, and the methodology of data collection may be found in Delgado (1979), pp. 43-75.

<sup>2</sup>The complete list of data collected by the farm management survey is given on pages 70-71 of Delgado (1979). The set of questionnaires used is contained in appendix C to this reference.

LABOR USE BY SAMPLE FARMS

Rationale for a Detailed Analysis of Labor Allocation

The analysis of labor use on sample farms serves to identify several key characteristics of the agricultural production system in the research area. In addition to the descriptive value of estimated labor allocations to each activity, the information generated will form the basis of the farm production model used to test the principal hypothesis. The value of the model results depends very much on the precision of the parameter estimates. Therefore, a major component of this study consists of the careful collection and synthesis of the daily work hours of every sample member, throughout the year.<sup>1</sup>

The Division of Labor and the Lack of Hired Help

In the first analysis, the breakdown of work hours by age, sex, and household status differences was useful primarily to establish an accurate division of labor, and also to measure the incidence of cooperative and hired work. There are three main results in this vein.<sup>2</sup> First, the division of labor is not immutable. There are distinct differences in the sexual division of labor between the three ethnic groups; most tasks, however, are shared between the members of all the age and sex categories. Virtually no activities are the exclusive domain of any one group. Second, cooperative labor supplied by neighbors can account for up to a tenth of the total hours worked during the peak weeding and harvesting periods. Nevertheless, this is not a pure gain for the household, since members are often required to repay the favor in kind. Third, sample members virtually never use

---

<sup>1</sup>The farm management survey collected the basic labor data by repeating the interviews every three days. The raw information is aggregated into the hours spent by each age and sex group, within each household, at each task, on each field, during each fortnight of the year. Similar information is compiled for male and female cooperative labor and hired help. Each datum measured in hours pertains to one level in each of several categories. The possible choices relate to 41 households, 26 fortnights, 750 fields (if applicable), 9 labor types, and 34 possible activities. The analysis of this immense dataset is made possible by aggregation over one or more of the strata.

<sup>2</sup>The reader interested in the detailed derivation and statement of these results is referred to Delgado (1979) pp. 76-79.

hired labor on their farms. The only exception is mango picking during the period of relatively slack labor in April. This implies a lack of an easy means of relieving a seasonal labor bottleneck with outside manpower.

Unlike many farm management surveys (Collinson, 1974, pp. 200-202), no effort was made to weight the labor hours supplied by persons other than prime male adults using "man-equivalent" coefficients of less than one. Since the study recorded the actual time spent at each task by each person rather than simply the number of workers, the argument that non-adult male and female workers tire sooner is not applicable here. This is because such behavior is automatically taken into account by the recording of less labor hours by these workers.<sup>1</sup>

In the subsequent analysis, the data are aggregated over all nine labor types in the form of estimates in terms of household labor hours. In order to get observations valid for an "average" farm, similar types of data were averaged over the forty-one households in the sample, to obtain the mean household labor hours for each fortnight, field, and activity.<sup>2</sup>

#### The Agricultural Calendar and Labor Use by Major Sector of Activity

The single most striking aspect of the agricultural system in Tenkodogo is the sharp seasonality of all operations. Therefore, the timing of labor input is of crucial importance to the effectiveness of operations. Table 1 gives the approximate agricultural calendar observed during the research period, and the correspondence of dates to the fortnight codes that will

---

<sup>1</sup>The only excuse for the use of man-equivalents in this context, then, is the assumption that work by women and children is of lower quality than that of males in their prime. This viewpoint will be rejected out of hand, since, as Collinson (1974, p. 201) points out, no one has ever demonstrated this, and it runs counter to the subjective impressions of the author. In any event, an attempt to weight the hours allocated by each type of labor would most likely introduce more inaccuracies than it would eliminate.

<sup>2</sup>The mean number of hours worked per household each fortnight was computed separately for both the Mossi and Bisa households. Tests revealed no significant differences between the means for the two ethnic groups, at the 95% confidence level. Other similarities observed in labor allocation to major tasks such as seedbed preparation and weeding indicated the desirability of pooling the data for the two groups. Taking the means over the larger sample presumably reduces the chance of sampling error.

TABLE 1

CALENDAR OF THE 1976-77 AGRICULTURAL YEAR  
(Divided into Fortnights)

<u>Calendar Dates</u>			<u>Fortnight Code</u>	<u>Principal Activity of Sample</u>
9	May - 22	May 1976	1	Sorghum Planting Begins May 9, Fields Prepared for Rice, and Planted
23	May - 5	June	2	First Weeding of Sorghum, then Millet Planted
6	June - 19	June	3	Groundnuts Planted
20	June - 3	July	4	Second Weeding of Sorghum and Millet, Cowpeas Planted, Rice Weeded and Transplanted
4	July - 17	July	5	
18	July - 31	July	6	Third Weeding and Ridging of Cereals
1	Aug. - 14	Aug.	7	
15	Aug. - 28	Aug.	8	Weeding of Root Crops, Cotton, Tobacco and Vegetables
29	Aug. - 11	Sept.	9	Maize Harvest
12	Sept. - 25	Sept.	10	Sorghum Harvest
26	Sept. - 9	Oct.	11	Relative Slack
10	Oct. - 23	Oct.	12	Cowpea Harvest
24	Oct. - 6	Nov.	13	Groundnut Harvest
7	Nov. - 20	Nov.	14	Millet Harvest, Rice Harvest
21	Nov. - 4	Dec.	15	
5	Dec. - 18	Dec.	16	Fence Construction Around Gardens
19	<u>1976</u> Dec. - <u>1977</u> 1	Jan.	17	Drying, Transport, Threshing, Storage of Cereals and Legumes, Period of Ceremonial Duties Begins (Sacrifices to Ancestors and Celebrations for the Dead)
2	Jan. - 15	Jan.	18	
16	Jan. - 29	Jan.	19	
30	Jan. - 12	Feb.	20	
13	Feb. - 26	Feb.	21	Non-Agricultural Work and Ceremonial Duties
27	Feb. - 12	Mar.	22	
13	Mar. - 26	Mar.	23	Manure Spread on Fields, Other Field Preparation, House Repair, Peak Period Ceremonial Duties
27	Mar. - 9	April	24	
10	April - 23	April	25	
24	April - 7	May 1977	26	

subsequently be used in graphs and in the model.<sup>1</sup>

The hours worked by each household each fortnight are divided between the following five major sectors of activity: nonagricultural, domestic, agricultural (crop), livestock work and social activity. The latter consists principally of visiting with neighbors or relatives. The total labor hours performed each fortnight by each household are averaged over households within each sector of activity and graphed in Figure 1. The total work load is heaviest during the rainy season, which corresponds to the crop-growing period. Social activity increases sharply as agricultural work diminishes in early October. Nonagricultural and domestic work increase as the burden of crop and livestock work decreases.

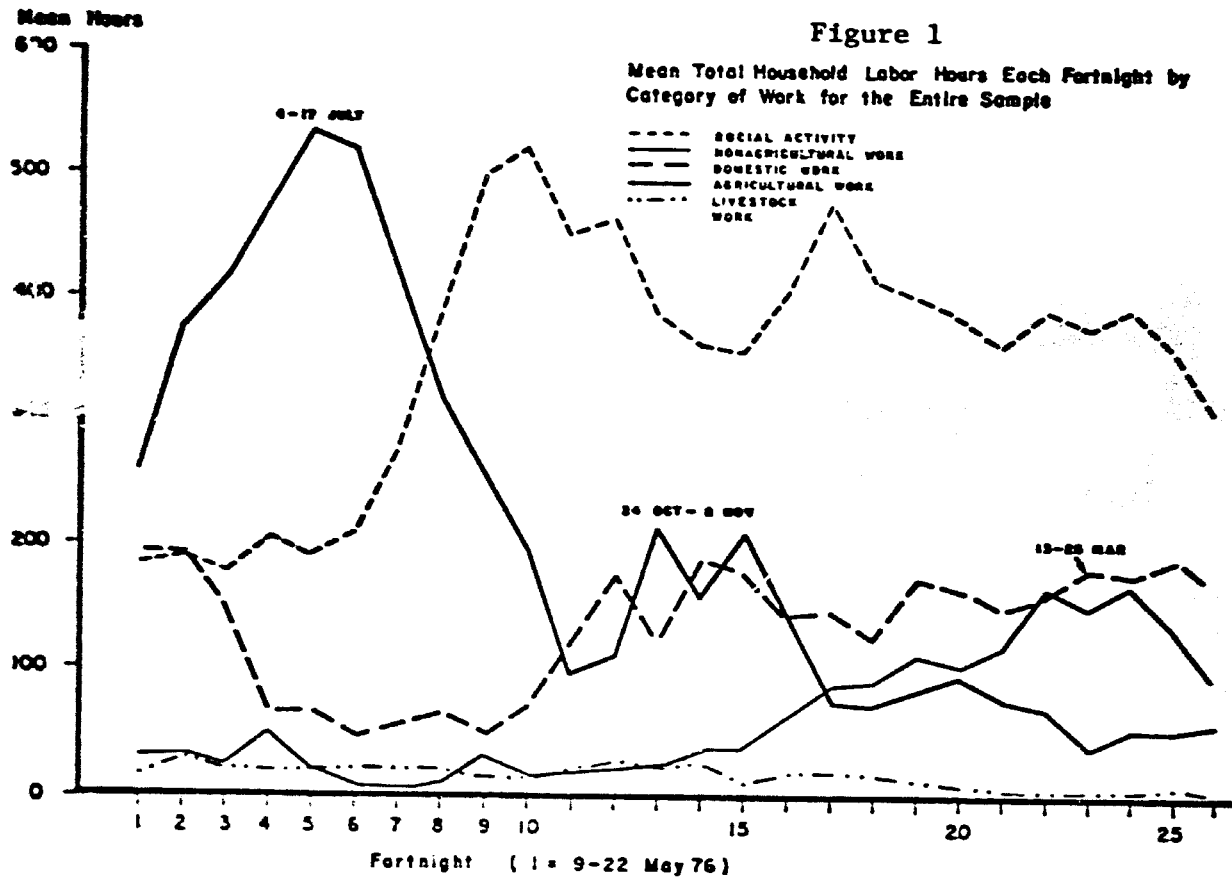
The relatively low levels of nonagricultural and domestic work observed in July and August do not necessarily indicate that these activities can be compressed during the dry season in the event of the introduction of a profitable new activity requiring labor at that time. Many of the nonagricultural tasks performed after the rainy season can be put off until another time of year, but they must be undertaken at some point. Roof repair provides an example of this form of activity. Domestic work, in a comparable vein, can be compressed for relatively short periods, but a family cannot live on skimpy meals and a nonrenewed supply of firewood throughout the year. Similarly, relaxation with friends, marriages, and other social functions can be delayed, but not abandoned. The conclusion is that the supply of labor during periods of relative agricultural slack may not be as elastic as the paucity of agricultural activity at this time may seem to indicate.

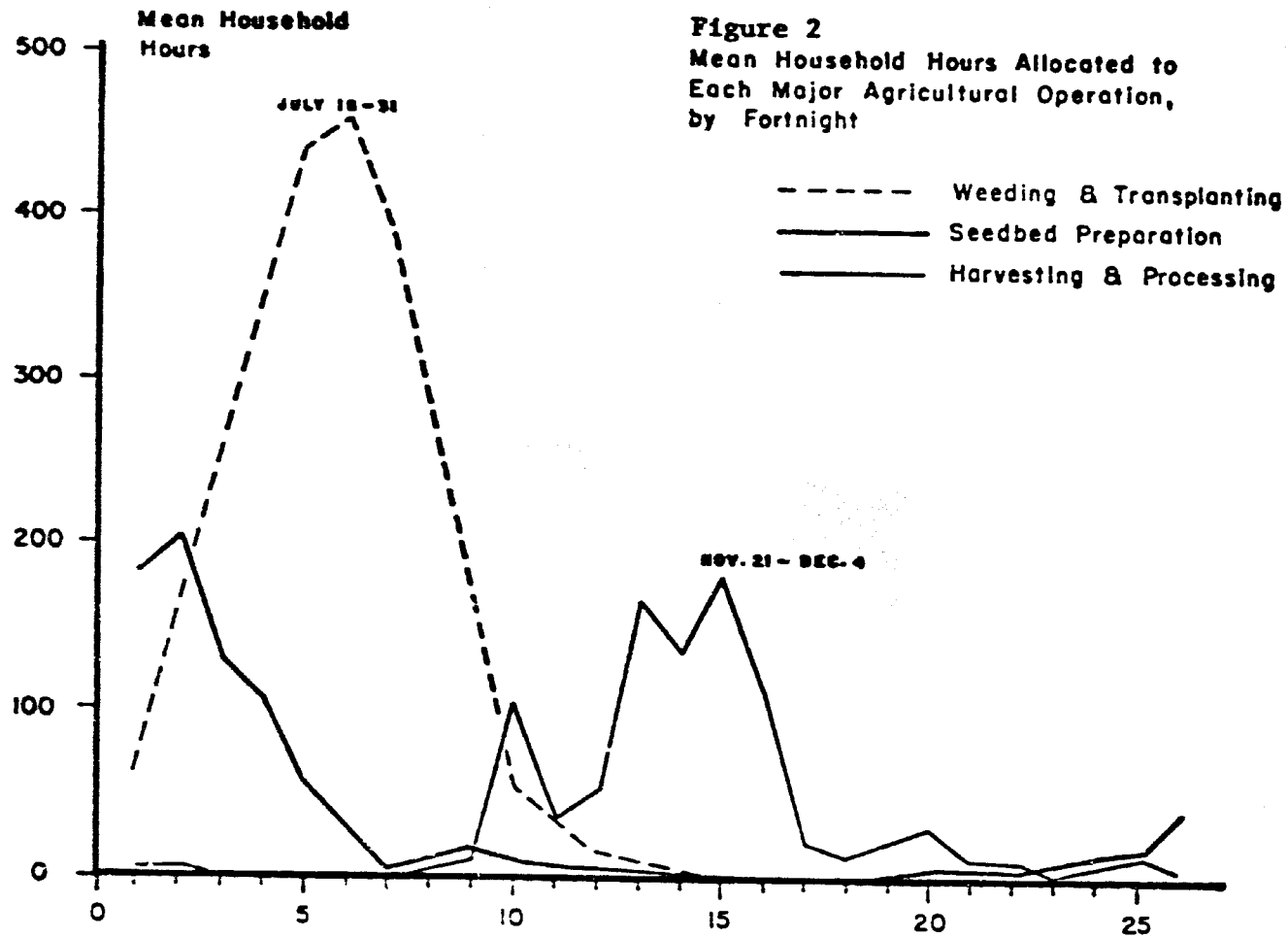
#### Labor Use by Major Agricultural Operation

Following Collinson (1972, p. 219), the three main crop activities in tropical Africa are defined as seedbed preparation, weeding and transplanting, and harvesting and processing. Figure 2 portrays the mean household

---

<sup>1</sup>The fortnights were coded in order to retain legibility and ease of handling. Fortnight one refers to the first two weeks after the beginning of the rainy season in 1976. Thus, work performed on August 19, 1976, falls within fortnight eight. The end of the rainy season of the research year occurred during fortnight twelve, in mid-October.







labor allocation, in hours per fortnight, to each one of these tasks, over the year. The period of peak activity occurs during July. The main activity at this time is the weeding of cereals, principally millet. Secondary peak periods of labor use occur in late May (planting) and November (the millet harvest). A minor interval of intense agricultural activity occurs in fortnight ten, when sorghum is harvested.

These peaks have particular significance for farm-level planning because of the relative inflexibility of labor requirements in rainfed subsistence agriculture. The crops compete with weeds for predominance in the fields during July, necessitating a prompt weeding. Grain that is not harvested after early December is likely to be severely damaged by pests and livestock. These conditions create bottlenecks when other inflexible demands for labor, such as the time required to tend livestock, are encountered during July and November.

#### Household Labor Allocation to Crops

The mean household hours allocated to a major crop mixture each fortnight provide an indication of its relative labor intensiveness at different times of the year.<sup>1</sup> The estimates for the seven major crop enterprises are given in Table 2; the last line of the table contains the sum of hours per hectare allocated to the mixture in question over the year.

The predominant food crop of millet mixed with cowpeas is significantly less labor-intensive per unit of land than the high value cash crops: cotton with tobacco, fruit, and vegetables. On the basis of total labor input, peanuts (or groundnuts), maize, and rice fall in the intermediate zone, between the two extremes. However, the work requirements for these crops during

---

<sup>1</sup>The household labor allocation to each major crop category each fortnight is divided by the total household area planted with the crop in question, to get the household labor hours spent per hectare for each crop and fortnight. The mean of these figures over households gives the number of hours spent by members of the average farm each fortnight, on each major crop category.

TABLE 2

MEAN TOTAL HOUSEHOLD HOURS SPENT PER HECTARE OF EACH CROP CATEGORY

<u>Fortnight</u>	<u>Millet and/or Sorghum with Cowpeas</u>	<u>Groundnuts</u>	<u>Maize</u>	<u>Rice</u>	<u>Root Crops</u>	<u>Cotton and Tobacco</u>	<u>Fruit and Vegetables</u>
1	134	0	0	2	1	0	0
2	170	115	280	204	26	0	0
3	159	174	549	264	0	0	0
4	172	109	119	327	10	0	0
5	146	216	589	380	16	67	53
6	157	293	392	355	91	6	6
7	105	142	200	283	259	293	231
8	86	102	38	171	256	1100	875
9	85	29	74	31	42	88	88
10	27	17	0	40	66	10	277
11	5	22	0	45	300	264	235
12	28	106	0	127	313	88	201
13	32	265	0	114	175	792	109
14	176	329	0	194	101	378	78
15	94	38	0	31	106	110	104
16	8	3	0	4	98	1144	174
17	0	0	0	0	215	440	398
18	0	0	0	0	118	220	454
19	0	0	0	0	62	0	450
20	0	0	0	0	30	0	335
21	0	0	0	0	53	0	391
22	0	0	0	0	20	0	416
23	1	0	0	0	4	0	303
24	3	0	0	0	0	0	386
25	8	0	71	0	0	0	391
26	21	0	69	0	0	0	37
<b>Σ-26</b>	<b>1617</b>	<b>1960</b>	<b>2256</b>	<b>2592</b>	<b>2067</b>	<b>5000</b>	<b>5892</b>

the peak seasons in July and November are very high relative to millet. Cassava presents the advantage that the main labor input comes outside the period when labor bottlenecks are likely to occur.

For the purposes at hand, it is very important to note the sharp peak in labor demand for millet, in fortnight fourteen. This corresponds to the grain harvest in November. The greater the proportion of farmland put under crop combinations involving millet, the greater will be the possibility of a harvest labor bottleneck in mid-November. Adding a farm livestock enterprise, which requires labor input at this time, will tend to aggravate the labor shortages associated with a desire for farm self-sufficiency in food grains.

#### Household Labor Allocations to Livestock

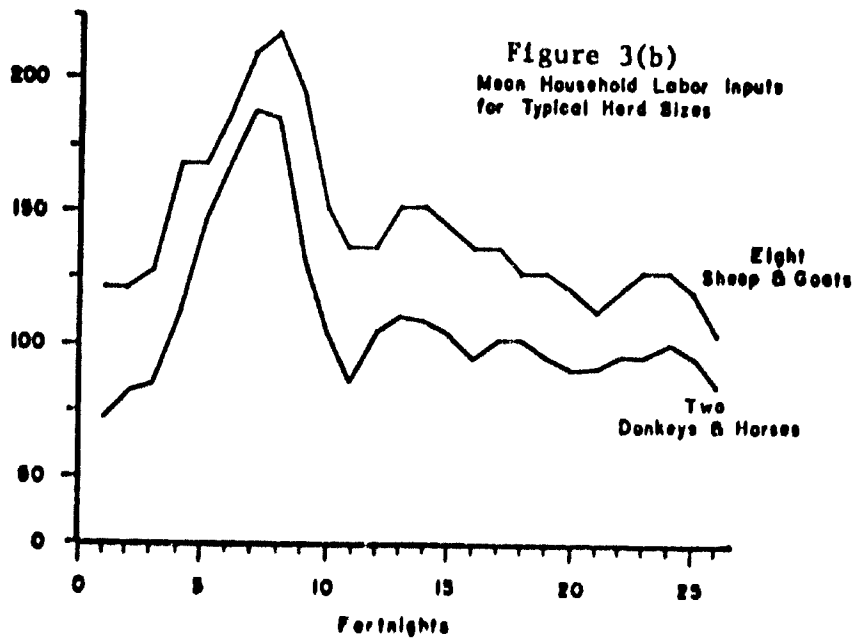
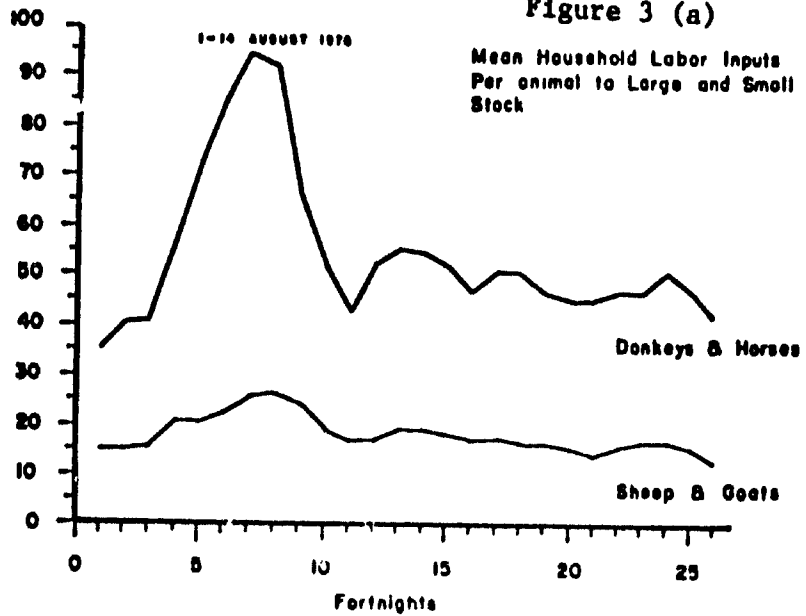
The Mossi and Bisa farmers in the sample kept sheep, goats, pigs, donkeys, horses, and poultry on the farm. No household maintained cattle, although several farmers owned animals entrusted to Fulani sample members. It is therefore possible to directly observe farm labor allocations to small ruminants, swine, and donkeys and horses. However, the amount of labor required to raise cattle must be inferred from the information provided by the Fulani sample.

Figure 3 (a) contains the estimates from the farm management survey data of the per animal labor input to donkeys and horses, on the one hand, and sheep and goats, on the other.<sup>1</sup> The figures cited are meaningful primarily for herds of a size commensurate with number of animals kept by the average farm. This results from the existence of economies of scale in herding which operate to diminish per animal labor requirements as herd size increases.

---

<sup>1</sup>The per-animal labor allocation for each activity actually undertaken by the household is calculated by dividing the total household work involved with each animal category by the number of head owned in that category. The values thus calculated for each household and fortnight are then averaged over households to obtain the mean labor allocation per head to each type of animal. Only four households in the sample kept swine, which counsels caution in interpreting the results. This procedure is not meaningful at all for poultry, where the relative magnitudes make useful measurement impractical.

Mean Household  
Labor Hours

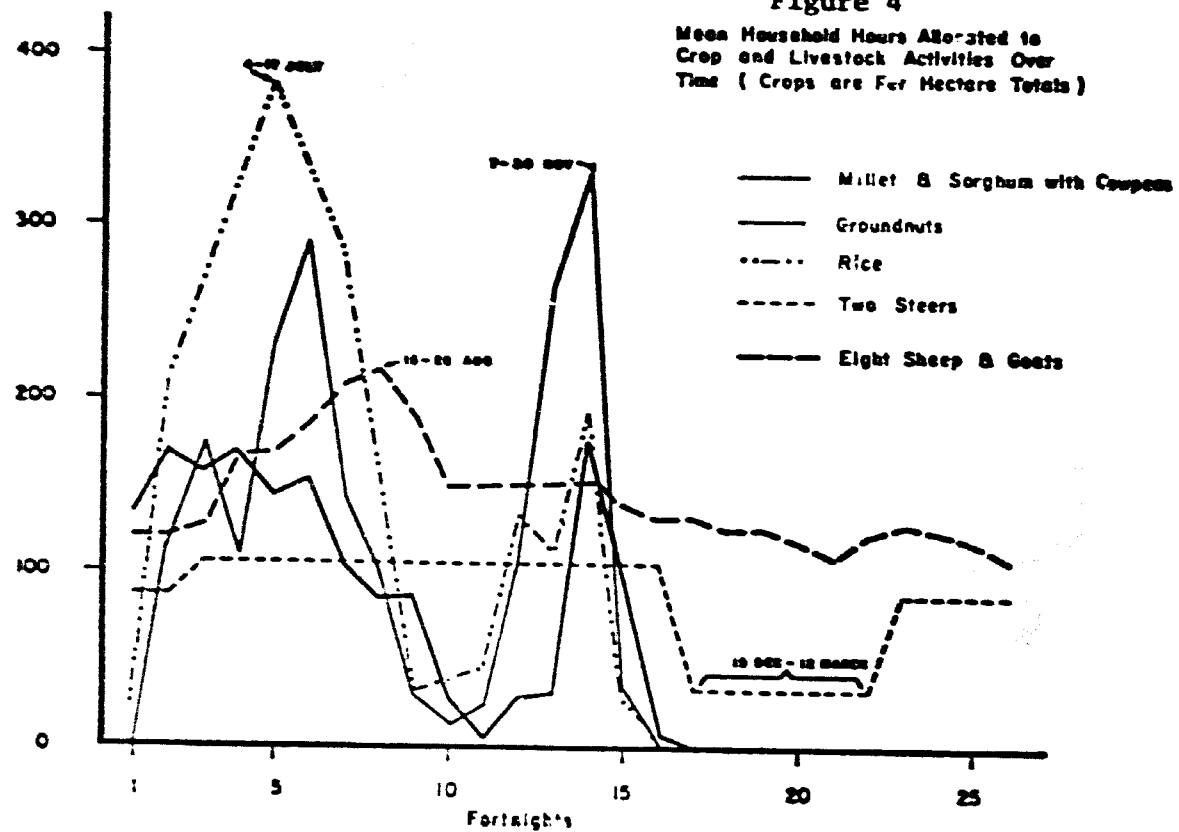


The distributions of labor requirements for animals over time in Figure 3(a) show that there is a distinct increase in the labor input to livestock during the height of the rainy season in August. This phenomenon is displayed even more clearly in Figure 3(b), where the per-animal allocations are multiplied by the number of animals typically kept by a household. Perhaps the best explanation for the peak in labor input to livestock is that great care must be exercised in grazing animals during the crop-growing season. This is because fields are not fenced, and almost all the land close to the village is under crops. As the rainy season wears on, the small amount of forage within the village is exhausted, and small ruminants must be tethered farther and farther away from the compound each day. Large stock are typically entrusted to relatives or herdsmen who live on the periphery of the inhabited area. The implication of the rainy season peak labor requirement for livestock is that the maintenance of cattle on the farm at that time precipitates a resource use conflict with crop enterprises. The extent of the trade-off between crops and cattle kept on the farm depends upon the labor requirements for both activities, with only the former directly observed in the sample.

#### Labor Requirements for Cattle and the Conflict between Crops and Livestock

The fortnightly labor requirements for maintaining two head of cattle on the farm for the purposes of growing-out for beef sale are derived from the results of the Fulani herder survey (Delgado, 1979, pp. 125-130). A separate forthcoming labor use survey of the Tenkodogo Fulani by the author confirms that the estimates used are approximately of the order of the actual labor allocation to cattle by the Fulani during the 1977-78 rainy season. The derivation used in the earlier report assumed that two animals require six hours of daily maintenance and supervision during the first month after planting, in order to prevent damage to the new sprouts. During the growing season, from early June until after the millet harvest in early December, the herd is assumed to require 7.5 hours daily. The time required for preventing damage to vegetable gardens and for watering amounts to 2.5 hours, by assumption, during the dry season. In practice, the actual labor involved in cattle supervision at this time is much

Mean Household  
Hours Per Unit



greater. However, most of the work can be performed by small children, provided that there is abundant crop stubble for feed. As such, this supervisory work entails a relatively low opportunity cost in terms of other outputs. When forage close to the village disappears towards the end of the dry season, however, the men must take the animals into the river valleys to feed and water them. The Fulani typically leave the village altogether at this time. The labor requirements for peasant on-farm stockraising are assumed to be six hours daily for the two head during April and early May.

Figure 4 shows the relative labor requirements at different times of the year associated with crops and livestock. The mean household labor inputs over the year to one hectare of each of the three main crops are plotted next to those for a typical herd of eight small ruminants and the hypothetical labor requirements for two head of cattle. The seasonal labor bottlenecks in July and August, on the one hand, and November on the other, are aggravated by keeping livestock. In practice, the November harvesting constraint is likely to be the most serious problem, since the high labor commitment required to farm an entire hectare of rice is rarely undertaken, while a typical farm may have two hectares of millet. The greater the desire of the farmer to produce the staple food grain, the greater the sharp demand for labor during November.

LAND, CAPITAL, AND FARM OUTPUT

Farm Land Holdings

Soils in the research area are typically divided into "upland" and "lowland" (Delgado, 1979, chapter 5). The latter category consists of the low-lying areas subject to flood in the rainy season. The earth is relatively rich in organic matter and plant nutrients. Upland soils, on the other hand, are typically covered by sandy tropical ferruginous soils over a hard lateritic crust. Areas that are cultivated for several years lose their fertility due to erosion and the lack, through flood or fallow, of nutrient replacement. Upland fields can conveniently be classified into three categories: house, in-village, and bush land. Of these, house fields are richest in plant nutrients, receiving the nightsoil and animal droppings from the compound. In-village fields, which begin within fifty meters of the household, contain the least fertile of the farm soils. These areas are continuously cultivated, because of their convenient proximity to the living area. They are a little too far from the compound, however, for fertilization with waste material from the home. Bush fields are similar to in-village fields, except that they are far enough from the farm and plentiful enough to avoid the need for continuous cultivation of the same area, year after year. These plots are typically left in fallow for several years, after three years of cropping. Thus, bush land benefits from relatively richer soils, but requires a greater labor commitment for cultivation because of its distance from the compound. Bush areas also have the disadvantage of being more difficult to protect from the ravages of pests and loosely guarded livestock.

The pressure of a growing population on a fixed supply of in-village land has contributed, in recent years, to the expansion of farm bush fields into areas that were traditionally used by the Fulani for grazing cattle. This has led to increased instances of crop damage by animals, one of the most visible forms of conflict in resource use between livestock and food grains.

The typical Mossi or Bisa farm in Tenkodogo is composed of a large number of small plots spread out over a large geographic area. Table 3



gives the mean area of each type of land farmed by an average household in the sample. The mean number of plots farmed by a given household on each type of land is also included.

TABLE 3  
MEAN HOUSEHOLD AREA AND NUMBER OF FIELDS CULTIVATED  
ON EACH TYPE OF LAND

Type of Land	Mean Household Area of Fields (in hectares)	Mean Number of Fields
House	.75	4
In-village	1.71	6
Bush	1.10	1
Lowland	.29	6
TOTAL	3.85	17

SOURCE: From the measurement of 750 fields in the sample, with the mean values calculated over 41 households.

#### Farm Land Allocation

Livestock in the research area are grazed exclusively on communal land, with the possible exception of the period after the harvest when herds are free to browse the stubble on farm fields. Even in the latter case, the use of fields for grazing is not limited to animals belonging to the farmer who cultivates the plot in question. Questions of land allocation within the farm, therefore, primarily concern the choice of cropping pattern, and not grazing.

More than four-fifths of the farmland of a typical household in the sample is cultivated with some crop mixture involving millet and cowpeas. The smallest proportion of land allocated to millet by a sample household in 1976 was 63 percent. This crop constitutes the basic source of food for the household. Sorghum is intercropped with millet and cowpeas on house fields, where the soil is rich enough in nutrients for this crop

to yield well. The other crops grown are, by order of importance: peanuts, rice, starchy roots such as cassava, and maize, in very small quantities. Table 4 gives the mean household area of farmland and the proportion of farm holdings allocated to each major crop category.

TABLE 4  
MEAN HOUSEHOLD LAND AREA AND PERCENTAGE OF FARMLAND  
ALLOCATED TO EACH CATEGORY

Crop Category	Mean Household Area (in hectares)	Mean Percentage of Household Land (%)
Millet & sorghum with cowpeas	3.27	82.9
Maize	.02	.5
Rice	.19	5.7
Groundnuts <sup>a</sup>	.27	7.6
Root crops	.06	2.0
Vegetables & fruits	.01	1.1
Cotton & tobacco	.002	.2

<sup>a</sup>Includes peanuts and an indigenous crop, Voandzeia subterranea.

SOURCE: Delgado, 1979, pp. 150-51.

Farm Access to Capital and the Investment Option Provided by Livestock

Smallholder agriculture in the research area, as in most of the Sahel, is characterized by a very low level of capital input into the production

process. The usual farm tools consist of short-handled implements with virtually no use of animal traction.<sup>1</sup> Seeds are selected from the crop of the previous year; fertilizer use is limited to nightsoil from the compound and animal dung spread on small plots of vegetables.

The typical farmer in Tenkodogo has little or no access to sources of financial capital outside his family. Wealthier peasants may advance small amounts to their neighbors for consumption purposes, against the promise of a large portion of the harvest of the following season. Bank loans are not available to the average farmer. Government credit schemes administered by the regional development authority (ORD) in the Tenkodogo area exist solely for the promotion of ox traction. This program elicited very little response from the population during the research period in 1976-77.

A brief survey of the major consumer durables owned by sample members, nonetheless, reveals that farmers do have a small amount of discretionary purchasing power (Delgado, 1979, pp.160-64). The items surveyed in 1976 were bicycles, mopeds, and radios. The inventory showed that the average sample household had a stock of these items worth approximately 20,000 CFA.<sup>2</sup> A 1973 study conducted in Zorgho, forty-five kilometers to the northwest of the research area, showed that the annual household cash income at that time was approximately 28,324 CFA, of which one-third was contributed by family members who had migrated away from the village in search of work (ORSTOM, 1975, III, pp. 71-90).

Even if farmers were to acquire access to a large amount of purchasing power, it is not clear at this time that suitable opportunities exist for investment in crop-growing. Small garden plots of market vegetables provide the one possible exception to this rule. Even if the opportunities were available, it is possible that farmers would not be able to find

---

<sup>1</sup>The exception is the occasional use of donkey carts by the wealthiest individuals.

<sup>2</sup>This was equivalent to approximately \$83 in 1976. The 1976 exchange rate used throughout this paper is 240 CFA = US \$1.00.

the necessary purchased inputs. Tenkodogo is virtually without distribution points for purchased agricultural technology adapted to the local environment.

Livestock, however, provide a productive outlet for capital investment that is easy for the Tenkodogo smallholder to take advantage of. The internal rate of return to cattle entrusted to Fulani herdsmen is consistent with the usual rule-of-thumb of a 20 percent opportunity cost of capital.<sup>1</sup> The rate of return to cash purchases of animals to be kept on the farm is higher than that for purchases of animals to be entrusted to herdsmen, but fails to take into account the opportunity cost of using resources to maintain two animals. A rule of thumb is that this cost is tantamount to the product of resources used to cultivate approximately one hectare of grain. When this cost is netted out from the projected benefits, it appears that the highest return to investment in cattle is obtained by entrusting the animals to the Fulani (Delgado, 1979, p. 174).

The calculations show that the expected internal rate of return for male cattle is 25 percent, if animals are kept on the farm and the opportunity cost of labor is not included, 8 percent if the latter is netted out, and 19 percent if the animals are entrusted to the Fulani.<sup>2</sup> The comparable figures for females are 33 percent, if the animals are kept on the farm and the opportunity cost of labor is not included, 21 percent if this cost is netted out, and 21 percent if the animals are entrusted. The figures suggest that it is clearly more profitable to entrust male cattle, while there is no extra benefit to keeping female animals on the farm, as opposed to entrusting them.

---

<sup>1</sup>See Delgado, (1979, pp. 164-75) for the derivation of these estimates. The calculations are in terms of expected values, to take account of the possibility of animal mortality.

<sup>2</sup>These estimates assume that male animals are purchased at age two and sold at age six. The returns to the activity are the annual cash value of manure used as fertilizer and the increased sale price of an older and fatter animal. Females are, by assumption, purchased at age four, and sold at age ten. The returns in this case refer to the expected value of manure, dairy products, and increased sale values.

The results are very sensitive to the assumptions on which they are based. Therefore, the issue will be resolved more satisfactorily by the linear programming model to be presented below. Suffice it to say here that the herdsmen function as mutual fund managers for the farmers. They manage a risk investment, while allowing the owner to turn his attention to other matters. A survey of cattle ownership by sample members in 1976 revealed that the sedentary farmers in the research area have non-negligible holdings of cattle.

### Farmer Livestock Ownership

The 1976 smallholder herd inventory concerned an expanded sample of 60 households. The Bisa subsample responded to this initiative in a much more satisfactory manner than their Mossi counterparts. Most likely, this is because the Bisa survey was performed by an enumerator related to the village by marriage, who intended to settle nearby after the study.<sup>1</sup> The results of the Loanga inventory correspond closely with the observations of the author and with the opinion of the neighboring Fulani who do the herding for the farmers. For these reasons, only the results of the Bisa survey are given here.

Approximately one household in three owned cattle, the average herd for those holding cattle being four head. No Bisa or Mossi farmer in the research area kept cattle on the farm in 1976, to the best knowledge of the author. Cattle were in every case entrusted to Fulani herdsmen. The average household herd of small ruminants consisted of seven to eight sheep and goats. Table 5 contains summary statistics of the different varieties of livestock owned by Bisa sample members.

Data on the age structure of the Bisa sample cattle holdings indicate that there is a distinct preference for younger female animals. No sample member owned a male animal over four years of age. Table 6 gives the age structure of the cattle listed in the Bisa survey.

---

<sup>1</sup>The importance of this may be ascertained in the remark by a sample member to the effect that if the villagers had tax repercussions from the survey, the enumerator would be the first to hear about it...(cattle were taxed 200 CFA per head in 1976).

TABLE 5  
SUMMARY OF BISA SAMPLE HOUSEHOLD LIVESTOCK HOLDINGS  
(N=30)<sup>a</sup>

<u>(Number of Head)</u>	<u>Mean<sup>b</sup></u>	<u>Standard Deviation</u>	<u>Maximum</u>	<u>Minimum</u>
Cattle	1.37	2.69	12	0
Sheep	4.63	3.74	17	0
Goats	2.83	3.47	15	0
Horses	.30	.70	3	0
Donkeys	.37	.72	2	0
Swine	.30	1.02	5	0

<sup>a</sup>Excludes the canton chief.

<sup>b</sup>Means taken over thirty households.

TABLE 6  
AGE STRUCTURE OF THE BISA SAMPLE CATTLE HERD

<u>Age</u>	<u>Males</u>				<u>Females</u>			
	<u>0-2 Years</u>	<u>3-4 Years</u>	<u>5-6 Years</u>	<u>Over 6 Years</u>	<u>0-2 Years</u>	<u>3-4 Years</u>	<u>5-6 Years</u>	<u>Over 6 Years</u>
Total Head in Sample	6	7	0	0	8	15	3	2
Mean Household Animals	.20	.17	0	0	.27	.50	.10	.07
(Standard Deviation)	(.55)	(.53)	(0)	(0)	(.78)	(1.36)	(.40)	(.37)

Given the preceding information on the use of labor, land, and capital by sample members, the next step in the construction of a farm production model is the derivation of a method for evaluating output.

### The Measurement and Evaluation of Farm Agricultural Output

Millet and rice did very poorly in 1976, while sorghum and cowpeas had relatively good yields. Given the preponderance of millet in the cropping mixture, use of data from 1976 in a comparison of the profitability of crops versus livestock tends to favor the latter, other things being equal. This trend is further emphasized by choosing a conservative set of prices to evaluate crop output. The latter are provided by using the harvest prices in December, since the price of millet and other crops may increase by a factor of two after the dry season, due to seasonal shortages. Details of the measurement of yields, involving data from 170 yield plots and a recall survey for every field in the sample, are contained in Delgado (1979, pp. 184-196). The rationale for the choice of December market prices is to evaluate output at prices which represent real terms of trade between outputs, at a time when products are available.<sup>1</sup> In that the harvest prices represent seasonal lows for crops, and December is the period of greatest body weight for cattle, the use of these prices also tends to weight profitability comparisons in favor of livestock, at the expense of crops. This bias will tend to strengthen results which show crops to be more profitable. The average yields and prices used are contained in columns (d) and (e), respectively, of Table 7.

Table 7 also serves to calculate the revenue from one hectare of each major crop enterprise undertaken by sample farms. This is a straightforward procedure in the case of crop mixtures with easily measurable components, such as sorghum, millet, and cowpeas grown on house fields. The average yields of these crops, grown on this type of land, are multiplied by the corresponding harvest prices; the products are consequently summed,

<sup>1</sup>The derivation of a set of prices for evaluating output is given in Delgado (1979, pp. 207-216).

**TABLE 7**  
**COMPUTATION OF THE REVENUE FROM ONE HECTARE OF**  
**EACH CROP ENTERPRISE**

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
Crop Enterprise	Individual Crop	Land Type	Average Yield (Kg./Ha.)	Price (CFA/Kg.)	Value of 1 Ha. Individual Crop (CFA/Ha.)	Net Revenue from 1 Ha. of Crop Enterprise (CFA/Ha.)	Enterprise Label
Red Sorghum, Millet and Cowpeas	Red Sorghum		584	19	11,096	37,700	HOUSMS
	Millet	House	343	34	11,662		
	Cowpeas	Land	713	21	14,973		
Wet Season Vegetables	Tomatoes		4,000	40	160,000	145,000	WET VEG
	Pimento	"					
	Okra	"					
Maize	Maize	"	650	32	20,800	20,800	MAIZE
Cotton and Tobacco	Cotton	"	400	33	13,200	93,200	CTNTBC
	Tobacco		400	200	80,000		
In-village Groundnuts	Peanuts	In-village	346	46	15,916	19,500	INVGNUT
	Voandzeia S.	Land	180	20	3,600		
In-village Millet and Cowpeas	Millet	In-village	280	34	9,520	23,600	INVGMCP
	Cowpeas	Land	672	21	14,112		
Rice	Rice	Lowland	561	71	39,831	39,800	RICE
Starchy Root Crops	Cassava	"	3,000	45	135,000	135,000	ROOTS
	Sweet Potatoes						
Dry Season Fruit and Vegetables	Mangoes	"	8,000	20	160,000	145,000	DRY VEG
	Oignons						
Bush Millet and Cowpeas	Millet	Bush	273	34	9,282	23,000	BUSHMCP
	Cowpeas	Land	652	21	13,692		
Bush Groundnuts	Peanuts	"	820	46	37,720	37,700	BUSHNUT

SOURCES: (a) The basic unit for which labor, land and yield data are available.  
(b) This covers virtually all crops grown by sample members.  
(c) From the classification in chapter five.  
(d) From chapter seven, Table 7.6, Delgado (1978) according to crop enterprise and land type.  
(e) From chapter seven, Table 7.12, (Ibid.)

(f) = (d) x (e)  
(g) = sum of (f) within each crop enterprise  
(h) at the head of Table 8.1, (Ibid.)  
(i) Assumes that a maximum of 15,000 CFA per hectare is spent on seeds, insecticide, water buckets, hired help picking mangoes, etc. In fact, it is likely that much less than this is actually spent, since the use of purchased inputs is very low.



assuming that each crop occupies one-third of the field area. The computation is more difficult in the case of less tangible mixtures, such as "wet season vegetables." Column (b) of Table 7 contains a list of crops that might enter each mixture. The corresponding aggregate price and yield figures for wet season vegetables are rough averages of the prices and yields typically obtained for tomatoes, pimentos, and okra. As with the choice of December prices to evaluate crop output, the overriding policy in constructing the estimates for vegetables and root crops is to choose very conservative figures that tend to underestimate the value of the output of one hectare of each of the crop categories in question.

It was not possible in 1976 to observe directly the value of annual household output of animal products. An estimate, however, contained in the Zorgho study (ORSTOM, 1975, III, pp. 71-90) suggests that the figure of 4,000 CFA is appropriate, after allowing for price inflation between 1973 and 1976 (Delgado, 1979, p. 220). While this may represent a realistic assessment of the actual income obtained from livestock by the typical Mossi household in 1976, for the purposes at hand it is appropriate to use estimates of the maximum attainable income from cattle kept on the farm, a practice currently not engaged in. It is also appropriate to err heavily on the side of overestimation to give the new enterprise the best possible chance in a comparison of overall profitability.

The procedure adopted here is to take the most optimistic estimates available in the literature concerning the cash returns to small-scale growing-out operations in the Sahel, and to convert the figures into the annual returns to maintaining two head of cattle on the farm, expressed in 1976 CFA. The resulting figure of 14,000 CFA represents the hypothesized annual 1976 return to the sale of two head of cattle grown-out one year on the farm (Delgado, 1979, pp. 236-238). This figure, therefore, represents both a return to the labor time required to look after the

animals and a return to the investment involved in their purchase.<sup>1</sup>

A similar procedure is used to calculate the annual returns to maintaining sheep, goats, and swine. The resulting figures are 1,100 CFA per small ruminant and 1,750 CFA per hog, on a per annum basis (Delgado, 1979, pp. 238-240). This completes the information required to model the smallholder farm in Tenkodogo for the purpose of ascertaining whether the farmer does better to entrust his cattle to the Fulani, or to keep it himself.

---

<sup>1</sup>The case for keeping cattle on the farm will be favored even more by using this value as the objective function coefficient in the farm model. This has the effect of taking the most optimistic estimate of the total return to investment in livestock for farm fattening, and then using the figure obtained as solely the returns to the extra labor required to keep the animals on the farm. The returns to investment in cattle do not figure in the farm model, since the hypothesis to be tested involves the relative profitability of entrustment versus that of keeping the animals on the farm. The result of this assumption is to greatly boost the hypothesized profitability of in-village cattle per unit of labor input, *vis à vis* crops.

## THE FARM PRODUCTION MODELS

### Objective and Requirements of the Modeling Exercise

The basic objective of the modeling exercise is to demonstrate that the value of annual farm production is maximized by entrusting to Fulani herdsmen two head of cattle that already belong to the household, as opposed to the alternative of maintaining them on the farm. The exercise will serve to suggest one possible reason why farmers have refused up to now to enter into growing-out operations under their own management. To accomplish this objective, the model chosen must accurately reflect the production enterprises, technological options, and resource constraints that apply to a representative smallholding in the region. The appropriate method is to construct a "typical" farm, using mean values for the relevant parameters, averaged over households.<sup>1</sup> The results from this analysis will be most easily applied to farms with the same characteristics as those described in previous sections. The attributes most in evidence in this context are: the absence in commercial quantities of an upland cash crop of high value, such as cotton, the small size and dispersion of land holdings, the absence of purchasable fodder for animals, peak labor use in July and November, a common technology, and a relatively high population density.

### Structure of the Basic Agricultural Production Model

The basic agricultural production model is a linear program which maximizes the value of eleven crop and three livestock enterprises, subject to resource and behavioral constraints. Nonagricultural and domestic work are regarded as secondary farm activities which require a fixed amount of time each fortnight, with the demands on labor time increasing after the end of the cropping season. Small-scale activity interactions, such as the yield-increasing effects of animal manure, are incorporated directly

---

<sup>1</sup>The construction of a representative farm model is discussed in Delgado, 1979, pp. 223-225).

into the objective function coefficient of livestock, as a return to that enterprise. A separate model will be introduced later to account for major interactions, such as the use of livestock for animal-powered cultivation.

The model can allocate fixed supplies of four kinds of land among enterprises, in addition to differing supplies of labor in twenty-six separate fortnights. Production is also constrained by seven maximum activity levels, which fulfill the role of implicit special resource or capital constraints. An example of the former is the limited area of heavily fertilized garden plots next to the door of the compound. This is the only part of the house fields adapted to growing maize. The limitation on the area of dry season vegetables farmed on lowland is an example of an implicit capital constraint. Six hundred square meters corresponds to the maximum surface that can, by assumption, be irrigated manually from a well.

Capital is not dealt with explicitly as a resource to be allocated, for three reasons. First, the maximum output constraints serve the same purpose as a capital constraint on a particular activity, and are easier to use. Second, as was seen above, sample members used virtually no purchased inputs in agricultural activities, which makes the definition of capital input requirements rather arbitrary. Third, a capital constraint would most likely operate on livestock activities; however, the objective of the exercise is to show that labor constraints alone preclude keeping cattle on the farm. To the extent that this is the case, a capital constraint on livestock would be redundant.

The one truly behavioral constraint concerns the minimum area that farmers are willing to plant with the staple food grain, millet. This is incorporated as a minimum production level pertaining to a linear combination of all activities involving millet production, consistent with the assumption that farmers are not willing to reduce resource allocation to millet beyond a certain point.

The symbolic expression of the model is:

Maximize:

$$R = \sum_{i=1}^{11} c_i X_i + \sum_{i=1}^3 d_i Y_i$$

where:

$c_i$  = the net cash revenue per hectare obtained from the  $i^{\text{th}}$  crop enterprise, expressed in CFA.

$d_i$  = the net cash revenue obtained from the  $i^{\text{th}}$  livestock enterprise, expressed in CFA.

$X_i$  = hectares of land allocated to the  $i^{\text{th}}$  crop enterprise.

$Y_i$  = animal units of the  $i^{\text{th}}$  variety kept on the farm during year.

The objective function is maximized, subject to a set of thirty-eight linear constraints. The land constraints apply only to crop activities, since, by assumption, livestock is grazed on communal land. They imply that different types of land are used for different sets of crops.<sup>1</sup> The constraints are written:

$$\sum_{i=1}^{11} t_{ij} X_i \leq b_j \quad j = 1, \dots, 4,$$

where:

$t_{ij}$  = 1 if the  $i^{\text{th}}$  crop can be planted on the  $j^{\text{th}}$  type of land.  
= 0 otherwise.

$b_j$  = the area in hectares available of the  $j^{\text{th}}$  land type.

The labor constraints apply to both crops and livestock, and are represented by:

$$\sum_{i=1}^{11} v_{ij} X_i + \sum_{i=1}^3 m_{ij} Y_i \leq f_j \quad j = 1, \dots, 26,$$

where:

$v_{ij}$  = the number of hours required in the  $j^{\text{th}}$  fortnight to cultivate one hectare of the  $i^{\text{th}}$  crop.

$m_{ij}$  = the number of hours required in the  $j^{\text{th}}$  fortnight by the  $i^{\text{th}}$  livestock activity in order to maintain one animal (or pair of animals in the case of steers).

$f_j$  = the total number of hours of labor time available to the household in fortnight  $j$ .

---

<sup>1</sup>For example, rice can only be cultivated on lowland.

The constraints on the maximum levels of output reflect that some scarce factor of production other than labor and land is required by the enterprise concerned. These are written:

$$\sum_{i=1}^{11} r_{ij} X_i + \sum_{i=1}^3 s_{ij} Y_i \leq G_j \quad j = 1, \dots, 7;$$

where:

$r_{ij}$  = 1 if there is an area limit on the  $i^{\text{th}}$  crop in the  $j^{\text{th}}$  maximum output constraint;

= 0, otherwise.

$s_{ij}$  = 1 if there is a limit on the number of animals of the  $i^{\text{th}}$  type that can be kept, in the  $j^{\text{th}}$  output constraint;

= 0, otherwise.

$G_j$  = the maximum levels of the  $j^{\text{th}}$  enterprise or combination of enterprises.

and:

$r_{ij} = 0$  if  $s_{ij} = 1$

$s_{ij} = 0$  if  $r_{ij} = 1$  for all  $i, j$ .

The one minimum constraint concerns the principal food grain, millet. It ensures that a minimum area of farm land ( $h$ ) is put under millet cultivation:

$$\sum_{i=1}^{14} n_i X_i \leq h$$

where:

$n_i$  = 1 if  $X_i$  is a crop combination including millet;

= 0, otherwise.

Finally, there is the usual set of nonnegativity conditions:

$$X_i \geq 0$$

$$Y_i \geq 0 \text{ for all } i$$

The tableau of the basic model (I) is displayed in Table 8. Activities (or enterprises) run across the top of the table. The objective function values ( $c_i, d_i$ ) are found directly below the activity

TABLE 8

TENKODOGO FARM LINEAR PROGRAM MODEL I

		HOUSMS 37,700	WET VEG 145,000	MALZE 20,800	CTNTBC 93,200	INVCNUT 19,500	INVCNCP 23,600	RICE 39,800	ROOTS 135,000	DRY VEG 145,000	BUSHMCP 23,000	BUSHNUT 37,700	SHPGOAT 1,100	PIG 1,750	2 STEERS 14,000
HOUSLD	0.75	1	1	1	1	0	0	0	0	0	0	0	0	0	0
INVCLD	1.71	0	0	0	0	1	1	0	0	0	0	0	0	0	0
LOWLD	0.29	0	0	0	0	0	0	1	1	1	0	0	0	0	0
BUSELD	1.10	0	0	0	0	0	0	0	0	0	1	1	0	0	0
LABOR 1	556	134	0	0	0	0	134	22	1	0	141	0	8	2	84
2	556	170	0	280	0	115	170	204	26	0	179	121	8	2	84
3	556	159	0	549	0	174	159	264	0	0	167	188	6	4	105
4	556	172	0	119	0	109	172	327	10	0	181	114	6	9	105
5	556	146	53	589	67	216	146	380	16	0	153	227	6	12	105
6	556	157	6	392	6	293	157	355	91	0	165	308	6	6	105
7	556	105	231	200	293	142	105	283	259	0	110	149	6	7	105
8	556	86	875	38	1,100	102	86	171	256	0	90	107	6	6	105
9	556	85	88	74	88	29	85	31	42	0	89	30	6	10	105
10	556	27	277	0	10	17	27	40	66	0	28	18	6	8	105
11	556	5	235	0	264	22	5	45	300	0	5	23	6	2	105
12	556	28	201	0	88	106	28	127	313	0	29	111	6	11	105
13	556	32	109	0	792	265	32	114	175	0	34	278	6	9	105
14	554	176	0	0	378	329	176	194	101	78	185	345	6	13	105
15	556	94	0	0	110	38	94	31	106	104	99	40	4	6	105
16	556	8	0	0	1,144	3	8	4	98	174	8	3	4	8	105
17	556	0	0	0	440	0	0	0	215	398	0	0	4	14	35
18	511	0	0	0	220	0	0	0	118	454	0	0	4	9	35
19	505	0	0	0	0	0	0	0	62	450	0	0	4	9	35
20	495	0	0	0	0	0	0	0	30	335	0	0	4	7	35
21	450	0	0	0	0	0	0	0	53	391	0	0	4	7	35
22	471	0	0	0	0	0	0	0	20	416	0	0	5	9	35
23	425	1	0	0	0	0	1	0	4	303	1	0	6	6	84
24	455	3	0	0	0	0	3	0	0	386	3	0	7	2	84
25	424	8	0	71	0	0	8	0	0	291	8	0	8	8	84
LABOR 26	368	21	0	69	0	0	21	0	0	37	22	0	8	4	84
MAXW	0.096	0	1	1	0	0	0	0	0	0	0	0	0	0	0
MAXC	0.244	0	0	0	1	0	0	0	0	0	0	0	0	0	0
MAXR	0.19	0	0	0	0	0	0	0	1	0	0	0	0	0	0
MAXV	0.06	0	0	0	0	0	0	0	0	1	0	0	0	0	0
MAXS	20	0	0	0	0	0	0	0	0	0	0	0	1	0	0
MAXP	10	0	0	0	0	0	0	0	0	0	0	0	0	1	0
MAXB	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
MINFD	2.43	1	0	0	0	0	1	0	0	0	1	0	0	0	0

labels. The column farthest to the left gives the labels of each resource used or other constraint imposed on production. The figures immediately to the right of these labels are the levels of resource supplies ( $b_j$ ,  $f_j$ ) or production levels ( $G_j$ ) which cannot be exceeded. The last element in the column is the minimum food grain constraint which states that at least 2.43 hectares of land must be planted with some combination involving millet. The figures in the body of the table are the input-output coefficients corresponding to  $t_{ij}$ ,  $v_{ij}$ ,  $m_{ij}$ ,  $r_{ij}$ ,  $s_{ij}$ ,  $n_i$ , mentioned above. Table 9 gives the key to each of the labels in the model.

### Activities, Resource Supplies, and Input Requirements

The crop activities suitable for house fields are millet and sorghum intercropped with cowpeas, wet season vegetables, maize, and cotton intercropped with tobacco. In-village land is used for millet planted with cowpeas, and groundnuts (peanuts intercropped with Voandzeia subterranea). Lowland can be put into rice, starchy root crops such as cassava, and dry season vegetables. Bush fields may contain either millet and cowpeas or groundnuts. The revenue from each one of these activities is expressed in CFA, on a per-hectare basis. The parameters of the objective function are taken from the estimates contained in Table 7, above.

The livestock enterprises are swine, small ruminants, and two head of cattle. The revenue and labor requirements per unit of small stock are given on a per-animal basis. Maximum production levels ensure that output figures remain realistic in view of the scale for which the input requirement data was specified. The cattle activity represents the practice of maintaining two head on the farm for mixed farming, and is conceptually different from the other enterprises. The crop and small stock activities represent a choice between producing on the farm, or not at all. The cattle enterprise in the model introduces the choice of producing cattle on the farm, as opposed to the alternative of entrusting them to the Fulani. The objective function coefficient for cattle represents the extra returns to keeping the animals at home, and the input requirement for securing this return is the labor required to look



TABLE 9  
KEY TO LABELS IN THE BASIC TABLEAU

<u>COMPONENT</u>	<u>LABEL</u>	<u>ITEM</u>
<u>Crop Enterprises</u>	HOUSMS	Millet, Sorghum, and Cowpeas (Grown on HOUSLD)
	WET VEG	Wet Season Vegetables (Grown on HOUSLD)
	MAIZE	Maize (Grown on HOUSLD)
	CTNTBC	Cotton and Tobacco (Grown on HOUSLD)
	INVGNT	In-Village Field Groundnuts (Grown on INVGLD)
	INVMCP	In-Village Field Millet and Cowpeas (Grown on INVGLD)
	RICE	Rice (Grown on LOWLAND)
	ROOTS	Starchy Root Crops (Grown on LOWLAND)
	DRY VEG	Dry Season Fruit and Vegetables (Grown on LOWLAND)
	BUSHMCP	Bush Field Millet and Cowpeas (Grown on BUSHLD)
	BUSHNT	Bush Field Groundnuts (Grown on BUSHLD)
<u>Live-stock Enterprises</u>	SHPGOAT	Sheep and Goats (1 Animal)
	FIG	Swine (1 Animal)
	2 STEERS	Adult Bullocks (2 Animals)
<u>Land Resources</u>	HOUSLD	House Field Land
	INVGLD	In-Village Field Land
	LOWLD	Lowland Fields
	BUSHLD	Bush Field Land
<u>Labor Resources</u>	LABOR 1 + LABOR 26	Labor each fortnight, beginning May 9, 1976 (for the conversion from fortnights to calendar dates, see Table 3.1 p. 74)
	<u>Maximum Production Levels</u>	MAXM
MAXCT		Maximum house land area suitable for cotton and tobacco
MAXRT		Maximum lowland area suitable for starchy root crops during one season
MAXDV		Maximum lowland area feasible for hand irrigation of dry season fruit and vegetables
MAXSG		Maximum sheep and goats that can be kept using same labor coefficients and assumption of no land requirement
MAXPG MAXBO		<u>Ibid.</u> for swine <u>Ibid.</u> for cattle
<u>Minimum Production Levels</u>	MINFD	The minimum amount of farm land that households are willing to crop with millet

after the stock. An optimal output level of zero for this activity would imply that it is more profitable to entrust the animals to the Fulani, and thereby divert the labor required to look after them on the farm to other pursuits. The values specified in the objective function are taken from pages 101 to 104 above.

The supply of each variety of land available to the average household is taken from Table 3, page 95. Since the returns to crops in the objective function are on a per hectare basis, the land requirement for each crop is unity if the crop can be grown on that type of land, or zero otherwise. The household land requirement for livestock is assumed to be nil, by virtue of the practice of communal pasturing. The implication of this is to favor the case of on-farm livestock by ignoring possible diseconomies of scale implicit in having everyone attempt to graze livestock within the village.

Labor availability for crops and livestock in fortnight  $j$  is equal to either the maximum amount of hours devoted to crops and livestock during any fortnight of the year, or the amount of total labor hours available in fortnight  $j$  after domestic and nonagricultural activity is provided for, whichever is smaller.

This implies that laborers in the farm model cannot work at crop and livestock enterprises for more hours per fortnight than members of the average farm did at the yearly peak. On the other hand, the farm in the model may be constrained to less than the peak number of hours. This would be the case for each fortnight where the sum of crop, livestock, and social activities on the average farm is less than the yearly peak allocation to these enterprises. This is likely to occur when the non-agricultural and domestic work hours on the average farm are high in a given fortnight, leaving relatively little time for other pursuits.

A glance at the left hand column of Table 8 shows that the result of this procedure is to fix the labor supply in the farm model at 556 hours per fortnight for the periods of May 9 through December 18. This hypothesized availability of labor in the model corresponds to the actual hours allocated to crops and livestock on the average farm between July 4 and 17, the annual peak work period. After the middle of December, the hours available for crops and livestock decline steadily as the dry season progresses, and nonagricultural and domestic work alloca-

tion on the average farm in 1976 account for a progressively greater share of total labor time available per fortnight.

The labor requirements per fortnight for one hectare of each crop enterprise are taken from the average values in Table 2, page 88. It is somewhat difficult to separate the labor allocations between wet and dry season fruit and vegetables, given the method of data collection. A somewhat arbitrary division is achieved by splitting the last column in Table 2 into periods 1-13 (May 9 - November 6), which correspond to the wet season, and periods 14-26 (November 7 - May 7), for the dry season. Fortnight 14 also represents a saddlepoint in the distribution of labor to fruit and vegetables. Wet season crops are harvested in late October and dry season crops are planted in late November.

The labor requirements for swine are taken from the actual allocations to this activity by sample members who kept pigs during 1976. The labor inputs each fortnight for cattle are taken from the allocations displayed in Figure 4, page 92. The requirements for small ruminants are revised downwards from the actual allocations reported in Figure 3a and 3b.

This is to take account of the fact that sheep and goats, unlike swine and cattle, can be tended by small children during the rainy season. Therefore the recorded hours devoted to these animals overstate the opportunity cost of undertaking this enterprise, since the labor is not fully transferable to the arduous task of weeding millet. Sensitivity analysis of this change in resource requirements for sheep and goats reveals that the main consequence of the change is to favor small ruminants over swine, with crops and cattle unaffected.

The first four production ceilings in the model involve the maximum area that may be planted with maize and wet season vegetables combined, cotton and tobacco, starchy root crops, and dry season vegetables. The next three ceilings apply as a form of implicit capital constraint to the numbers of animals that can be kept on the farm. The levels are set rather arbitrarily according to a subjective judgement of the maximum financial capacity of the average household.

It is somewhat trickier to specify correctly the maximum permissible level for crops. In the four cases where production is constrained, the maximum output level is either the maximum percentage in the sample of household land attributed to the enterprise in question times the

average total landholding, or the maximum household area devoted to that crop across the sample in enterprise 1, whichever is smallest. This procedure ensures that the chosen output ceiling is a maximum based on the sample data, and also that it reflects the scale of the average farm. Data on the maximum area or percentage of landholdings devoted by the average farm to each crop category are taken from the figures underlying Table 4, page 96.

The behavioral constraint on the minimum area that farmers are willing to plant with food grains is specified using the minimum area so planted by any sample member, adjusted to be consistent with the size of the average farm in the model. The minimum food grain constraint, or MINFD, is equal to either the smallest percentage in the sample of farmland under millet times the area of the average farm, or the smallest area in hectares, whichever is larger. The figure arrived at by this method involves multiplying the average farm area of 3.85 hectares by 63 percent, the smallest proportion of landholdings devoted to millet. Delgado (1979) contains extensive sensitivity analysis of this figure, the import of which will be reported below.

#### Adding Animal Traction to the Basic Model

The basic model of Table 8 is adequate to test the relative profitability of cattle entrustment versus on-farm management when ox cultivation is not feasible. However, the proponents of mixed farming might object that the use of animal traction cultivation techniques permitted by keeping cattle on the farm decreases labor requirements for seedbed preparation and greatly increases crop yields.

In this vein, several experts have suggested that the combination of bovine animal traction with the type of growing-out cattle enterprise typified by "2 STEERS" in the basic model may make the joint on-farm livestock activity relatively profitable, even if the individual components are not (Boudet, 1969; Tacher, Lachaux, and Nicolas, 1969; Robinet, 1972). Presumably this would be the case by providing an extra return to the (supposedly) constant cash or labor cost of maintaining the animals. The proposed strategy involves the purchase of two young males which are

trained for traction by age four. They are sold between ages six and eight for meat (Ibid.).

Since no one in the sample -- and very few individuals in the region -- used bovine animal traction, this hypothesis cannot be tested here using direct observation.<sup>1</sup> The approach employed therefore, incorporates the yield and labor requirement changes predicted by the expatriate proponents of bovine animal traction, in order to modify the activities in the basic model in such a way as to create hypothetical traction enterprises. The source of these predictions is a joint paper by staff members of the two principal agricultural research stations in Upper Volta, entitled: "State of the Art in the Association of Crop and Stock Raising in Upper Volta."<sup>2</sup> This appears to be the most authoritative statement to date of the conventional expatriate wisdom on the subject. For brevity, the figures cited will be referred to as the "IRAT predictions."<sup>3</sup>

The IRAT study claims that bovine animal traction raises the yields of sorghum, peanuts, and cotton by factors of two to three. The procedure also changes labor requirements, according to this account. The time required for seedbed preparation decreases in all three cases, due to the use of the plow. The IRAT article is not clear as to whether animal traction affects other tasks directly, or only changes the pattern and density of plants in the field. In any event, the predictions state that weeding labor requirements increase slightly for sorghum and peanuts, but not for cotton. Harvesting labor requirements increase greatly, however, primarily because of the yield increases. The latter require extra labor for harvesting and transporting the extra produce. Given the labor-intensive methods used, there is a slight tendency for diminishing returns with respect to labor input.

---

<sup>1</sup> Figures from the Center-East O.R.D., which includes Tenkodogo, show that there were 52 teams of plow oxen, in 1975, for a region with 365,000 inhabitants in 1976.

<sup>2</sup> Dupont de Dinechin et al., 1969. This is my translation of: "Données Actuelles Sur l'Association de l'Agriculture et de l'Élevage en Haute-Volta."

<sup>3</sup> Institut de Recherches Agronomiques Tropicales, the institute employing experts cited in the previous footnote.

It should be clear that the author in no way endorses these estimates, which were made by a research group with a vested interest in animal traction programs. The point here is to follow the implications of the IRAT statements through the production process, to gauge the overall effect of this activity on farm output if the predictions are true. This is done via the labor allocation scheme of the basic model, with the added option of ox cultivation of most crops. The new model assumes that the farmer can use animal traction on a wide variety of plants, including food grains, or that he can use traction on some crops and hand cultivation on others. The model is free to select any combination of manual and animal-powered cultivation that maximizes farm revenue.

The IRAT predictions for yield increases stemming from the use of animal traction are given in Table 10. The table converts the French estimates into a form usable in the basic model. Following the policy of making animal traction as attractive as possible, millet yields are assumed to increase as much as those of sorghum, even though there is some evidence that this is not the case (De Wilde, 1967, II, p. 389). In the same vein, rice yields are increased by a factor of two, although the IRAT study does not mention this crop. The justification for this is that plowing may be especially useful in the aeration of the relatively dense lowland soils.

Small cash costs of the minimum purchased inputs (other than traction equipment)<sup>1</sup> necessary for achieving the predicted yields are netted out from the objective function coefficients. The subsidized price of inputs serves to insure that the estimated cash costs understate the true expense involved, particularly since these items are typically not available in Tenkodogo. Finally, the traction option is assumed to be available to a sufficiently limited number of farmers that any ensuing yield benefits will not depress the market price of outputs. Besides being realistic, this also serves to favor the profitability of animal traction in the model.

---

<sup>1</sup>For greater impact, it is assumed that traction equipment is costless.

TABLE 10

THE IRAT ANIMAL TRACTION YIELD MULTIPLIERS IN THE  
CONTEXT OF THE BASIC MODEL

IRAT Activity	Basic Model Activity	Yield Multipliers <sup>a</sup>	Added Cash Cost of Intermediate Inputs <sup>b</sup> (CFA-Ha.)	New Net Revenue per Ha for Enterprises in Basic Model with Animal Traction <sup>c</sup>
Sorghum	HOUSMS	2.2	875 <sup>e</sup>	82,940
	INVMCP			51,045
	BUSHMCP			49,725
Peanuts	INVGNT	2.9	875 <sup>e</sup>	55,675
	BUSHNT			108,455
Cotton	CTNTBC	3.3	12,500 <sup>f</sup>	295,060
	Rice <sup>d</sup>			2

SOURCES: <sup>a</sup>Derived from figures in Dupont de Dinechin et al., 1969, p. 282. The increase in yields predicted for each enterprise using animal traction is obtained by multiplying the pre-traction yields by these numbers.

<sup>b</sup>The minimum extra input in subsidized fertilizer and insecticide in order to achieve the predicted yields.

<sup>c</sup>= Objective function coefficients in the basic model multiplied by (a), minus (b)

<sup>d</sup>In order to make the most favorable case for animal traction, it is assumed, rather arbitrarily, that plowing increases rice yields by a factor of two. The IRAT study makes no mention of this crop.

<sup>e</sup> = 25 kg of fertilizer x 35 CFA = 875 CFA/Ha.

<sup>f</sup> = 100 kg of fertilizer + 16 liters insecticide + rental on sprayers = 12,500 CFA/Ha.



The IRAT predictions for the effect of animal traction on labor requirements are contained in Table 11. Seedbed preparation labor requirements for sorghum, peanuts, and cotton decline, while weeding time increases. Harvest labor inputs for all three crops are up sharply because of greatly increased yields. The added rice enterprise also has modified labor requirements in the animal traction model. The somewhat arbitrary hypothesis is that plowing reduces seedbed preparation by 60 percent. As in the case of the IRAT estimate for cotton and tobacco, ox plowing, by assumption, does not affect labor requirements for weeding rice.<sup>1</sup> Only one negative effect of animal traction on this crop is assumed in the model: the projected twofold increase in yields doubles the amount of labor time required per hectare to harvest and transport output.

The correspondence between cropping tasks and the fortnights when labor requirements must be supplied is derived from the data in the previous sections. In a final effort to present the case as favorably for the proponents of ox cultivation as possible, the labor requirements for crop enterprises are reduced according to the proportions stated in Table 10 for every fortnight which might involve seedbed preparation work. However, increases in requirements due to weeding are only registered during fortnight 6 (late July), even though by the same logic every coefficient in fortnights 3 to 8 should be multiplied by the figures in Table 11. Furthermore, the extra labor requirements for harvesting are only taken into consideration for fortnight 14 (mid-November). Again, a consistent logic would involve increasing all the coefficients from periods 9 through 16.

A few final adjustments remain in order to introduce animal traction into the basic model. These also operate in favor of the pro-livestock case. First, the supply of bush land is explicitly increased to five hectares in response to the argument that traction permits the farmer to cultivate a greater area. Second, the original minimum food grain constraint is modified such that 0.45 hectares of millet cultivated using animal traction contributes to the satisfaction of the constraint as much

---

<sup>1</sup>Much of the rice weeding actually involves transplanting shoots by hand.



TABLE 11

THE IRAT ANIMAL TRACTION LABOR MULTIPLIERS<sup>a</sup> IN THE  
CONTEXT OF THE BASIC MODEL

IRAT Task	Seed Bed Preparation	Weeding and Maintenance	Harvesting and Processing
Basic Model Labor Period	Fortnights 1, 2, 17-26	Fortnight 6	Fortnight 14
IRAT Activity	Basic Model Activity		
Sorghum	All Food Grains	0.83	1.25
Peanuts	All Ground-nuts	0.5	1.5
Cotton	Cotton and Tobacco	0.58	1
	Rice <sup>c</sup>	0.4	1
			2.5
			2.84
			5.8
			2

SOURCES: <sup>a</sup>The numbers in the body of the table are derived from figures in Dupont de Dinechin et al., 1969, p. 281. The change in labor requirements predicted for each enterprise using animal traction is obtained by multiplying the pre-traction requirements by these numbers.

<sup>b</sup>The correspondence between task and time period is derived using Figure 2, page 17.

<sup>c</sup>In order to make the most favorable case for animal traction, it is assumed, somewhat arbitrarily, that plowing reduces seed bed preparation by 60%, does not affect weeding (which is largely transplanting in the case of rice), and increases harvest labor in direct proportion to the predicted increase in yields.

TABLE 12

TENKODOGO FARM LINEAR PROGRAM MODEL II

		(Assuming Traction Boosts Labor Requirements and Yields)						
		HOUSMS	CTNIBC	INVGNT	INVMCP	RICE	BUSHMCP	BUSHNT
		82,940	295,060	55,675	51,045	76,100	49,725	108,455
HOUSLD	.75	1	1	0	0	0	0	0
INVGLD	1.71	0	0	1	1	0	0	0
LOWLD	0.29	0	0	0	0	1	0	0
BUSHLD	5	0	0	0	0	0	1	1
LABOR								
1	556	111	0	0	111	9	117	0
2	556	141	0	58	141	82	149	61
3	556	159	0	174	159	264	167	188
4	556	172	0	109	172	327	181	114
5	556	146	67	216	146	380	153	227
6	556	196	6	440	196	355	206	462
7	556	105	293	142	105	283	110	149
8	556	86	1,100	102	86	171	90	107
9	556	85	88	29	85	31	89	30
10	556	27	10	17	27	40	28	18
11	556	5	264	22	5	45	5	23
12	556	28	88	106	28	127	29	111
13	556	32	792	265	32	114	34	278
14	554	440	2,192	931	440	388	463	976
15	556	94	110	38	94	31	99	40
16	556	8	1,144	3	8	4	8	3
17	556	0	440	0	0	0	0	0
18	511	0	220	0	0	0	0	0
19	505	0	0	0	0	0	0	0
20	495	0	0	0	0	0	0	0
21	450	0	0	0	0	0	0	0
22	471	0	0	0	0	0	0	0
23	425	1	0	0	1	0	1	0
24	455	2	0	0	2	0	3	0
25	424	7	0	0	7	0	8	0
LABOR	363	17	0	0	17	0	22	0
MAINT	.096	0	0	0	0	0	0	0
MAICT	.244	0	1	0	0	0	0	0
MAIRT	.19	0	0	0	0	0	0	0
MAIDV	.06	0	0	0	0	0	0	0
MAISC	20	0	0	0	0	0	0	0
MAIPG	10	0	0	0	0	0	0	0
MAISO	1	0	0	0	0	0	0	0

(ACTIVITY  
COLUMNS OF THE  
BASIC  
MODEL,  
TABLE 8)

as one hectare of grain without traction.<sup>1</sup> Finally, a forcing unit ensures that, in the optimal solution, two head of cattle are kept in order to provide the required animal power. The new Model II, taking account of the predicted effects of animal traction, is displayed in Table 12.

### RESULTS AND CONCLUSIONS

#### Optimal Farm Production Strategies Under Different Assumptions

The major result of the modeling exercise is that, in most cases, farmers do distinctly better to entrust their cattle to the Fulani than to herd them themselves. Even under the most favorable circumstances, assuming that animal traction is highly profitable, that plow equipment is free, that farmers know how to allocate their resources in an optimal manner, and that they have no strong preferences for growing food grains, the maximum increase in farm revenue from keeping two steers is less than 3 percent of the overall income potentially attainable by entrusting household cattle to specialized herdsmen. Against this marginal benefit from retaining large stock on the farm, the peasant has assumed a new risk of crop damage, a greater risk of loss of capital through lack of expertise in animal husbandry, and a significant degree of extra work in slack periods.

The comparative optimal solutions to seven different linear programming runs, under different assumptions, are contained in Table 13. The first four columns are solutions to the basic model encountered in Table 8. Column A gives the results to this model, as originally formulated. The minimum food grain constraint (MINFD) is then relaxed, with the new results in column B. Next, the basic model is modified such that food grain prices are doubled. The new solution, contained in column C, pertains to the case where millet and sorghum are evaluated at their seasonally high (August) prices, rather than the low harvest season values. The model which generated column D is exactly similar to the original basic model, except that the farmer is required to maintain two head of cattle. The next three columns refer to the expanded model of Table 12, with animal traction activities added on. In column E, the farmer was forced to use

---

<sup>1</sup>In accordance with the postulated 2.2-fold yield increase for food grains cultivated with ox plowing (Table 10).

TABLE 13

**SUMMARY OF THE OPTIMAL SOLUTIONS TO THE FARM PRODUCTION MODELS UNDER DIFFERENT ASSUMPTIONS**  
(With and without the option of animal traction)

Enterprises (Solution in hectares unless specified otherwise; n.a.= not applicable)	Model	A		B		C		D		E		F		G		H	
		STEERS OPTIONAL, NO TRACTION								2 STEERS FORCED INTO SOLUTION							
		MINFD=2.43 <sup>a</sup>	MINFD=0 <sup>b</sup>	Value of Millet Activities Doubled <sup>c</sup>	No Traction Allowed MINFD=2.43 <sup>d</sup>	Traction Required Where Feasible MINFD=2.25 <sup>e</sup>	Traction Optional MINFD=0 <sup>f</sup>	Traction Optional MINFD=2.43 <sup>g</sup>	Actual Average Farm in 1976 MINFD= 3.27 <sup>h</sup>								
House Millet (hand cultivation)		.496	.541	.654	.654	n.a.	0	.654	.723								
House Millet (traction)		n.a.	n.a.	n.a.	n.a.	.654	0	0	0								
Wet Season Veg.(hand cultivation)		.096	.096	.096	.096	.096	.096	.096	.005								
Maize (hand cultivation)		0	0	0	0	0	0	0	.020								
Cotton and Tab.(hand cultivation)		.153	.113	0	0	n.a.	0	0	.002								
Cotton and Tab.(traction)		n.a.	n.a.	n.a.	n.a.	0	0	0	0								
Village Nuts (hand cultivation)		0	0	0	0	n.a.	0	0	.170								
Village Nuts (traction)		n.a.	n.a.	n.a.	n.a.	0	0	0	0								
Village Millet (hand cultivation)		1.710	.764	1.710	1.710	n.a.	0	1.710	1.540								
Village Millet (traction)		n.a.	n.a.	n.a.	n.a.	.366	0	0	0								
Rice (hand cultivation)		.040	.040	0	0	n.a.	0	0	.190								
Rice (traction)		n.a.	n.a.	n.a.	n.a.	0	.040	0	0								
Starchy Roots (hand cultivation)		.190	.190	.190	.159	0	.190	.159	.060								
Dry Season Veg.(hand cultivation)		.060	.060	.060	.060	0	.060	.060	.005								
Bush Millet (hand cultivation)		.224	0	.617	.066	n.a.	0	.066	1.007								
Bush Millet (traction)		n.a.	n.a.	n.a.	n.a.	0	0	0	0								
Bush Nut (hand cultivation)		0	0	0	0	n.a.	0	0	.100								
Bush Nut (traction)		n.a.	n.a.	n.a.	n.a.	0	0	0	0								
Sheep and Goats (head)		5.501	20.0	0	0	0	20.0	0	5.8								
Swine (head)		0	10	0	0	0	.142	0	.3								
Two Steers (2 head)		0	0	0	1.0	1.0	1.0	1.0	0								
Maximum Value of Production (in CFA)		134,834	138,317	206,656	124,597	100,868	141,806	124,597	118,467								

<sup>a</sup>Cattle are optional; animal traction is not permitted; at least 2.43 hectares of millet must be grown.

<sup>b</sup>Ditto, but there is no minimum area of millet required.

<sup>c</sup>Ditto, but the objective function values of millet are doubled, which is equivalent to evaluating food grains at August prices.

<sup>d</sup>Two steers must be kept; traction not permitted; 2.43 hectares of millet required.

<sup>e</sup>Traction required on all crops where possible; MINFD relaxed slightly to make problem feasible.

<sup>f</sup>Traction or hand cultivation permitted, no grain requirement.

<sup>g</sup>Ditto, but equivalent of 2.43 hectares of hand-cultivated millet is required.

<sup>h</sup>From Delgado (1978) p. 270 (corrected).

traction on all crops amenable to this technique.<sup>1</sup> Column F represents the case where the use of traction is optional and the farmer has no particular preference for food grains. This is the least constrained case. Column G is exactly similar, except that a minimum food grain production level is imposed, equivalent to that in the basic model.<sup>2</sup> Finally, the last column contains the average allocation of farmland to each crop activity by sample farmers in 1976 and the mean number of animal units kept on the farm.

The value of the optimal production strategy (column A) increases only 3 percent when farmers are no longer obligated to cultivate food grains (column B). Evaluating millet at August prices, however, increases the optimal land allocation to food grains to just under three hectares (column C), not far from the average sample allocation in 1976 of 3.27 hectares (column H). This tends to support the hypothesis that farmers perceive the cost of running out of millet next season in terms of the maximum price of food grains last season. Using a higher value for millet output than the low harvest price incorporated in the basic model tends to reinforce the case against maintaining cattle on the farm.

Forcing the farmer to keep two steers, in the absence of animal traction, lowers the value of the maximum attainable farm income by 8 percent (column D), relative to the basic model. On the other hand, the lowest objective function value occurs when traction is feasible and the farmer is required to use it on food grains (column E). This surprising

---

<sup>1</sup>With allowance made for the assumed higher yields of crops under animal traction, MINFD is expressed in terms of areas of millet cultivated by hand, for comparative purposes. Even so, MINFD had to be relaxed to get a feasible solution to this model. The first feasible solution is that given in column E. The 1.02 hectares cultivated with traction are assumed to yield as much as 2.25 hectares cultivated by hand.

<sup>2</sup>See previous footnote. MINFD = 2.43 in the basic model yields, by assumption, the same amount of grain as 1.10 hectares in the traction model.

state of affairs is attributable to the labor bottleneck in November that results from harvesting large amounts of millet and looking after the plow team at the same time.

The highest attainable farm revenue applies to the case where traction is optional and there is no minimum food production level (column F). The optimal objective function value of this model is, however, only three percent above the comparable value where the animals are not kept on the farm (column B). Furthermore, the low profitability of traction actually becomes a loss if farmers are also obliged to produce the same amount of food grains as in the basic model. In this case (column G), the maximum attainable farm income falls 8 percent below the comparable figure in column A, where no steers are kept.

Two overall conclusions arise from these results. First, the desirability of using animal traction, never very high from an economic standpoint, declines further with an increasing desire to put a large portion of holdings under food grains. Second, mixed farming in areas similar to Tenkodogo, where a cattle-entrusting option exists, does not present the very profitable new opportunities that would most likely be necessary to substantially modify current behavior. Since the traditional entrustment relationship is pervasive in West Africa (Quéant and Rouville, 1969; Müller, 1967; Horowitz, 1972), the prospects for smallholder mixed farming programs are somewhat limited in much of the Savannah.

#### Sensitivity Analysis and the Opportunity Cost of Resources<sup>1</sup>

The sensitivity of results to the specification of the hypothetical cattle enterprise and the minimum food production level is a primary area of concern. The analysis of the basic model in Table 8 shows that cattle do not begin to enter the optimal production strategy until the revenue

---

<sup>1</sup>The sensitivity of the results in Table 13 to parameter changes in the model is extensively analyzed in Delgado (1978), chapters 9 and 10.

from the cattle enterprise increases by at least 38 percent.<sup>1</sup> Since the revenue from this activity constitutes solely the returns to the labor required to keep the animals on the farm, as opposed to entrusting them, an increase in the revenue from the enterprise is approximately equivalent to an equal decrease in labor requirements.<sup>2</sup> Therefore, in the absence of improved weight gains or meat prices, a substantial effort would be required to reduce the labor input requirements for on-farm cattle in order for this activity to begin to be as profitable as entrusting the animals, and specializing in crops.

Results clearly demonstrate, furthermore, that the desirability of keeping cattle on the farm is very sensitive to the returns to millet farming. The very conservative approach to evaluating crops and the optimistic method of calculating the returns to livestock combine to ensure that the results from the basic model are qualitatively correct for the real world. This conclusion is strengthened by the observation that an 85 percent decrease in the labor requirements for cattle is required before this activity begins to enter the optimal solution if millet is evaluated at the seasonally high price. In other words, the labor requirements for two head of stock kept on the farm would have to be less than one hour per day, in peak periods. This is clearly not the case in Tenkodogo.

Requiring the farmer to produce either millet or cattle increases, ceteris paribus, the demand for farm resources used most intensively in these activities. Millet uses July and November labor and house land, with in-village land as a poor substitute for the latter. Cattle require adult labor in the cropping season, including July, August, and November. If a resource is in short supply, then an increase in the demand for this input will tend to raise the opportunity cost of using one unit of the resource in question.

---

<sup>1</sup>Returns may have to increase substantially more than this amount in order to ensure that a feasible (i.e. integer) quantity of animals are included in the optimal solution.

<sup>2</sup>The uniform decrease in fortnightly labor requirements that produces the same change in the optimal solution to the model as the revenue increase is, in fact, slightly less than 38 percent. This is the result of an "index number" problem.

The opportunity cost of one unit of a scarce (fully used) resource in each of the farm production models is represented by the value of the dual variable associated with that input in each optimal solution. Table 14 portrays these values for each one of the models listed in Table 13. Each line of the table shows how the opportunity cost of a given resource changes with respect to different assumptions concerning cattle and food grains.

House land is a scarce resource in the optimal solution to all the models. The opportunity cost of one hectare of this input is relatively constant with respect to the minimum production level of millet and sorghum; this land is used mainly for this purpose under any assumption concerning minimum production levels. The shadow value of house land increases with the number of cattle kept on the farm, because the subsequent reallocation of labor in the new optimal solution has the effect of increasing the share of farm production attributable to the richest land near the household.

The opportunity cost of in-village land is very sensitive to the minimum food grain production level. A relatively high level of millet output requires that this land be fully used. More intensive cultivation of the fertile house and lowland areas tends to diminish the value of in-village land, given a fixed supply of labor. In a similar vein, the opportunity cost of lowland is highly dependent upon the household preference for food grain production. An increase in MINFD tends to decrease the shadow value of lowland, particularly if the demand for labor is tight due to the presence of cattle.

Late August labor is fully used only when cattle are not kept and farmers cultivate high labor input vegetable and root crops. Under these circumstances, the opportunity cost of fortnight 8 labor is a decreasing function of the level of the minimum food grain constraint. Late July labor is not fully used in any of the models represented in Table 13 and 14. This resource becomes scarce, however, as the level of millet cultivation exceeds 3 hectares, a figure which should be compared to the average sample farm allocation of 3.27 hectares of food grains.



TABLE 14

DUAL VARIABLE VALUES IN THE OPTIMAL SOLUTIONS TO VARIOUS MODELS  
(Interpreted as the opportunity cost in CFA of one unit of a scarce resource)

RESOURCE	Model	STEERS OPTIONAL, NO TRACTION			2 STEERS FORCED INTO SOLUTION			
		MINFD=2.43 <sup>a</sup>	MINFD=0 <sup>b</sup>	Value of Millet Activities Doubled <sup>c</sup>	No Traction MINFD=2.43 <sup>d</sup>	Traction Required Where Feasible MINFD=2.25 <sup>e</sup>	Traction Optional MINFD=0 <sup>f</sup>	Traction Optional MINFD=2.43 <sup>g</sup>
One hectare of house land		16,297	14,100	31,638	26,730	31,895	23,709	26,730
One hectare of in-village land		2,197	0	3,438	12,630	0	0	12,630
One hectare of lowland		4,476	11,421	0	0	0	23,869	0
One hour period 8 labor, (August 15 to 28)		11	31	0	0	0	0	0
One hour period 14 labor, (November 7 to 20)		173	119	249	1,337	1,859	135	1,337
Rate of change in farm revenue from adding another two head of cattle to the optimal solution, valid only for a small region around the optimal solution <sup>h</sup>		-5,250 per two head	-103,737 per two head	-1,208 per two head	-126,347 per two head	-181,192 per two head	-135 per two head	-126,347 per two head

<sup>a-g</sup>See the notes of Table 13

<sup>h</sup>This is properly interpreted as a rate of change, about the current optimal solution, since forcing two extra head of cattle into the solution would change optimal allocations to such an extent that these figures would no longer be valid. The main interest of these numbers is to give a relative measure of the cost of forcing the farmer to keep cattle under different assumptions.

Mid-November labor in fortnight 14 constitutes the greatest bottleneck in all the models. The opportunity cost of this resource, which corresponds to the millet harvest period, increases sharply with the required minimum production level of food grains. The scarcity of harvest-time labor is most notable when cattle are kept on the farm and millet is also cultivated. In the model with optional animal traction and MINFD set at 2.43 hectares, the opportunity cost of one hour of labor is estimated at 1,337 CFA in mid-November, and zero for the rest of the year. This may be compared to an average hourly wage rate of 30 to 40 CFA for hired rural labor involved in jobs lasting an entire season.<sup>1</sup>

### Trade-offs in Production Between Cattle and Food Grains

In light of the evident resource use conflicts between cattle and millet, it is instructive to compute the opportunity cost of two head of cattle directly in terms of foregone grain output. The result has the advantage of being independent of prices, since the trade-off between the two enterprises is established solely on the basis of requirements for scarce resources.<sup>2</sup>

The point of departure is the optimal solution to the basic model of Table 8, reported in column A of Table 13. Land and labor allocations to all activities, except those involving millet, are fixed in a new program. Two head of cattle are then forced into the solution set, and the minimum food grain constraint is removed. The new optimal solution to the model includes, perforce, the two head of cattle and the levels of non-millet activities previously chosen as optimal. Food grain enterprises are diminished by just enough to free the minimum amount of labor required to maintain the two head of cattle.

---

<sup>1</sup>An example would be unskilled labor employed to repair roads during the 1975-76 rainy season, at 250 CFA per seven-hour day.

<sup>2</sup>This procedure also has the disadvantage that a small amount of inefficiency is introduced by the assumption that only food grains are sacrificed in order to produce cattle. Optimally, the output of other crops and livestock should be free to vary as well, in order to identify the highest value package involving two head of cattle. This is essentially what occurred in the comparison of columns A and D of Table 13. The degree of inefficiency incurred by the procedure here is low, due to the high proportion of resources devoted to food grains.

The results indicate that bush millet cultivation has disappeared entirely, and that the in-village millet area is reduced (Delgado, 1979, p. 274). The net effect of keeping the two head of cattle on the farm, as opposed to entrusting them, is to use the labor previously allocated to 1.21 hectares of millet intercropped with cowpeas. This provides an estimate of the opportunity cost of maintaining two head of cattle on the farm, in terms of food grains. The 50 percent reduction in millet area would correspond in 1976 to a decrease in household crop production of approximately 340 kg of millet and 800 kg of cowpeas.<sup>1</sup> For the foreseeable future, this remains a prohibitive opportunity cost, even allowing for a large margin of error.

#### Critical Assumptions and Applicability of the Results to Other Areas

Similar results are likely to apply to other regions in the West African Savannah which are characterized by the six underlying attributes of the Tenkodogo farming system. These are: the availability of a cattle entrusting option, relatively high population density, the absence of a suitable forage crop, the lack of agro-industrial by-products for feedstuffs, the effective absence of means to relieve seasonal labor bottlenecks, and the presence of unfavorable soil and land tenure conditions for animal traction. Sedentary stockraising may be a more attractive option where these attributes are not present. In areas without a cattle entrusting option, farmers must look after their cattle if they want any returns from livestock, whereas in Tenkodogo they can still retain partial benefits by purchasing animals and leaving the maintenance problems to the Fulani. A low population density would reduce the incidence of conflicts between crops and livestock, thus reducing the labor requirements for cattle. The availability of cheaply obtained feedstuffs would make stall-fattening feasible, and thus largely eliminate the need for grazing labor. If labor-saving

---

<sup>1</sup>With a market value in 1976 of approximately twice the amount added by keeping the animals on the farm.

technology or a supply of cheap seasonal manpower were available to farmers during July and November, they could expand production of both crops and livestock. Finally, if landholding consolidation and cooperative tilling were feasible, then ox plowing would be a more efficient enterprise.

## POLICY RECOMMENDATIONS

### Principal Policy Recommendations for Livestock Intensification in the Research Area

The principal policy recommendation for areas similar to Tenkodogo is to use the scarce development funds destined for the direct support of cattle production intensification to support the cattle entrusting system, rather than to encourage stockraising by sedentary peasants. The traditional peasant-herder relationship allows the farmer to invest in cattle at little opportunity cost of resources other than that of the capital involved. It also offers employment in their chosen occupation to the Fulani, a factor which should not be neglected. Development funds should be used for the usual livestock improvement interventions concerning dry season waterpoints, dips, and other preventive medicine projects. The key point is that these funds should be directed to Fulani herds. It should be pointed out, in the interest of equity, that this would also benefit nearby peasant farmers, since they own more than half of the Fulani-managed animals. The need for these projects is well-established, regardless of whether cattle are entrusted to specialized herdsmen or kept by their owners.

The policy actions specifically required in support of the peasant-herder cattle entrusting system are less well known and therefore require elaboration here. They concern lowering the special risks of keeping cattle in a crop-growing area and promoting the socially optimal division of labor between herdsmen and farmers. The primary risk in managing cattle in Tenkodogo is that of expensive lawsuits from animal-induced crop damage. Herders are held responsible for these incidents regardless of their ethnic affiliation or of the ownership of the livestock involved. This means that they must spend a great deal of time during the cropping season keeping the animals away from bush fields. The Fulani are even reluctant to take the herds into the village in the dry season because of the vegetable and cassava plots which are still being cultivated at this time. This discourages the herder from the socially beneficial practice of grazing the crop stubble and thereby fertilizing the fields with the animal droppings. The risk of crop damage grows

each year as peasant bush fields expand into zones that were previously used by the Fulani as grazing areas. There are three policy actions that would help to reduce this risk, and thus would lower the costs of livestock production.

First, policy makers should be encouraged to confer with canton chiefs -- the traditional arbiters of land use -- and delineate for range control those areas which are not yet exploited agriculturally. In Tenkodogo, these lands can be found on the periphery of the wet season river valleys. While it is hard for canton chiefs to resist pressures on them to allocate more arable land, this form of range management appears to be the only solution for the immediate future.

Second, policy emphasis should be put on the official recognition of cattle tracks through village cropping areas. Several customary routes exist in Oueguedo, although no agreement exists as to where the trail side ends and house fields begin. Several cattle paths have been delineated by the government and used with considerable success along the major north-south national cattle routes. The trails consist of single cement posts spaced approximately 100 meters apart in a line. Herders are not liable for any damage sustained by crops within fifty meters on either side of the posts. Presumably the village tracks would have smaller widths.

Third, the continued viability of the peasant-herder system also depends upon sharing the risk of retribution for crop damage between the cattle managers and proprietors. Volatile policy makers should be urged to evolve a judicial code specifically delegating some of the financial responsibility to the owners of the animals. This action may also serve to encourage the acceptance of a land use policy among the peasant constituency, since cattle owners would then have the same interest as cattle herders in avoiding expensive damage suits.

Policy Recommendations for Livestock Intensification in Areas Similar to Tenkodogo without a Cattle Entrusting Option

In areas similar to Tenkodogo, but without a cattle entrusting option, the desirability of keeping more cattle depends upon the alternative uses

of labor as well as those of capital. In the current state of the art in crop raising, increased livestock production appears to offer new opportunities for expanding rural incomes and export earnings. Policies designed to favor the cattle enterprise in this context should focus upon five critical issues: the reduction of the peak season labor requirements for animals, raising the returns to a given labor commitment, the easing of labor bottlenecks in food grain production, the abandonment of bush field cultivation in favor of more intensively cultivated in-village plots, and a decline in the opportunity cost of peak season labor from an increased confidence in the market to supply food staples. Each of the above issues will be considered below.

Reducing the labor requirements for on-farm cattle during peak periods reduces labor conflicts between livestock and crops. It also raises the opportunity cost of labor in terms of cattle, thus favoring the diversion of scarce resources to this enterprise. The specific actions advocated are the construction of communal fences, the consolidation of land holdings, and extension programs dealing with the care of animals and the processing of feedstuffs. Stock-proof fences lower the risks of crop damage from livestock, and, thus, the time required to supervise the animals. Fences built with indigenous materials and methods require a great deal of labor for construction, are built individually around small plots, last only one season, and are not sufficiently strong to resist cattle. The consolidation of land holdings, which may not be socially acceptable at the village level, would serve to reduce the labor requirements for animal traction and field supervision. Extension programs dealing with the care of animals and the processing of feedstuffs are essential in an environment where farmers have no tradition of keeping large stock. The production of forage is a central issue, in that it is directly linked to the labor time required to maintain cattle.

In addition to decreasing the labor requirements for cattle, policies designed to favor sedentary livestock production need to raise the return to this activity. More specifically, attention should be devoted to defraying the cost of maintaining an ox plow and team. One possibility would be the encouragement of the rental of equipment to

neighbors by the owners. This would defray the cost of the plow and would be conceptually equivalent to an increase in the returns to on-farm cattle in the model. It should be noted, however, that the model already assumes that traction equipment is costless! Therefore the resulting increase in returns from leasing would have to be substantial in order to alter the conclusions for policy purposes.

The reduction of peak labor requirements for food grains permits the farmer to continue cultivating a fixed area of millet consistent with his desire to be self-sufficient in food staples, while transferring labor to the livestock enterprise. This can be achieved either through the reduction of overall labor requirements for a given amount of output, or through the shifting of input to periods where people are free to work longer hours. The paradoxical result of this is that it is the introduction of technology used in food grain cultivation which permits the expansion of cattle output.

There are four recommended policy actions with the objective of relieving labor bottlenecks in millet production. These concern both the spreading and overall reduction of the labor required to harvest a given amount of grain from a given field. First, efforts need to be made to facilitate the acquisition by smallholders of existing labor-saving implements that have an impact on harvesting. The donkey cart is a prime example of the potential offered by existing, but relatively inaccessible, technology. Combined with improved tracks, these implements offer the possibility of substantial labor savings in the collection and spreading of manure, the transport of the grain harvest, and in the gathering and carrying of forage materials to the compound. They also facilitate the marketing and purchase of millet in bulk quantities. Second, it should be a priority to develop yield-increasing technology which does not place an added burden on labor resources at peak periods. An example would be new varieties of millet which mature earlier. Third, the eradication of pests that eat millet on the stalk reduces the urgency in harvesting the mature grain. Fourth, the reinforcement with statutes of a village-level consensus concerning the dates when small stock are permitted to roam freely in the village would also decrease the penalty for late harvest, thus spreading the harvesting labor requirement.



Increased livestock production by sedentary farmers will also involve increased competition for land resources. The principal points of contact between cattle and food grains are the peasant bush fields of millet, which are expanding into traditional grazing areas as the fertility of in-village fields declines. One of the first actions required in order to promote the intensification of cattle output in Savannah areas, whether by the Fulani or peasant farmers, is control over the expansion of bush fields.

An administrative decree is not sufficient to accomplish this objective, since farmers under present conditions require the extra land in order to make a subsistence living. Rather, the appropriate long term policy is to improve the productivity of the peasant farming system in order to allow existing farms to operate more intensively on in-village land. Such research could well take a fresh look at the yield, cost, and labor requirement consequences of using fertilizer on food grains.

The research results above showed that a decrease in the minimum amount of land that farmers are willing to plant with food grains will tend to favor the optimality of production strategies in general, and that of keeping cattle on the farm in particular. Village food grain storage facilities help to reduce storage losses and the risk of running short of millet during the rainy season. In the long run, improved feeder roads, transportation equipment, and regional storage facilities should make reliance upon the market to supply food grains less risky. It would then be a realistic possibility to rely upon the exchange of livestock for food grains at the harvest. This should encourage the expansion of sedentary cattle-raising, if it is in fact more profitable than crop cultivation.

The overall conclusion of the Tenkodogo field study supports the view that traditional smallholders usually have solid economic reasons for their behavior. Accordingly, development policy needs to look carefully at what is in the interest of the individual farmer. The costs and benefits of sedentary livestock production include the incidence of this activity upon other farm enterprises. The successful introduction of village cattleraising into a farming system that has hitherto not engaged in this enterprise requires an integrated approach to the farming

system itself. In the absence of attention to critical points of resource allocation and the availability of food grains, it seems unlikely that sedentary farmer cattle production schemes will have much chance of success in Tenkodogo. While this is clearly the case in similar areas that have a cattle entrusting system, the caveat concerning food grains is also likely to hold for other places in the West African Savannah which have the same environmental characteristics and farming system as the research site.

LIST OF REFERENCES

- Beneke, R. and Winterboer, R., 1973. Linear Programming Applications to Agriculture. Ames, Iowa: Iowa State University Press.
- Benoit, Michel. 1974. Introduction à la Géographie des Zones Pastorales Soudaniennes de Haute-Volta. Ouagadougou: ORSTOM.
- Cleave, John H. 1974. African Farmers: Labor Use in the Development of Smallholder Agriculture. New York: Praeger.
- Collinson, M.P. 1972. Farm Management in Peasant Agriculture. A Handbook for Rural Development Planning in Africa. New York: Praeger.
- Delgado, Christopher L. 1977. "Economic Interactions between Peasants and Herders in the West African Savannah: A Case Study from Tenkodogo, Upper Volta." Report to (REDSO/WA). Ann Arbor: USAID and Center for Research on Economic Development, University of Michigan.
- \_\_\_\_\_. 1979. Livestock Versus Food Grain Production in Southeastern Upper Volta: A Resource Allocation Analysis. Report to USAID, Tenkodogo Field Study of the Entente Livestock Project, (Ann Arbor: Center for Research on Economic Development, University of Michigan, and USAID).
- De Wilde, John C. et al. 1967. Experiences with Agricultural Development in Tropical Africa. Two volumes. Baltimore: Johns Hopkins University Press.
- Dupont de Dinechin, B., Malcoiffe, C., D'Arondel de Hayes, J. 1969. "Données actuelles sur l'association de l'agriculture et de l'élevage en Haute-Volta." In Colloque sur L'Elevage, pp. 266-286. Edited by IEMVT. Paris.
- Ferguson, D.S. 1973. "The Potential (sic) for the Stratification of the Cattle Industry in Cameroon and Central Africa." In L'embouche intensive des bovins au pays tropicaux. Actes du Colloque, Dakar, 4-8 Décembre, pp. 251-259. Maisons-Alfort, France: IEMVT.
- Guinard, A. 1967. "Conservation and Improvements of Soil Fertility in Africa." Part two. World Crops, 19(6).
- Hunter, John M. 1966. "Seasonal Hunger in a Part of the West African Savanna: A Survey of Bodyweights in Nangodi, N.E. Ghana." In Markets and Marketing in West Africa. Proceedings of a Seminar in the Centre for African Studies, University of Edinburgh, 29 and 30 April, 1966.

- Institut d'Élevage et de Médecine Vétérinaire des Pays Tropicaux (IEMVT), 1973. L'Embouche intensive des bovins en pays tropicaux. Actes du Colloque, Dakar, 4-8 Décembre. Maisons-Alfort, France.
- Jeune Afrique. 1975. Atlas de la Haute-Volta. Paris: Editions Jeune Afrique.
- Lahuec, Jean-Paul. 1970. "Une communauté évolutive mossi Zaongho (Haute-Volta)." Etudes Rurales, 37/38/39.
- Letenneur, L. 1973. "Quelques éléments d'appréciation de la rentabilité des essais d'embouche." In L'embouche intensive des bovins en pays tropicaux. Actes du Colloque, Dakar, 4-8 Décembre, pp. 271-283. Maisons-Alfort, France: IEMVT.
- Lhoste, Ph. 1973. "Note sur l'économie de l'embouche intensive au Cameroun." In L'embouche intensive des bovins en pays tropicaux. Actes du Colloque, Dakar, 4-8 Décembre, pp. 247-249. Maisons-Alfort, France: IEMVT.
- M'Bodji, M. 1973. "L'élevage de rente dans une exploitation agricole intégrée: bilan de quatre années d'activité." In L'embouche intensive des bovins en pays tropicaux. Actes du Colloque, Dakar, 4-8 Décembre, pp. 263-267. Maisons-Alfort, France: IEMVT.
- McCalla, T.M. 1975. "Use of Animal Wastes as a Soil Amendment." Soils Bulletin, 27. Rome: FAO/SIDA.
- Mesnil, J. 1970. Connaissance du milieu et vulgarisation agricole dans le cas de l'opération Centre Mossi. 9 volumes. Paris: SATEC.
- Norman, D.W. 1973a. "Economic Analysis of Agricultural Production and Labour Utilization among the Hausa in the North of Nigeria." East Lansing: African Rural Employment Paper No. 4, Department of Agricultural Economics, Michigan State University.
- \_\_\_\_\_. 1973b. "Methodology and Problems of Farm Management Investigations: Experiences from Northern Nigeria." African Rural Employment Paper No. 8. East Lansing: Department of Agricultural Economics, Michigan State University.
- Office de la Recherche Scientifique et Technique Outre-Mer (ORSTOM). 1975. Enquête sur les mouvements de population à partir du pays Mossi (Haute-Volta). Ouagadougou.
- Quéant, T. and de Rouville, C. 1969. Agriculteurs et Eleveurs de la région du Gondo-Sourou, two volumes. Centre Voltaïque de la Recherche Scientifique, Ouagadougou.

- République de Haute-Volta, Ministère de l'Agriculture et de l'Elevage, Institut de Recherches Agronomiques Tropicales et des Cultures Vivrières, n.d. Principaux Resultats Agronomiques Obtenus par l'Institut de Recherches Agronomiques Tropicales et des Cultures Vivrières en Haute-Volta, 1960-1971. n.p.
- République de Haute-Volta, Ministère du Développement Rural (MDR). 1976. Réunion du Comité de Coordination du Développement Rural, Rapport de la Sous-Commission de la Production Animale. Nos. 5,6,7.
- Robinet, H. 1972. "Réflexions sur l'Association Agriculture-Elevage (1)." Revue Trimestrielle. Communauté Economique du Bétail et de Viande (Ouagadougou), 2.
- Robinet, H. 1973. "Réflexions sur l'Association Agriculture-Elevage (2)." Revue Trimestrielle. Communauté Economique du Bétail et de Viande (Ouagadougou), 3.
- Ruthenberg, Hans. 1976. Farming Systems in the Tropics. 2nd Edition. Oxford: Clarendon Press.
- Sarniguet, J. 1973. "Economie de l'embouche intensive." In L'embouche intensive des bovins en pays tropicaux. Actes du Colloque, Dakar, 4-8 Décembre, pp.243-246. Maisons-Alfort, France: IEMVT.
- Serres, H. 1973. "Etude économique de deux essais d'embouche de zébus adultes à Madagascar." In L'embouche intensive des bovins en pays tropicaux. Actes du Colloque, Dakar, 4-8 Décembre, pp.269-270. Maisons-Alfort, France: IEMVT.
- Serres, Hübl and Roider. 1975. Etude des possibilités d'embouche bovine en Côte d'Ivoire. Tome I, Généralités. Paris: Ministère de la Coopération.
- Shapiro, Kenneth Howard. 1973. "Efficiency and Modernization in African Agriculture: A Case Study in Geita District, Tanzania." Ph.D. Dissertation, Stanford University.
- Tacher, G., Lachaux, P. and Nicolas, F. 1969. "Les 'Bovins' de Culture Attelée au Tchad." In Colloque sur L'Elevage, pp.252-267. Paris: edited by IEMVT.
- Tyc, J. 1975. L'Elevage en Haute-Volta, Analyse et Propositions d'Ori-entation. République de Haute-Volta, Ministère du Plan, du Développement Rural, de l'Environnement et du Tourisme, Rapport de la Mission Bailhâche. Ouagadougou.
- United States Agency for International Development (USAID). 1975. Development Assistance Program, FY 1975, Upper Volta and Niger. Washington, D.C.

CHAPTER 3

THE ECONOMICS OF CATTLE AND MEAT MARKETING IN IVORY COAST -  
A SUMMARY

by John Staatz

TABLE OF CONTENTS

	<u>Page</u>
<u>LIST OF TABLES</u> . . . . .	142
<u>INTRODUCTION</u> . . . . .	144
<u>THE RECENT EVOLUTION OF IVORY COAST'S RED MEAT SUPPLY</u> . . . . .	146
Domestic Livestock Production . . . . .	147
Livestock Imports . . . . .	151
Imports of Chilled and Frozen Meat . . . . .	157
The Ivorian Red Meat Supply: A Summary . . . . .	162
<u>MARKET ORGANIZATION: A CONSTRAINT TO DEVELOPMENT?</u> . . . . .	165
Market Structure . . . . .	166
Market Conduct . . . . .	169
Market Performance . . . . .	172
<u>MARKET INFRASTRUCTURE NEEDS</u> . . . . .	174
<u>PROBLEMS AND COSTS OF TRANSPORTING CATTLE</u> . . . . .	178
Current Pattern of Cattle Transport . . . . .	178
Transport Costs . . . . .	179
Conclusions . . . . .	189
<u>FACTORS AFFECTING THE LOCATION OF SLAUGHTER</u> . . . . .	189
<u>CATTLE AND MEAT PRICES: THEIR IMPLICATIONS FOR NORTHERN FATTENING PROJECTS</u> . . . . .	194
Types of Markets for Beef In Ivory Coast and Projected Production of Different Grades of Beef . . . . .	194
Demand for Fattened Beef In the Class 2 Market . . . . .	195
Factors Limiting the Effective Demand for Fattened Beef . . . . .	200
<u>CONCLUSIONS AND POLICY RECOMMENDATIONS</u> . . . . .	201

	<u>Page</u>
The Changing Ivorian Market for Beef . . . . .	202
The Organization of Cattle and Meat Marketing . . . . .	204
Market Infrastructure Needs . . . . .	205
Problems of Cattle Transport . . . . .	206
The Location of Slaughter . . . . .	209
The Nature of Demand for Beef in Ivory Coast: Implications for Fattening Projects . . . . .	210
General Considerations to Guide Marketing Policy . . . . .	211
<u>APPENDIX: MEAT VERSUS LIVE ANIMAL SHIPMENTS</u> . . . . .	215
<u>LIST OF REFERENCES</u> . . . . .	226

CHAPTER 3 - LIST OF TABLES

<u>Table</u>	<u>Page</u>
1. Estimated Value of Livestock Production in Ivory Coast in 1974 . . .	148
2. Estimate of Ivorian Domestic Beef Production: 1970-76 . . . . .	149
3. Estimated Ivorian Red Meat Production in 1975 . . . . .	151
4. Officially Recorded Imports of Cattle into Ivory Coast: 1965-76 .	152
5. Officially Recorded Imports of Sheep and Goats into Ivory Coast: 1965-76 . . . . .	155
6. Estimated Tonnage of Beef, Mutton, and Goat Meat Imported into Ivory Coast on the Hoof: 1970-76 . . . . .	158
7. Recorded Imports of Chilled and Frozen Meat by Country of Origin: 1960-76 . . . . .	160
8. Estimated Ivorian Red Meat Supply in 1976 . . . . .	163
9. The Ivorian Beef Supply: 1970-76 . . . . .	164
10. Concentration Ratios for Large and Medium-Scale Intermediaries in Abidjan and Bouaké . . . . .	168
11. Evolution of the Cost of Beef and Offals Sold Retail in Abidjan .	173
12. Cost of Transporting Fifty Head of Cattle From Tingrela to Bouaké by Trekking and by Truck: 1976-77 . . . . .	180
13. Cost of Transporting Fifty Head of Cattle From Ouagadougou to Abidjan by Rail . . . . .	186
14. Estimated Mortality Rates of Cattle During Rail Shipment to Abidjan: 1976-77 . . . . .	188
15. Comparison of the Profitability of Shipping Meat and Cattle From Ferkéniédougou to Abidjan . . . . .	191



<u>Table</u>	<u>Page</u>
16. Average Monthly Cattle Prices in Bouaké: July, 1976-July, 1977 .	198
17. Relative Prices per kg of Different Types of Cattle Sold in Bouaké, 1976-77 . . . . .	200

LIST OF ILLUSTRATIONS

<u>Figure</u>	<u>Page</u>
1. Relationship Between the Profitability of Exporting Meat and Animals to Abidjan and the Abidjan Offal/Meat Price Ratio . . . .	224

### CHAPTER 3

## THE ECONOMICS OF CATTLE AND MEAT MARKETING IN IVORY COAST - A SUMMARY

by

John Staatz

### INTRODUCTION

This study examines the organization and recent evolution of the markets for cattle and meat in Ivory Coast, and discusses constraints to expansion of the Ivorian cattle and meat trades. Ivory Coast plays a crucial role in cattle and meat marketing in central West Africa. Relative economic prosperity has resulted in a strong demand for meat, making Ivory Coast an important market for livestock exports from the Sahelian countries, particularly from Mali and Upper Volta. Livestock production traditionally has played a small role in the Ivorian economy, and the country is highly dependent on imports for the bulk of its red meat supply, including over 80 percent of its beef.

With the recent decline in the Ghanaian market for meat, Mali and Upper Volta have become increasingly dependent on Ivory Coast as a market for their livestock exports. In 1970 Ivory Coast bought 60 percent of Mali's cattle exports and 67 percent of Upper Volta's cattle exports; by 1975, it absorbed 83 percent of Mali's cattle exports and 87 percent of Upper Volta's cattle exports (24, pp. 96-7, 150-60; 6, p. 115; 20).<sup>1</sup> Changes in the Ivorian market therefore affect not only the welfare of livestock producers and meat consumers within Ivory Coast, but also the incomes of livestock producers and traders in Mali and Upper Volta, as well as the export earnings and tax revenues of these livestock-exporting countries.

In recent years, the Ivorian market for cattle and meat has changed markedly as a result of the drought in the Sahel and changes in the world beef market. The drought had two long-term effects on the livestock trade in West Africa. First, it reduced the number of animals available in the Sahelian countries for export to the coastal states. The results were higher livestock and meat prices in both the Sahelian and the coastal countries.<sup>2</sup> Second, donor agencies and the West African governments

---

<sup>1</sup>The numbers in parentheses indicate the references cited. The list of citations is at the end of the study.

<sup>2</sup>The initial effect of the drought, especially in the Sahel, was to depress livestock prices, as livestock raisers were forced to destock their herds in order to meet their cash needs. This was a short-term effect, however, followed by an increase in prices as the supply of livestock fell.

responded to the losses of livestock suffered during the drought by creating new organizations to coordinate livestock policy and designing new programs aimed at changing the way in which livestock and meat traditionally had been produced and marketed. On the production side, planners tried to encourage regional stratification of livestock, particularly cattle production. Arid Sahelian zones were to be used as breeding areas, with growing out occurring in more humid zones, and final fattening taking place near terminal markets or export zone abattoirs (22, p.1). On the marketing side, livestock markets were rebuilt and equipped with cattle scales and other materiel; modern abattoirs were constructed in the Sahelian states, with the goal of exporting chilled meat to the coastal states; governments encouraged merchants to truck rather than trek their livestock to market, in order to reduce weight losses during shipment and crop damage by trade herds; and inter-African organizations called for widespread reorganization of the professions engaged in livestock and meat marketing. (See, for example, 5.)

In addition to the drought, changes in the world beef market during the mid 1970s had a strong impact on cattle and meat marketing in West Africa, particularly in the coastal states. Traditional meat exporting countries, such as Argentina, faced with increased stocks of meat in 1975, began prospecting for new markets, including West Africa. In 1975 Ivory Coast was faced with a shortage of livestock and meat from its traditional suppliers, the Sahelian countries, and therefore began importing large amounts of frozen beef from overseas. As a result, the share of the Ivorian beef supply made up by imports from non-West African countries grew from 0.3 percent in 1974 to 37.6 percent in 1976.

This study was conducted in order to analyze these recent changes in the Ivorian market for cattle and meat and to identify constraints to expansion of the cattle and meat trades. The study involved analysis of data already collected by agencies of the Ivorian government, as well as collection and analysis of additional data in Abidjan and Bouaké. The research in Ivory Coast upon which this study is based took place between March 1976 and July 1977. The major findings of the study are presented below in seven sections. The first section examines the recent evolution of Ivory Coast's red meat supply, showing the changes that occurred from

1970 through 1976 in domestic livestock production and in imports of livestock and meat. The second section looks at the current organization and functioning of cattle and meat markets in Ivory Coast and discusses whether the current market organization represents a constraint to expansion of the trade. The third section examines the need for improved physical infrastructure for cattle and meat marketing in Ivory Coast. The fourth section describes the problems and costs of transporting cattle in Ivory Coast and discusses the implications of these costs for transportation policy. The fifth section examines the conditions under which it would become more profitable to slaughter cattle in the north (near where they are produced) and ship their carcasses south than to ship the cattle south for slaughter, as is currently done. The sixth section examines variations in cattle and meat prices in Abidjan and Bouaké during 1976-77 and uses these price variations to draw inferences about the nature of the demand for cattle and meat in Ivory Coast; the section then discusses the implications of this pattern of demand for cattle fattening projects in the north. Finally, the seventh section summarizes the major conclusions of the study and makes policy recommendations aimed at improving cattle and meat marketing in Ivory Coast.

#### THE RECENT EVOLUTION OF IVORY COAST'S RED MEAT SUPPLY<sup>1</sup>

The meat Ivory Coast consumes comes from three sources: domestic production, imports of live animals from the Sahelian countries, and imports of chilled and frozen meat. Through 1974, imports of live animals, especially cattle, were by far the most important source of supply. SEDES figures (24, pp. 439-41, 450-52) indicate that in 1970 imports of live animals provided 73 percent of Ivory Coast's total red meat supply and 84

---

<sup>1</sup>The recent evolution of the Ivorian market for red meat and its outlook through 1985 is discussed in detail in a forthcoming report by the author. This report, to be published in 1979, is part of a larger study on livestock and meat marketing in the "central corridor" of West Africa, being conducted by the University of Michigan's Center for Research on Economic Development for the United States Agency for International Development (Contract REDSO/WA 77-105).

percent of its beef supply. Domestic production accounted for 23 percent of the red meat supply and 12 percent of the beef supply, while imports of chilled and frozen meat made up the remaining 4 percent of the red meat supply and 4 percent of the beef supply. Beef was the most widely consumed red meat in the country, accounting for 75 percent of total consumption. Goat meat and mutton made up 20 percent, and pork accounted for the remaining 5 percent.

Figures presented below indicate that the pattern of consumption in 1976 was about the same as in 1970. The pattern of supply, however, had changed radically. In 1976, imports of livestock from the Sahelian countries accounted for only 45 percent of the Ivorian red meat supply. Domestic production made up 26 percent of the total supply, and imports of chilled and frozen meat accounted for 29 percent. Obviously, the Ivorian market for meat changed considerably between 1970 and 1976, as the figures presented below demonstrate.

#### Domestic Livestock Production

Table 1 shows the small role that livestock production, and particularly cattle production, play in the Ivorian economy. In 1974, total livestock production accounted for only 2.5 percent of Ivory Coast's GDP, with 1.0 percent of this being attributable to red meat production and merely 0.4 percent to cattle production. In contrast, agriculture contributed 28.9 percent of the GDP in 1974 (11, p. 84). For health and economic reasons, there is little tradition of cattle raising in Ivory Coast, and the country has met its meat requirements (especially its beef requirement) by importing live animals from the Sahelian countries, as stated in the introduction.<sup>1</sup>

---

<sup>1</sup>Because of the many livestock diseases endemic in the country (e.g., trypanosomiasis, contagious bovine pleuro-pneumonia) and the humid climate of the southern half of the country, Ivory Coast has had a comparative advantage in export crop production over livestock production. The country has found it cheaper to produce and sell export crops and use the receipts to import its meat from its northern neighbors (largely in the form of live animals) than to produce the meat itself.

TABLE 1

ESTIMATED VALUE OF LIVESTOCK PRODUCTION IN IVORY COAST IN 1974  
(in millions of CFA F)

	Cattle	Sheep/Goats	Swine	Poultry	Eggs, Milk Hides, etc.	Total
Value	1,560	1,447	1,207	5,260	753	10,227
Percent of GDP	0.4	0.3	0.3	1.3	0.2	2.5

SOURCE: République de Côte d'Ivoire, Ministère du Plan, La Côte d'Ivoire en chiffres, 84, 149.

Domestic Beef Production.-- Two species of cattle are raised in Ivory Coast -- zebus, or humped cattle (varieties of the species Bos indicus), and taurins, or humpless cattle (varieties of the species Bos taurus). Zebus, which numbered about 115,000 head in 1976, are highly susceptible to trypanosomiasis and other diseases endemic in the humid regions of Ivory Coast. They are therefore raised exclusively in the dryer savanna areas of the north. Taurins raised in Ivory Coast have some resistance to trypanosomiasis and are found throughout the country, although they, too, are concentrated in the north. Three distinct breeds of taurins are raised in Ivory Coast. Baoulés, a type of West African shorthorn, are by far the most numerous, accounting for about 300,000 head. N'dama's, a slightly larger breed, number between 40,000 and 60,000 head, and are concentrated in the northwest of the country, around Odienné. Lagune cattle account for only about 4,500 head. They are extremely small, highly disease resistant cattle found along the coast.

Table 2 presents estimates of Ivory Coast's domestic beef production from 1970 through 1976.<sup>1</sup> Table 2 shows that domestic beef production grew from 4,700 tons in 1970 to 6,923 tons in 1976, an increase of 46 percent, or approximately 6.5 percent per year. One reason for this rapid growth was that many Fulani herders moved their animals into Ivory Coast during

<sup>1</sup>For discussion of the data upon which Table 2 is based, see 27, Chapter 1.

TABLE 2

## ESTIMATE OF IVORIAN DOMESTIC BEEF PRODUCTION: 1970-76 (tons)

Year	Cattle Population <sup>a</sup>	Off-take Rate	Number Slaughtered	Ave. Carcass Weight	Meat Production (tons)	Edible Offals <sup>b</sup> (tons)	Total (tons)
<b>Taurins</b>							
1970	289,000	10%	28,900	100 kg.	2,890.0	722.5	3,612.5
1971	297,600	"	29,760	"	2,976.0	744.0	3,720.0
1972	306,600	"	30,660	"	3,066.0	766.5	3,832.5
1973	315,800	"	31,580	"	3,158.0	789.5	3,947.5
1974	325,200	"	32,520	"	3,252.0	813.0	4,065.0
1975	335,000	"	33,500	"	3,350.0	837.5	4,187.5
1976	345,000	"	34,500	"	3,450.0	862.5	4,312.5
<b>Zebus</b>							
1970	50,000	12%	6,000	145 kg.	870.0	217.5	1,087.5
1971	70,000	"	8,400	"	1,218.0	304.5	1,522.5
1972	77,000	"	9,240	"	1,339.8	335.0	1,674.8
1973	85,000	"	10,200	"	1,479.0	369.8	1,848.8
1974	105,000	"	12,600	"	1,827.0	456.8	2,283.8
1975	115,000	"	13,800	"	2,001.0	500.3	2,501.3
1976	120,000	"	14,400	"	2,088.0	522.0	2,610.0
<b>Total Production</b>							
1970	339,000		34,900		3,760.0	940.0	4,700.0
1971	367,600		38,160		4,194.0	1,048.5	5,242.5
1972	383,600		39,900		4,405.8	1,101.5	5,507.3
1973	400,800		41,780		4,637.0	1,159.3	5,796.3
1974	430,200		45,120		5,079.0	1,269.8	6,348.8
1975	450,000		47,300		5,351.0	1,337.8	6,688.8
1976	465,000		48,900		5,538.0	1,364.5	6,922.5

NOTES: Based on data from République de Côte-d'Ivoire, Ministère de la Production Animale, and the following assumptions:

a Cattle population:

- 1) Taurins: Based on a population of 335,000 in 1975 and a 3 percent annual growth rate
- 2) Zebus: Figures provided by Ministry of Animal Production

b Edible offals estimated at 25 percent of carcass weight.

Estimates of carcass weights and off-take rates provided by the Ministère de la Production Animale.

the early 1970s to avoid the drought farther north in Mali and Upper Volta. Between 1970 and 1976, the number of zebus in Ivory Coast increased by 140 percent.

Domestic Production of Small Ruminants.-- No solid statistics exist on the number of small ruminants in Ivory Coast. Estimates run from 1.3 million (16), to 1.8 million (15, p. 14). The Planning Ministry estimated there were 1,000,000 sheep and 760,000 goats in the country in 1975, with sheep producing 3,500 tons of meat and edible offals and goats producing 2,000 tons (12). Lacking more accurate statistics, the figures of the Planning Ministry are used in this report.

Domestic Pork Production.-- Pork production in Ivory Coast takes place both in villages and in a few modern pig farms. The official estimate of pork production in 1975 was 5,000 tons, of which 3,600 tons came from traditional village production, and 1,400 tons came from modern pig farms. In contrast to other types of red meat, Ivory Coast is largely self-sufficient in pork, producing 98 percent of its domestic consumption (12, Tables 6, 10).

Game.-- In addition to the red meat production just mentioned, officials estimated the production of game, snails, and other viande de brousse equaled 16,000 tons in 1975 (12, Table 10). One must regard this figure with caution, however, as there are practically no data on which to base such an estimate.

Domestic Production: A Summary.-- Table 3 summarizes Ivory Coast's domestic red meat production in 1975. In 1975 Ivory Coast produced about 17,000 tons of red meat, excluding game, out of a total domestic consumption (excluding game) of roughly 53,000 tons.



TABLE 3

ESTIMATED IVORIAN RED MEAT PRODUCTION IN 1975  
(tons of meat and edible offals)

---

---

Beef	6,689
Mutton	3,500
Goat Meat	2,000
Pork	<u>5,000</u>
Subtotal	17,189
Game <sup>a</sup>	16,000

---

SOURCES: Table 1, and text.

<sup>a</sup>The reliability of the figure for game is questionable.

Livestock Imports

Given the low level of domestic livestock production, Ivory Coast has traditionally relied on imports of cattle and small ruminants from the Sahelian countries to provide the bulk of its red meat supply. This section outlines recent changes in the pattern of livestock imports.

Cattle Imports.-- Table 4 presents officially recorded imports of cattle into Ivory Coast from 1965 through 1976. Between 1965 and 1970, officially recorded cattle imports increased steadily, rising from 80,200 to 198,000 head. The annual average rate of increase of recorded cattle imports during this period was 20 percent. Real per capita income was increasing rapidly during this period and undoubtedly was one of the main forces boosting demand for meat, hence cattle. Larger exports from Mali accounted for much of the increase over this period. Mali's share of the market increased from 30.5 percent in 1965 to 65.8 percent in 1969. During the same period, the number of cattle imported from Upper Volta actually fell by about 12,000, and the Voltaic share of the market fell

TABLE 4

OFFICIALLY RECORDED IMPORTS OF CATTLE INTO IVORY COAST: 1965-76

Year	Mali		Mauritania		Upper Volta		Niger		France		Total	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent <sup>a</sup>
1965	24,446	30.5	1,914	2.4	53,828	67.1	10	—	—	—	80,198	100.0
1966	19,996	19.7	37,234	36.6	44,273	43.6	119	0.1	—	—	101,622	100.0
1967	46,063	38.5	16,739	14.0	56,123	46.9	718	0.6	—	—	119,643	100.0
1968	67,836	41.2	16,356	9.9	80,566	48.9	—	—	—	—	164,758	100.0
1969	113,234	65.8	16,908	9.8	41,335	24.0	567	0.3	—	—	172,064	100.0
1970	143,080 <sup>b</sup>	72.1 <sup>b</sup>	b	b	51,199	25.8	4,121	2.1	—	—	198,400	100.0
1971	—	—	—	—	—	—	—	—	—	—	175,896	100.0
1972	137,074 <sup>b</sup>	64.5 <sup>b</sup>	b	b	73,658	34.7	1,746	0.8	—	—	212,478	100.0
1973	117,942	52.7	29,001	13.0	73,054	32.6	3,938	1.7	—	—	223,935	100.0
1974	123,148	63.6	31,397	16.2	39,084	20.2	—	—	—	—	193,629	100.0
1975	77,065	54.7	5,069	3.6	58,441	41.5	395	0.3	—	—	140,970	100.0
1976	75,851	67.5	830	0.7	35,264	31.4	—	—	369	0.3	112,314	100.0

SOURCE: République de Côte-d'Ivoire, Ministère de la Production Animale, unpublished data; République de Côte-d'Ivoire, Ministère de l'Economie et des Finances, Direction de la Statistique, *Situation économique de la Côte-d'Ivoire*, various issues; and SEDES, *Recueil statistique de la production animale*, study done for République Française, Ministère de la Coopération (Paris: 1975), p. 450.

## NOTES:

--- Not available

— None or negligible

The Ivorian Ministry of Animal Production accepts the figures published in the *Recueil statistique de la production animale* as the official figures for years prior to 1972. These figures differ in some years from the figures reported by the Veterinary Service and published in *Situation économique de la Côte-d'Ivoire*. For 1966 and 1967, these differences are very small; therefore the Veterinary Service's statistics are used, since they give the country of origin of the imported animals, which the SEDES figures for 1966 and 1967 do not. In years where there are large differences between the Veterinary Service's statistics and the SEDES figures, the latter are used. Figures for the years 1973-76 are from unpublished data of the Ministry of Animal Production.

<sup>a</sup> Totals may differ slightly from sum of subtotals due to rounding.

<sup>b</sup> Figures for Mauritania included in the figures for Mali.

from 67 percent to 24 percent.<sup>1</sup> Much of the recorded increase in Malian exports was probably due to the lifting of Malian exchange controls in 1967 and the reduction in the Malian export tax on cattle in 1969 (28, p. 9). The growth of Malian exports was also tied to the growth of Ivorian cities such as Daloa, Yamoussoukro, San Pedro, and Bouaké, whose meat supply is met by Malian animals transported south on hoof.

In 1971, total recorded imports fell by almost 23,000 head, reflecting the impact of the drought in the Sahel. Faced with increased mortality, Sahelian herders apparently held back animals and tried to maintain their herds. This was followed in 1972 through 1974 by a destocking of herds as the drought became more severe, and herders were obliged to sell even young males and cows to meet their cash needs. This destocking of northern herds is reflected in increased cattle imports into Ivory Coast during 1972-1973, particularly by a sharp increase in imports from Mauritania, where the effects of the drought were severe. The high level of cattle imports into Ivory Coast from Mali during the period 1970-74 was also a by-product of the decline in the Ghanaian market for beef, which resulted from economic instability and the reorganization of the cattle trade in Ghana. Many of the cattle that "normally" would have been exported to Ghana ended up in Ivory Coast during this period.

In 1974, total recorded cattle imports into Ivory Coast fell by 30,000 head from the previous year. The decline in recorded imports continued at an accelerating rate in 1975. Imports fell in 1975 not only because the marketable surplus of animals in the Sahelian countries was reduced by the drought and the subsequent destocking of herds in 1972-74, but also because Mali and Niger closed their borders to livestock exports during part of the year. This did not cut off the trade completely, but it certainly reduced it. Imports were also reduced because of the hostilities between Upper Volta and Mali, which essentially ended the transit of Malian animals through Upper Volta along the route

---

<sup>1</sup>Part of the apparent growth in the Malian share of the market probably reflected an improvement in the statistics gathered along the Mali-Ivory Coast border.

Mopti-San-Bobo-Dioulasso-Ouangolodougou (Ivory Coast). In response to this drop in total cattle imports, the Ivorian government, through its state-owned company AGRIPAC, began importing large amounts of frozen meat, mainly from Europe, in September 1975.

The decline in recorded imports continued in 1976, falling to 112,314 head. Imports continued to fall in 1976 for two reasons. First, the effects of the drought continued to be felt. (Many of the young animals that died in 1969-72 normally would have been marketed in 1976.) Secondly, part of Ivory Coast's "normal" supply of cattle, particularly from Upper Volta, apparently was diverted toward more profitable markets in Niger and Nigeria. The high prices offered in Niger stemmed from two causes: the Nigerian herd reconstitution program, which resulted in high prices being offered for young animals, especially heifers; and the strong demand for slaughter animals in Nigeria.<sup>1</sup> Many Voltaic cattle merchants abandoned the Abidjan market in 1976 to sell their animals at Téra, on the border between Niger and Upper Volta. It thus appears that the Ivorian government's policy of importing large amounts of cheap frozen meat in order to hold down meat prices in the major retail markets had the effect of diverting part of the traditional supply of slaughter animals, particularly from Upper Volta, to more profitable markets elsewhere.<sup>2</sup>

Imports of Sheep and Goats.-- Table 5 presents officially recorded imports of sheep and goats from 1965 through 1976. In general, the pattern of small ruminant imports was the same as that for cattle. Recorded imports more than doubled between 1965 and 1970, declined slightly

---

<sup>1</sup> Because the port of Lagos was blocked throughout 1976, Nigeria was not able to adopt the Ivorian expedient of importing large quantities of frozen meat by sea in order to hold down retail meat prices. As a result, prices for cattle in Lagos reportedly rose to approximately 300 CFA F per kg. liveweight near the end of 1976, compared to roughly 210 CFA F per kg. liveweight in Abidjan (10).

<sup>2</sup> Many Voltaic cattle merchants complained to the investigator that the Abidjan market had been "ruined" by frozen meat imports.

TABLE 5

OFFICIALLY RECORDED IMPORTS OF SHEEP AND GOATS INTO IVORY COAST: 1965-76

Year	Mali		Mauritania		Upper Volta		Niger		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent <sup>a</sup>
1965	39,902	23.1	4,936	3.5	86,347	60.8	10,780	7.6	141,965	100.0
1966	18,875	10.4	107,072	59.1	55,311	30.5	—	—	181,258	100.0
1967	—	—	—	—	—	—	—	—	180,517	100.0
1968	27,605	12.3	15,568	6.9	182,015	80.8	—	—	225,188	100.0
1969	89,503	32.0	29,928	10.7	159,929 <sup>b</sup>	57.4 <sup>b</sup>	b	b	279,360	100.0
1970	122,673	39.6	36,135	11.7	128,490	41.5	22,104	7.1	309,402	100.0
1971	—	—	—	—	—	—	—	—	303,479	100.0
1972	—	—	—	—	—	—	—	—	394,044 <sup>c</sup>	100.0
1973	147,295	34.5	23,991	5.6	241,137	56.5	14,636	3.4	427,059	100.0
1974	165,710	42.9	29,919	7.8	187,804	48.7	2,397	0.6	385,830	100.0
1975	96,005	27.2	2,811	0.8	253,517	71.9	309	0.1	352,642	100.0
1976	120,744	43.5	—	—	167,264	55.7	2,263	0.8	300,305	100.0

SOURCES: République de Côte-d'Ivoire, Ministère de la Production Animale, unpublished data; République de Côte-d'Ivoire, Ministère de l'Economie et des Finances, Direction de la Statistique, *Situation économique de la Côte-d'Ivoire*, various issues; and SEDES, *Recueil statistique de la production animale*, study done for République Française, Ministère de la Coopération (Paris: 1975), p. 45.

## NOTES:

— Not available

— None or negligible

The Ivorian Ministry of Animal Production accepts the figures published in the *Recueil statistique de la production animale* as the official figures for the years prior to 1972. These figures differ in some years from the figures reported by the Veterinary Service and published in *Situation économique de la Côte-d'Ivoire*. In years where there are large differences between the Veterinary Service's statistics and the SEDES figures, the latter are used. Figures for the years 1973-76 are from unpublished data of the Ministry of Animal Production.

<sup>a</sup>Totals may differ slightly from sum of subtotals due to rounding.

<sup>b</sup>Figures for Niger included in the figures for Upper Volta.

<sup>c</sup>Recently revised figure, differs from figure previously published by Ministry of Animal Production.

from 1970 to 1971, increased sharply in 1972 and 1973, and then declined markedly from 1973 through 1976.<sup>1</sup> It appears that the same forces that affected cattle imports influenced sheep and goat imports. Rapidly rising incomes in the period 1965-1970 stimulated demand for meat, and imports grew. The effects of the drought started to be felt in 1971, resulting in a slight reduction of imports in that year, followed by a massive destocking of herds in 1972 and 1973. This destocking boosted imports into Ivory Coast during these two years, but was followed by a decline in recorded imports from 1973 through 1976, as the number of animals available for sale from the Sahelian countries dropped as a result of the destocking. Recorded imports of sheep and goats fell proportionately less than did recorded cattle imports, however, declining by roughly 30 percent from 1973 to 1976, compared with a 50 percent drop in recorded cattle imports during the same period. In 1976, recorded sheep and goat imports stood at the same level as in 1970, whereas recorded cattle imports were considerably below their 1970 levels. Sheep and goat imports suffered less direct competition from frozen meat imports than did cattle imports, as the bulk of the frozen meat imported was beef, and practically no frozen mutton or goat meat was sold on the traditional African market.<sup>2</sup>

Tonnage of Meat Imported on the Hoof.-- The destocking of cattle herds in the Sahelian countries during the period 1972-76 resulted in a change in the composition by sex of cattle herds imported for slaughter

---

<sup>1</sup>The official Ivorian statistics on imports of small ruminants, at least from Upper Volta, appear less accurate than those for cattle, however. For four of the five years for which comparable data are available (1970 and 1973-76), Ivorian import statistics show an average of 20 percent fewer Voltaic small ruminants arriving in Ivory Coast than the Voltaic figures indicate left that country for Ivory Coast. The Voltaic figures, however, show the same pattern of fluctuations as the Ivorian statistics.

<sup>2</sup>Sales of sheep and goats may have been affected indirectly if consumers shifted from mutton to beef consumption as relatively inexpensive frozen beef became available. This probably did not happen very much. Many of the sheep sold in Ivory Coast are slaughtered for ceremonial occasions. In these circumstances, consumers do not consider beef an acceptable substitute for mutton.

in Ivory Coast. As the drought reduced herd sizes in the north, cattle owners were forced to sell even females and young males to meet their cash needs. As a result, the average carcass weight of cattle slaughtered in Abidjan fell from 151 kg in 1970 to 138 kg in 1976.<sup>1</sup> The carcass weights of small ruminants may also have fallen during this period, but data are unavailable to confirm this. Therefore, in the following calculations, a constant carcass weight of 17 kg is assumed for small ruminants. (This weight is taken from 23, p. 117.)

Table 6 presents the estimated tonnage of beef and small ruminant meat imported into Ivory Coast from 1970 through 1976, based on the data presented in Tables 4 and 5 and the average carcass weights mentioned above. Table 6 shows that the total tonnage of beef imported on the hoof fell by nearly half between 1970 and 1976, from 37,448 tons to 20,076 tons. A small part of this decline was offset by an increase in domestic production resulting from Fulani cattlemen moving their herds south into Ivory Coast to escape the drought, but most of it was not met by a corresponding increase in other fresh beef supplies. The result was a decreasing total and per capita fresh beef supply throughout this period. Table 6 also shows that the tonnage of meat represented by recorded small ruminant imports rose from roughly 6,000 tons in 1970 to 8,300 tons in 1973, then fell to less than 6,000 tons in 1976. The Ivorian Planning Ministry (12, Table 10) estimates that imports were somewhat higher than indicated in Table 6, roughly 6,800 tons in 1970 and 8,000 tons in 1975. Examination of Voltaic export statistics (see p. 156, footnote 1) supports the view that the official Ivorian statistics underestimate the number of small ruminants imported. The tonnage of mutton and goat meat imported on the hoof in 1976 was probably closer to 7,000 tons than the 5,900 tons indicated in Table 6.

#### Imports of Chilled and Frozen Meat

In addition to domestic production and imports of live animals, imports of chilled and frozen meat are the other main source of meat supply

---

<sup>1</sup>See 27, pp. 35-38 for details of how these average carcass weights were estimated.



TABLE 6

ESTIMATED TONNAGE OF BEEF, MUTTON, AND GOAT MEAT  
IMPORTED INTO IVORY COAST ON THE HOOF: 1970-76

BEEF					
Year	Number of Animals Imported	Average Carcass Weight (kg.)	Meat (Tons)	Edible Offals (tons) <sup>a</sup>	Total (tons)
1970	198,400	151	29,958	7,490	37,448
1971	175,896	149	26,209	6,522	32,761
1972	212,478	142	30,172	7,543	37,715
1973	223,935	139	31,127	7,782	38,909
1974	193,629	140	27,108	6,777	33,885
1975	140,970	138	19,454	4,863	24,317
1976	112,314	143	16,061	4,015	20,076

MUTTON AND GOAT MEAT

1970	309,402	17	5,260	789	6,049
1971	303,479	17	5,164	744	5,908
1972	394,044	17	6,699	1,005	7,704
1973	427,059	17	7,260	1,089	8,349
1974	385,830	17	6,559	984	7,543
1975	352,642	17	5,995	899	6,894
1976	300,305	17	5,105	766	5,871

SOURCES; Tables 4 and 5. Average slaughter weights for cattle from Staatz, John M., The Economics of Cattle and Meat Marketing in Ivory Coast (Ann Arbor: Center for Research on Economic Development, 1979), pp. 35-8. Average slaughter weights for small ruminants from SEDES, Approvisionnement en viandes de l'Afrique centre ouest, Secretariat d'Etat aux Affaires Etrangères (France) and Conseil de l'Entente (Paris: 1969), p. 117.

<sup>a</sup>Estimated at 25 percent of carcass weight for cattle and 15 percent of carcass weight for small ruminants.



for Ivory Coast. Until 1975, these imports represented a modest volume and were destined almost exclusively for a high-income, largely expatriate clientele in Abidjan. In 1975, however, the pattern completely changed, with large amounts of imported frozen meat (mainly beef) being sold on the traditional African market. Table 7 shows how the volume and sources of supply of Ivory Coast's imports of chilled and frozen meat changed from 1960 through 1976.<sup>1</sup>

From 1960 to 1970 recorded imports of chilled and frozen red meat increased from about 500 tons to 2,000 tons per year. Between 60 and 75 percent of this meat was beef, depending on the year, and the bulk of it came from Upper Volta. Recorded imports of chilled and frozen meat declined from 1970 through 1974, reflecting the ending of chilled meat shipments from Mali, Ivory Coast's increasing self-sufficiency in pork production, and a decline in the quality of refrigerated rail transport between Upper Volta and Abidjan.

The decline in chilled frozen meat imports continued through the first half of 1975. The abrupt drop in live animal imports in 1975 reduced the total meat supply on the market, and, in order to check the resulting price rise, the Ivorian government began importing surplus frozen meat from Europe. In one year, recorded imports jumped from 1,473 tons to 6,329 tons. In 1976, recorded imports increased even more rapidly, reaching 17,030 tons, much of it from South America. Almost all this new frozen meat was beef; as a result, beef accounted for over 97 percent of the imports in 1976, compared with 81 percent in the 1971-74 period.

In contrast to previous years, the bulk of the chilled and frozen meat imported in 1975 and 1976 was destined for the traditional African market, not a high-income clientele. This meat was sold on the traditional market (with bones) for between 50 to 100 CFA F less per kg than locally slaughtered meat, which sold in 1976 in Abidjan for 350 to 400 CFA F per kg.

---

<sup>1</sup>For a breakdown of imports by type of meat, see 27, p. 36.

TABLE 7

RECORDED IMPORTS OF CHILLED AND FROZEN RED MEAT BY COUNTRY OF ORIGIN: 1960-76 (tons)

Year	Mali		Upper Volta		Niger		Other African Countries		Total African Countries		Europe		South America		Total <sup>a</sup>	
	Tons	Percent	Tons	Percent	Tons	Percent	Tons	Percent	Tons	Percent	Tons	Percent	Tons	Percent	Tons	Percent
1960	77	14.6	260	49.2	42	8.0	—	—	379	71.8	149	28.2	—	—	528	100.0
1961	—	—	471	54.0	179	20.5	—	—	650	74.5	223	25.5	—	—	873	100.0
1962	—	—	782	70.1	186	16.7	—	—	968	86.8	147	13.2	—	—	1,115	100.0
1963	95	6.4	910	60.9	270	18.1	—	—	1,275	85.3	219	14.7	—	—	1,494	100.0
1964	181	11.3	979	61.0	220	13.7	—	—	1,380	86.0	225	14.0	—	—	1,605	100.0
1965	167	10.7	960	61.3	236	15.1	—	—	1,363	87.0	203	13.0	—	—	1,567	100.0
1966	309	16.2	935	48.9	473	24.8	—	—	1,717	90.9	194	10.1	—	—	1,911	100.0
1967	57	3.0	1,317	68.5	363	18.9	—	—	1,737	90.3	188	9.7	—	—	1,924	100.0
1968	95	4.8	1,304	65.9	418	21.1	—	—	1,817	91.9	160	8.1	—	—	1,978	100.0
1969	179	9.0	1,232	61.7	406	20.3	—	—	1,817	90.9	181	9.1	—	—	1,998	100.0
1970	153	7.6	1,176	58.8	487	24.3	—	—	1,816	90.7	186	9.3	—	—	2,001	100.0
1971	—	—	1,326	72.1	340	18.5	—	—	1,666	90.6	173	9.4	—	—	1,839	100.0
1972	—	—	1,065	71.3	234	15.7	—	—	1,299	87.0	194	13.0	—	—	1,494	100.0
1973	—	—	915	70.7	194	15.0	—	—	1,109	85.7	185	14.3	—	—	1,294	100.0
1974	—	—	1,078	73.2	187	12.7	8	0.5	1,273	86.4	199	13.5	—	—	1,473	100.0
1975	—	—	591	9.3	277	4.4	891	14.1	1,759	27.8	3,990	63.0	580	9.2	6,329	100.0
1976	—	—	247	1.5	162	1.0	896	5.3	1,305	7.7	2,669	15.7	13,056	76.7	17,030	100.0

SOURCE: République de Côte-d'Ivoire, Ministère de la Production Animale, unpublished data.

<sup>a</sup>Totals may differ slightly from sum of subtotals due to rounding.

The large imports of frozen meat were initially a reaction to and not the cause of the decline in live animal imports in 1975. Imports of live animals fell sharply in mid-1975 and it was not until September that the massive frozen meat imports began. Once started, however, the sales of cheap frozen meat had the effect of checking the price increase of fresh meat and, as mentioned above, may have served to reduce live animal imports, particularly from Upper Volta.

Not only did the quantities of frozen and chilled meat imported increase tremendously between 1974 and 1976; the pattern of supply completely changed, as well. Up until 1975, the Sahelian countries usually accounted for between 85 and 90 percent of Ivory Coast's recorded frozen and chilled meat imports, with Europe (mainly France) making up the rest. In 1975, however, large imports arrived from Europe, non-Sahelian Africa, and, for the first time, South America. In one year, the combined market share of Mali, Upper Volta, and Niger fell from 85.9 percent to 13.7 percent, and by 1976 it represented only 2.5 percent of total recorded meat imports.

Non-African suppliers entered the Ivorian meat market in 1975 for two reasons. Meat prices in Ivory Coast rose sharply in 1975 because of the shortage of local slaughter animals, thus making Ivory Coast a more attractive market to overseas meat suppliers. More importantly, the world's traditional meat-exporting countries, especially Argentina, were faced with increased stocks of meat in 1975 and fewer markets in which to sell. These countries had expanded their beef production in the early 1970s in response to rising consumer incomes in most developed countries. With the economic slowdown and rise in grain prices in 1973, however, most meat importing countries imposed import restrictions on beef in order to protect domestic producers. This left the meat-exporting countries with large stocks of unsold meat, forcing them to seek out new markets, including West Africa. Ivory Coast was thus able to find very inexpensive frozen beef on the world market just at the time when its traditional beef suppliers, the Sahelian countries, were unable to meet its demand for beef. World meat prices began to rise in late 1976, however, and it is unlikely that in the next five to ten years Ivory Coast

will be able to rely on the world market to the degree it did in 1976 without incurring a large outflow of foreign exchange.

The Ivorian Red Meat Supply: A Summary

Table 8 summarizes the statistics on the Ivorian red meat supply in 1976; it shows that beef is by far the most widely consumed red meat in Ivory Coast, accounting for nearly three-fourths of the total supply. In 1976, meat from small ruminants made up 18 percent of the total, and pork accounted for 9 percent. The bulk of the meat supply is imported. Domestic production accounted for only 26 percent of total red meat consumption in 1976, while imports of live animals from the Sahelian countries supplied about 45 percent; imports of frozen and chilled meat accounted for the remaining 29 percent.

Table 9 presents changes in the Ivorian beef supply in recent years. The table shows that while the total quantity of beef consumed was the same in 1970 and 1976 (approximately 43,600 tons), the pattern of supply changed considerably between these two years. The share of the total supply met by domestic production increased gradually from 11 percent to 16 percent over the period. The major change, however, was the large increase in the relative share of frozen and chilled meat imports. From supplying an average of 3 percent of the total beef supply during the period 1970-74, chilled and frozen beef imports increased to 16 percent of the total supply in 1975 and 38 percent in 1976. The proportion of the total supply met by live animal imports from the Sahelian countries fell from 84 percent in the 1970-74 period to 66 percent in 1975 and 46 percent in 1976.

The massive increase in frozen meat imports in 1975 and 1976 represented the opening of the Ivorian market to non-West African suppliers. Until 1975, 99.7 percent of the Ivorian beef supply was met by domestic production and imports of live stock and meat from neighboring Sahelian countries. By 1976, however, 37.6 percent of the total supply came from outside the West African region: 29.4 percent from South America, 6.2

TABLE 8

ESTIMATED IVORIAN RED MEAT SUPPLY IN 1976  
(tons of meat and edible offals)

Type of Meat	Domestic Production		Imports: Live Animals		Imports: Meat		Total	
	Tons	Percent	Tons	Percent	Tons	Percent	Tons	Percent
Beef	6,923	11.6	20,076	33.6	16,611	27.8	43,610	73.0
Mutton/Goat Meat	3,600 <sup>a</sup>	6.0	7,000 <sup>b</sup>	11.7	339	0.6	10,939	18.3
Pork	5,150 <sup>a</sup>	8.6	--	--	47	0.1	5,197	8.7
Horse	--	--	--	--	33	--	33	--
Total	15,673	26.2	27,076	45.3	17,030	28.5	59,779	100.0

SOURCES: Tables 3, 6, 7 and text.

<sup>a</sup>Domestic goat, mutton, and pork production estimated at three percent above their 1975 levels.

<sup>b</sup>Author's estimate based on examination of statistics from exporting countries (see p.157).

TABLE 9

THE IVORIAN BEEF SUPPLY: 1970-76 (TONS OF MEAT AND EDIBLE OFFALS)

Year	Imports						Domestic Production		Total <sup>a</sup>	
	Live Animals		Fresh, Chilled, and Frozen Meat		Total Imports		Tons	Percent	Tons	Percent
	Tons	Percent	Tons	Percent	Tons	Percent				
1970	37,448	85.8	1,477	3.4	38,925	89.2	4,700	10.8	43,625	100.0
1971	32,761	83.1	1,405	3.6	34,166	86.7	5,243	13.3	39,409	100.0
1972	37,715	84.9	1,205	2.7	38,920	87.6	5,507	12.4	44,426	100.0
1973	38,909	85.0	1,077	2.3	39,986	87.3	5,796	12.7	45,782	100.0
1974	33,885	81.7	1,243	3.0	35,128	84.7	6,349	15.3	41,477	100.0
1975	24,317	65.5	6,093	16.4	30,410	82.0	6,689	18.0	37,100	100.0
1976	20,076	46.0	16,611	38.1	36,687	84.1	6,923	15.9	43,610	100.0

SOURCES: Tables 2.6, and 7.

<sup>a</sup>Totals may differ slightly from sum of subtotals due to rounding.

percent from Europe, and 2.0 percent from Southern and East Africa. The total recorded amount of non-West African meat imported in 1976 equaled 16,424 tons. This was the equivalent of roughly 91,880 head of Sahelian cattle.<sup>1</sup>

The Ivorian market for cattle and beef thus changed radically between 1974 and 1976. Meat imports from Latin America and Europe began to play an important role in supplying Ivory Coast with meat, and the Sahelian states faced the spectre of having to compete with non-West African meat exporters for a share of the Ivorian market. Ivory Coast itself was trying to increase domestic livestock production during this period in order to reduce the country's reliance on livestock and meat imports from all sources. Within the context of this changing supply pattern, the question of the efficiency of the traditional cattle and meat marketing system became especially important. Was inefficiency in the traditional marketing system partly to blame for the Sahelian countries' declining share of the Ivorian market? Did exploitative livestock traders offer extremely low prices to Ivorian cattle producers, thus discouraging domestic production? Could the traditional marketing system adapt to the new supply conditions, or were new marketing structures needed? The micro-economic-level research described in the following sections of this paper was aimed at answering these questions.

#### MARKET ORGANIZATION: A CONSTRAINT TO DEVELOPMENT?

Many government officials and foreign advisors in West Africa believe that the traditional organization of cattle and meat marketing prevents efficient market operation. Three problems are alleged to exist: 1) that a large number of the market participants, particularly intermediaries, provides no useful services to buyers or sellers and are unnecessary "parasites" on the system; 2) that traders and intermediaries sometimes conspire to restrict the number of animals sold, thus artificially raising

---

<sup>1</sup> Based on an average carcass weight of 143 kg plus edible offals equal to 25 percent of carcass weight. (See Table 6.)

prices; 3) that many market participants, particularly butchers, lack the basic business skills needed for expansion of the trade. Most West African governments have called for reorganization of the cattle trade in recent years. For example, the Entente states (Ivory Coast, Togo, Benin, Niger, and Upper Volta) have signed agreements (5) aimed at guaranteeing more state control over the trade. Ghana has gone even further, replacing the traditional marketing system with a state monopoly.

This study examined the need for market reorganization by looking at the structure, conduct, and performance of the current marketing system. Market structure was evaluated by measuring the degree of buyer and seller concentration in the Abidjan and Bouaké markets. Market conduct was examined by studying the roles played by different agents in the marketing system and by examining the incidence of collusion. Market performance was judged by examining the net margins of butchers and traders. The research showed that the traditional marketing system is fairly competitive. Market concentration among both buyers and sellers is, in most instances, low enough to make collusive agreements inherently unstable. Collusion among intermediaries to restrict the number of animals sold appears rare, although intermediaries sometimes do collude in deciding to whom they will sell. The research also showed that most intermediaries provide important services to buyers and sellers, including guaranteeing credit, facilitating sales, and speeding the flow of market information. The research also showed that the net margins of butchers and cattle traders are modest, together accounting for about 14 percent of the retail price of beef in Abidjan and Bouaké.

### Market Structure

Economic theory suggests that a high degree of market concentration is often associated with non-competitive pricing arrangements. While a high degree of market concentration does not prove the existence of collusive pricing in a market, there are strong theoretical reasons to believe that the presence of few sellers in a market, each having a large



market share, is often associated with non-competitive pricing.<sup>1</sup> In West Africa, it is often alleged that a few large cattle merchants and intermediaries control such a high proportion of sales in certain markets that they can restrict the number of animals sold, thereby forcing up prices and earning monopoly profits.

Data collected during the field studies in Bouaké and Abidjan can be used to measure the degree of market concentration among major intermediaries in these two cities and to draw inferences about the likely degree of competition among them. Concentration ratios, which measure the proportion of total sales handled by a given person, were calculated for intermediaries in both Abidjan and Bouaké, based on several months' data.<sup>2</sup> Table 10 summarizes the results.

Table 10 indicates that in Abidjan a large number of sellers were present and market shares were typically small. Even in the month of highest seller concentration, the four largest intermediaries in Abidjan controlled only 36 percent of total sales and the largest eight controlled only 56 percent. Most authors agree that with such a low degree of market concentration it would be extremely difficult to maintain collusive agreements aimed at restricting sales (2, pp. 112-24). In Bouaké, there were fewer total sellers in the market, and market shares were larger. During the month of highest concentration, the four largest intermediaries controlled nearly 70 percent of total sales. During most months, however, the market share of the four largest intermediaries was between 50 and 60 percent. Although market concentration was higher in Bouaké than in Abidjan, in most months it was still low enough to make collusive agreements inherently unstable. Furthermore, most intermediaries received the largest part of their income from a fixed commission which was paid to them (by the purchaser) for every animal they sold. Since the commission did not vary with the price of the animal, intermediaries usually had an interest in maximizing, not restricting, the number of cattle sold.

---

<sup>1</sup>These theoretical arguments are discussed in 27, pp. 124-26.

<sup>2</sup>See 27, pp. 128-31 for details of how these concentration ratios were calculated.

TABLE 10  
 CONCENTRATION RATIOS FOR LARGE AND MEDIUM-SCALE  
 INTERMEDIARIES IN ABIDJAN AND BOUAKE<sup>a</sup>

Number of Sellers	Percentage of Total Sales	
	Abidjan	Bouaké
	Entire Period of Observation (Dec., 1976-June, 1977) (Sept., 1976-June, 1977)	
Largest 1	6.8	20.1
Largest 4	23.2	45.3
Largest 8	37.1	63.5
Largest 20	64.4	87.8
Total Number of Sellers	140	62
	Month of Highest Concentration <sup>b</sup> (February, 1977) (January, 1977)	
Largest 1	12.4	23.6
Largest 4	35.7	69.0
Largest 8	55.6	86.7
Largest 20	76.4	--
Total Number of Sellers	62	17
	Month of Lowest Concentration (May, 1977) (November, 1976)	
Largest 1	7.6	12.4
Largest 4	26.6	43.6
Largest 8	44.4	64.5
Largest 20	77.0	83.3
Total Number of Sellers	61	24

<sup>a</sup> Includes intermediaries and merchants who sold without the aid of an intermediary.

<sup>b</sup> Degree of concentration measured by the percentage of total sales handled by the four largest intermediaries.

Therefore, even in the months of highest seller concentration in Bouaké, when it would have been easiest for intermediaries to collude to restrict sales, it is not clear that it would have been in their interest to do so.

Concentration among butchers in Abidjan appeared to be at roughly the same level as that among intermediaries in Abidjan, although the data necessary to calculate concentration ratios for most butchers were unavailable. About fifty-five butchers bought and slaughtered cattle in Abidjan in early 1977, and the market share of the largest butcher was approximately 15 percent. In Bouaké, market concentration among butchers was very low. Approximately forty-five butchers were active in the Bouaké cattle market in 1976-77; no butcher slaughtered more than two head of cattle per day, and most slaughtered only one. On the buyers' side, the Bouaké cattle market therefore approached the perfectly competitive model of many buyers, each with equally small market shares.

In summary, the data on market structure suggest that the scope for collusive behavior by buyers and sellers of cattle in Abidjan and Bouaké was quite limited. The degree to which sellers could artificially raise prices was further limited by the availability to butchers of inexpensive frozen beef. If butchers found cattle prices too high, they could sell frozen meat instead of slaughtering cattle.

### Market Conduct

Market conduct was examined by studying the roles played by different agents in the marketing system and by noting the incidence of collusion. A detailed description of the roles of different marketing agents is presented elsewhere (27, Chapters 3 and 4). The discussion below concentrates on the role of intermediaries, the market agents most frequently criticized as being "parasites" on the marketing system, and on the organization of the indigenous training systems for butchers and traders. The discussion also deals with the types and incidence of collusion observed in Bouaké and Abidjan.

The research showed that the term "intermediary" covers a wide variety of marketing agents, ranging from large-scale cattle brokers to small-scale traders. In its broadest sense, the work refers to anyone who comes between a northern cattle merchant and a southern butcher. In a narrower sense, however, the word refers only to cattle brokers, who arrange to sell a cattle merchant's animals, but do not actually buy the animals themselves. Most intermediaries (especially large-scale intermediaries) play important roles in helping northern cattle merchants sell their animals in unfamiliar markets, transmitting market information, and guaranteeing the credit of local buyers. Roughly 25 percent of all cattle sales in Bouaké and 50 percent of all sales in Abidjan are on credit, and the bulk of this credit is guaranteed by intermediaries. If authorities tried to eliminate intermediaries from the marketing system (as is sometimes advocated) without creating an organization to replace the intermediaries' credit function, a severe credit constraint would arise in the Bouaké and Abidjan cattle markets. A reduction in the availability of credit of this sort would greatly increase the working capital required to buy and slaughter cattle. This, in turn, would make it more difficult to enter the butchering trade and would probably force some butchers out of business, thus reducing competition in the trade and probably leading to higher meat prices.

Many butchers, however, complain about the large number of small-scale intermediaries in the Abidjan and Bouaké markets. Small-scale intermediaries handle only a few animals at a time and typically do not extend or guarantee credit. Usually they restrict their activities to buying animals on credit from large-scale intermediaries and reselling the animals to butchers for a profit. Interviews with butchers and traders in Abidjan and Bouaké indicated that the number of small-scale intermediaries in these markets increased substantially following the Sahelian drought of the late 1960s and early 1970s. The research showed that in the short run, the activities of these small-scale intermediaries may indeed raise the price of cattle. Their activities also have the effect, however, of speeding up the sale of cattle in the south, thereby increasing the rate of capital rotation of northern merchants.

This, in turn, raises the profitability of the north-south cattle trade (See 27, pp. 138-40). The higher profitability encourages more merchants to ship animals south and may, in the long run, lead to lower prices. Thus, even where the charge of intermediaries being "parasites" seems strongest, it is far from proven.

Cattle and meat marketing require specialized knowledge, and the traditional marketing system has developed indigenous training programs to impart this knowledge to people entering the trade. Most cattle merchants, large-scale intermediaries, and butchers spend several years as assistants or apprentices before entering the trade themselves. For example, butchers interviewed in Bouaké spent an average of 7.5 years as apprentices before becoming independent butchers. During their apprenticeships, young butchers and cattle merchants learn the fundamentals of cattle and meat marketing and accumulate the capital needed to enter the trade. There is, therefore, little evidence that merchants and butchers need special government training programs to teach them business fundamentals. Most cattle traders and butchers are highly experienced individuals having a detailed knowledge of their profession.

In over a year's observation of the Bouaké and Abidjan cattle markets, the investigator never observed collusion among intermediaries to restrict the number of cattle sold in order to force up prices, nor among butchers to restrict the volume of meat sold. Butchers, in fact, often complained about their inability to form a collusive bloc to deal with the intermediaries. Intermediaries, for their part, usually received the majority of their income from a fixed commission on every animal sold, and therefore has an interest in maximizing, not restricting, the number of animals sold.

Intermediaries would sometimes collude in deciding to whom they would sell, but not on the volume of sales. Intermediaries sometimes refused to sell to buyers who had defaulted on previous purchases on credit, in order to try to force repayment of the debt. Butchers also claimed that large-scale intermediaries would sometimes refuse to deal directly with butchers, preferring to pass through smaller scale intermediaries, who were often related to the large intermediaries. This occasional refusal

by some large-scale intermediaries to deal directly with butchers led to many of the charges of "parasitism" that were discussed above.

### Market Performance

Market performance was examined by looking at butchers' and traders' net margins, the net returns to these agents' capital and labor. Although the gross margin<sup>1</sup> of merchants who ship cattle to Ivory Coast from Mali and Upper Volta is typically large, most of this gross margin is attributable to transport costs and export taxes, not profits. The merchants' profits typically account for between 4 and 9 percent of the final sale price of cattle shipped to Abidjan and Bouaké. Rates of return to capital of traders who shipped cattle to Bouaké in 1976-77 varied between 16 and 30 percent per year, within the range of the accepted opportunity cost of capital in West Africa. Rates of return to capital of merchants who shipped cattle to Abidjan in 1976-77 were higher, but the high returns were apparently due to a transportation bottleneck that restricted cattle shipments to Abidjan and to the high risk of shipping cattle to Abidjan (due to the volatility of Abidjan cattle prices), not to collusion on the part of cattle merchants.

Similarly, the net margins of class 2 (traditional) butchers in Bouaké and Abidjan were fairly low, accounting for between 8 and 12 percent of the retail price of beef. These margins were considerably below those earned by class 1 (European-style) butchers in Ivory Coast.

Table 11 shows how much of the retail price of beef in Abidjan in 1977 was attributable to different costs. The figures are based on a 150-kg carcass weight animal purchased in Ouagadougou and shipped to Abidjan by rail.<sup>2</sup> Table 11 indicates that although the gross marketing

---

<sup>1</sup>The gross margin is the difference between the producer price and the retail price.

<sup>2</sup>See 27, pp. 428-30, for details of how the figures in Table 11 were calculated. During 1976-77 Ouagadougou was the single most important source of cattle sold in Abidjan, accounting for about 44 percent of the total.

TABLE 11  
EVOLUTION OF THE COST OF BEEF AND OFFALS SOLD RETAIL IN ABIDJAN

Item	Percent of Final Sale Price
1. Purchase of animal in Ouagadougou	46.8
2. Labor	
Shipping Cattle	0.5
Slaughter	<u>0.6</u>
Total Labor	1.1
3. Intermediaries' commissions & margins	1.9
4. Taxes and licenses	
Ivory Coast	4.3
Upper Volta	<u>8.4</u>
Total Taxes	12.7
5. Transport of cattle	
Transport fees	6.1
Shrinkage	7.0
Losses and forced sales	<u>1.5</u>
Total Transport	14.6
6. Selling costs of meat	
Transport, stall rental, & Labor <sup>a</sup>	4.4
Wastage (bone)	1.0
Losses due to condemnations & default on credit sales	<u>0.8</u>
Total Selling Costs	6.2
7. Profits	
Cattle trader	5.0
Wholesale retail butcher	7.5
Vendor of fifth quarter	<u>4.1</u>
Total Profits	16.6

<sup>a</sup>Includes an estimated total cost of selling offala (stall rental, labor, transport, and wastage) of 2,500 CFAF per animal.

margin accounted for over half the retail price of beef and offals in Abidjan, only about 19 percent of the retail price was attributable to total profits. Cattle traders' profits accounted for about 5 percent of the retail price of beef in Abidjan, and the profits of wholesale and retail butchers accounted for less than 8 percent. Intermediaries' commissions, which officials often decry as inflationary, accounted for only about 2 percent. Therefore, even if the profits of all butchers, traders, and intermediaries were reduced to zero, the retail price of beef in Abidjan would fall by less than 20 percent. In contrast, transport costs (including the high implicit cost of weight loss en route) accounted for about 15 percent of the retail price of beef, while taxes and licenses accounted for about 13 percent.

In summary, the data on market structure, function, and performance seem to indicate that the traditional cattle and meat marketing system works fairly efficiently. The data lend little support to the assertions that a few intermediaries and traders exercise monopoly power over major markets or that traders profits are exorbitant.

### MARKET INFRASTRUCTURE NEEDS<sup>1</sup>

Most cattle marketing projects undertaken by the Ivorian government and donor agencies have emphasized improving market infrastructure, e.g., by providing cattle scales to markets and by constructing modern abattoirs. Planners seem to hope that by duplicating the structure of cattle markets in developed countries, the efficiency of those markets can be duplicated. Some officials also seem to hope that by moving to the sale of cattle on a per-kg basis it will be easier for the government to set cattle prices. Most marketing projects have therefore emphasized changing the structure of the marketing system to make it correspond more closely to the market structure in developed countries rather than looking at the functions a

---

<sup>1</sup>This section deals exclusively with the infrastructure needs of cattle markets and abattoirs in Ivory Coast. Needs for improved transportation infrastructure are discussed in the following section.



marketing system must perform, identifying the infrastructure constraints that prevent the current system from performing those tasks efficiently, and moving to relax these constraints.

As a result of the this "structuralist" approach to market reform, the infrastructure provided by several marketing projects has not corresponded to the needs of the marketing system. For example, plans have called for installing cattle scales in major cattle markets and encouraging the sale of cattle on a per-kg basis, even though there is little evidence that a lack of scales has hindered efficient market operation. In fact, cattle and meat prices in Ivory Coast fluctuate seasonally and from day to day in a manner entirely consistent with fluctuations in supply and demand, and the distribution of prices per kg. of cattle sold on sight in Abidjan and Bouaké is tightly clustered about the mean, indicating that butchers accurately estimate carcass weights without using scales.<sup>1</sup> Furthermore, in markets where cattle scales have been installed, butchers and traders have refused to use them.<sup>2</sup>

There are, however, serious market infrastructure constraints to cattle and meat marketing in Ivory Coast (particularly in Abidjan) that marketing projects have not addressed. These involve inadequate slaughterhouses in Abidjan and Bouaké, the lack of grazing space near the Abidjan market, and poor unloading facilities for cattle. Each is discussed briefly below.

---

<sup>1</sup>For zebu males with carcass weights of between 130 and 160 kg sold in Bouaké during the study period, the standard deviation of average monthly prices per kg was only 8.5 percent of the mean. In other words, 68 percent of all prices fell within  $\pm 8.5$  percent of the mean. Furthermore, not all of the variation around the mean was random; some was due to daily fluctuations in supply and demand and to differences in the degree of finish of the animals.

<sup>2</sup>There are three main reasons why butchers and traders in these markets are reluctant to sell animals by weight. First, it is difficult to weigh cattle that are not used to being handled, and the risk of injury, either to the animals or to the person trying to weigh them, is significant. Second, the scales are often out of adjustment, giving inaccurate weights. Third, differences in gut fill among animals can lead to significant fluctuations in liveweights.

The Abidjan abattoir, originally constructed as modern, assembly-line slaughterhouse, has not been maintained, and currently, conditions of slaughter are extremely poor. Few carcass hoists in the abattoir still function, so animals are gutted on the floor, where they lie surrounded by blood and intestinal contents. Extensive refurbishing of the Abidjan abattoir is needed to insure the basic cleanliness of slaughter facilities in the Ivorian capital. In contrast, the Bouaké abattoir is an extremely simple structure (an open-sided building with cement floors and hand-operated carcass hoists), and conditions during slaughter in Bouaké are much more hygienic than in Abidjan. The Bouaké abattoir, however, was built in 1946 and is now too small to handle adequately the number of animals passing through it. It needs replacing, preferably by a structure designed along the lines of the current abattoir.

A second major infrastructure constraint to cattle marketing in Ivory Coast is a lack of grazing space around the abattoir and cattle market in Abidjan, Ivory Coast's largest market for beef. The lack of grazing prevents butchers and merchants from holding a buffer stock of animals to smooth out supply fluctuations. Since rail shipments of cattle to Abidjan are irregular, the supply of cattle in Abidjan varies widely from day to day. With no buffer stock to absorb some of this variation, prices there are volatile. The instability of cattle prices in Abidjan leads to a higher rate of default on debts by butchers and more fluctuant meat prices than in Bouaké, where cattle can be held as a hedge against supply fluctuations. As a result, Abidjan is a riskier market for northern cattle merchants than is Bouaké.<sup>1</sup>

A third problem at the Abidjan cattle market is that inadequate unloading facilities prevent cattle from being unloaded from rail cars at night. As a result, cattle arriving in Abidjan often must wait ten hours or more before they can be unloaded. Most cattle arriving in Abidjan by rail have already spent two to three days en route without food or water. The additional ten-hour wait in Abidjan at the end of the journey,

---

<sup>1</sup>Similar problems due to a lack of grazing are developing on a smaller scale at the cattle market in Man.

when the animals are very weak from the trip, significantly increases mortality and weight losses of cattle shipped by rail.

Given the difficulties of holding cattle in Abidjan and the poor condition of the Abidjan abattoir, officials should seriously consider moving the cattle market-abattoir complex out of the industrial zone of Port Bouët to an area where adequate grazing and water are available. Unless the market is moved or unless means are found to provide forage economically to the cattle at the present location, many of the current problems of cattle marketing in Abidjan (e.g., the high rate of default on debts) are likely to continue.

Even if the Abidjan abattoir is not moved from its present location, it will eventually become necessary to refurbish or rebuild it. When refurbishing the Abidjan abattoir or building new abattoirs in other cities, officials should keep two principles in mind. First, they should avoid overcapitalizing the slaughterhouses, i.e., replacing inexpensive labor with expensive imported capital equipment. Most modern abattoirs constructed in Africa are designed after abattoirs in developed countries, where capital is relatively cheap and labor is relatively expensive. In developing countries, however, the relative prices of capital and labor are just the reverse. If officials contract for the construction of abattoirs with companies that simply copy the plans of European or North American slaughterhouses rather than try to adapt these plans to African price conditions, the cost of slaughtering probably will be raised substantially above what it otherwise would have been, and many of the laborers currently involved in slaughtering will be thrown out of work.

The second point to be kept in mind is that the equipment used in the abattoirs should be simple and easy to repair. Equipment like power hoists and electric scales are likely to break down often when given heavy use by relatively untrained abattoir personnel. Simple manual equipment for which spare parts can be made locally, is likely to be both cheaper and more reliable than more complicated power equipment.

A "functional" approach to improving market infrastructure may prove more valuable than the "structural" approach used widely up to now. The goal of improved market infrastructure is to help the marketing system

efficiently perform its tasks of distributing cattle and meat. Given the problems facing cattle merchants and butchers in Ivory Coast, the infrastructure needs may not always be the same as those in developed countries. Plans for improving market infrastructure should therefore be preceded by an analysis of the critical constraints to marketing, and the improvements in infrastructure should be designed to relax those constraints.

### PROBLEMS AND COSTS OF TRANSPORTING CATTLE

Cattle marketing in West Africa is characterized by long distances between the areas of livestock production in the Sahelian countries and the major meat-consuming regions in the coastal countries. Because of the distances involved, transport costs for livestock become important components of the retail price of meat in the coastal areas. Reducing transport costs for cattle could therefore benefit both producers and consumers of beef considerably. This section examines the costs of alternative means of transporting cattle in West Africa and discusses some of the policy issues involved in livestock transport.

#### Current Pattern of Cattle Transport

Cattle travel to market in West Africa on hoof, by truck, by train, or by some combination of these methods. Trekking remains the most common means of transport, with almost all animals except those from government feedlots trekking at least part of the way to market. Rail transport is commonly used to ship cattle very long distances (e.g., from Ouagadougou to Abidjan) and to ship cattle shorter distances during the dry season, when grazing along trek routes is sparse. Long-distance trucking of cattle all the way from livestock-producing areas in the north to major consumption markets in the south is used very rarely, but intermediate-distance trucking of cattle within the forest zone of Ivory Coast is fairly common. Many observers feel that the heavy reliance placed on trekking results in

several problems, including high mortality and weight losses during shipment and extensive crop damage to fields along major trek routes. In order to reduce these alleged problems, the Ivorian government has advocated increased use of truck and rail transport for cattle.

### Transport Costs

The cost of transporting cattle includes direct cash costs, such as truck rental and wages of drovers; indirect (non-cash) private costs, such as mortality and weight losses during shipment; and social costs, such as the value of damaged crops for which no compensation is paid. This subsection outlines these costs, evaluating the advantages and disadvantages of transporting cattle by trek, truck, and rail.

Trekking.-- Trekking is a relatively inexpensive means of transporting cattle within the Sudanese and Guinea savanna zones. Most cattle merchants prefer trekking to other means of transport because trekking requires a low cash outlay and allows the merchant more flexibility than trucking or rail transport in timing the arrival of his herd to coincide with favorable market conditions. Typically a merchant whose cattle are trekked to market arrives at the market of destination a few days before the scheduled arrival of this herd in order to contact an intermediary and to evaluate market conditions. If prices are high, the merchant sends word to his drovers to rush the cattle to market so that he can benefit from the high prices. If prices are low, he tells the drovers to slow down and wait for market conditions to improve. When shipping cattle by truck or rail, merchants must often wait several days for trucks or train cars to become available, and it is therefore more difficult to time the animals arrival to correspond with favorable market conditions.

The low cash outlay required for trekking is illustrated in Table 12, which compares the cost of trekking cattle to Bouaké from Tingrela, on the Mali - Ivory Coast border, with the cost of trucking them along the same route. Table 12 indicates that for a cash outlay of 86,000 CFA F

TABLE 12

COST OF TRANSPORTING FIFTY HEAD OF CATTLE FROM TINGRELA OR BOUNDIALI TO BOUAKE  
BY TREKKING AND BY TRUCK: 1976-77 (in CFAP)

Expense	Trek		Truck	
	Total	Per Animal	Total	Per Animal
1. Salary of drovers	3 @ 10,000 = 30,000	600	2 @ 5,000 = 10,000	200
2. Food for drovers	15,000	300	—	—
3. Return trip for drovers	3 @ 2,500 = 7,500	150	2 @ 2,500 = 5,000	100
4. Round-trip for owner	5,000	100	5,000	100
5. Food for owner in Bouaké 7 days @ 200 CFAP/day	1,400	28	1,400	28
6. Health certificate	2,000	40	2,000	40
7. Vaccination	1,750	35	1,750	35
8. Amortization of cattle merchant's license	12,100	242	12,100	242
9. Indemnity for damaged fields	475	10	—	—
10. Loss of animals	1.0% of 50 animals @ 40,000 CFAP per animal = 20,000	400	1.6% of 50 animals @ 40,000 CFAP per animal = 32,000	640
11. Forced sales	0.6% of 50 animals @ 20,000 CFAP loss per animal = 6,000	120	0.6% of 50 animals @ 20,000 CFAP loss per animal = 6,000	120
12. Truck rental	—	—	2 trucks @ 87,500 CFAP each = 175,000	3,500

TABLE 12 CONTINUED

Expense	Trek		Truck Transport	
	Total	Per Animal	Total	Per Animal -
13. Unofficial costs	—	—	10,000	200
14. Cattle market tax: Bouaké	10,000	200	10,000	200
15. Gift to landlord	0-5,000	0-100	0-5,000	0-100
<b>Total Cost (excluding weight loss)</b>	<b>111,225 - 116,225</b>	<b>2,225 - 2,325</b>	<b>270,250 - 275,250</b>	<b>5,405 - 5,505</b>
Days in transit from:				
Boundiali		25		1
Tingrela		30		1

(total costs excluding weight losses, losses of animals, and forced sales) a merchant could trek fifty head of cattle from Tingrela to Bouaké and sell them in the Bouaké market. To ship the same animals by truck and sell them in the Bouaké market required a cash outlay nearly three times as large, 233,000 CFA F. Time in transit, however, was only one day by truck compared with 30 days by trek.

The indirect costs of trekking (losses of animals en route, forced sales, weight losses, and crop damage) are typically low in the Sudanese and Guinea savanna zones. Interviews conducted in 1976-77 with the chief drovers of thirty herds trekked to Bouaké indicated that only 1 percent of their animals were lost en route, and that mortality per se among trekked animals was extremely low.<sup>1</sup> Forced sales (sales at a loss of animals that were too ill, too injured, or too exhausted to continue the trip) were likewise extremely low, accounting for 0.6 percent of the animals trekked to Bouaké. (See 27, pp. 218-20 for details.) Weight losses during trekking are extremely variable, depending, among other things, on the season, the state of health of the animals, and the speed at which the cattle are trekked. Data on weight losses are scarce, but those that do exist suggest that weight losses during trekking may not be as high as is sometimes alleged. Weighings of cattle trekked between Sikasso, Mali and Bouaké during the rainy season indicated that herds can actually gain weight when trekked during the rainy season (27, pp. 221-24). Data from Upper Volta (18) show that even during the dry season, cattle do not always lose weight during trekking.

Government officials in Ivory Coast often cite crop damage by trade herds as a major social cost of trekking. Data collected in Bouaké, how-

---

<sup>1</sup>Most animals lost during trekking simply became separated from the herds and were lost in the surrounding countryside. Only mortality losses represented net losses to society. Animals lost in the bush during trekking represent losses to cattle merchants, but not to society as a whole, because someone presumably found the lost animals and either raised them or slaughtered them.



ever, indicate that cost of crop damage per animal trekked to market is extremely low, on the order of 10 CFA F. Even if the incidence of crop damage were several times higher than indicated by these data, it would not be high enough, from an economic standpoint, to justify trucking.<sup>1</sup>

The major disadvantage of trekking, from a merchant's point of view, is that it takes longer than trucking or rail shipment; therefore, a merchant cannot rotate his capital as quickly as with other means of transport. Nevertheless, during the study period, trekking cattle to market was generally more profitable than trucking them, even taking into account the slower rate of capital rotation involved.

Trucking.-- Long-distance trucking is often advocated as a solution to the problems of weight loss and crop damage associated with trekking. Data collected during the study (as typified by the figures presented in Table 12), however, indicate that trucking is an expensive way of moving cattle in the Sudanese and Guinea savanna zones. The high cost of trucking explains why few merchants currently truck cattle long distances in Ivory Coast. Trucking is competitive within the forest zone, however, where trekking is difficult (and in some areas forbidden), and trucking within the forest zone is common.

Several factors work against long-distance trucking of cattle in Ivory Coast. Truck rental rates per animal are high because truckers can usually earn more money hauling cargoes with higher weight-to-volume ratios than cattle. Truckers therefore regard cattle as a backhaul cargo of last resort, a cargo that pays only some of the costs of the return trip south.<sup>2</sup> In 1977 truck rentals fees accounted for 75 percent of cash cost and 65 percent of the total cost (excluding weight losses) of trucking cattle between Tingrela

---

<sup>1</sup>An alternative means of dealing with the problem of crop damage is discussed below in the section on policy recommendations.

<sup>2</sup>Data on transport costs in Ivory Coast collected by SETEC International (21) indicate that in 1976 it cost roughly 117,000 CFA F to operate an 18-ton truck (capable of hauling 25 head of cattle) between Tingrela and Bouake. Table 12 shows that this was 29,500 CFA F more than could be earned hauling cattle along this route.

and Bouaké. Other major costs of trucking are the bribes and "gifts" that truckers and merchants are sometimes forced to pay police and customs officials along the route. These costs are less important for trekked herds than for trucked herds because drovers can often avoid police checkpoints by trekking their animals away from the main roads.

The indirect costs of mortality and weight losses during trucking also appear to be substantial. Because of the small number of cattle shipped long distances by truck in Ivory Coast, it proved impossible during the study to empirically determine the mortality rate for trucked cattle. Cattle traders interviewed in Abidjan and Bouaké, however, generally stated that about twice as many animals were lost during trucking as during trekking. Weighings of cattle trucked to Abidjan from Niono, Mali and from Ferkéssédougou, Ivory Coast indicated that net carcass weight losses during trucking were fairly high, about 2.7 percent per day in transit (27, pp. 242-43).

The main advantages of long-distance trucking of cattle are that it allows merchants to react quickly to shortages of cattle in the consumption markets (if they can quickly find trucks to transport their animals) and it permits a more rapid rotation of capital. For example, instead of trekking his animals for thirty days between Tingrela and Bouaké, a merchant can truck them to Bouaké in a single day. Even if it takes him a week to assemble the herd in Tingrela, three days to find a truck, a week to sell the animals in Bouaké, and a day to return to Tingrela, his rate of capital rotation will be two and one-half times that of a merchant who trekked his cattle to market (eighteen days versus forty-five days). During most of the study period, however, the price differential between markets was not high enough to make trucking more profitable than trekking, even taking into account the faster rate of capital rotation. Long-distance trucking was therefore used only when price differentials between markets were unusually high.

The above discussion applies to trucking costs within the Sudanese and Guinea savanna zones. Within the forest zone (i.e., the area south of Bouaké) trekking cattle is difficult because of dense vegetation and heavy tsetse infestation, and in some areas trekking is outlawed. The

real costs of trekking are therefore higher in the forest zone than in the savanna. Trucking costs, on the other hand, are generally lower in the forest zone than in the savanna because most of the main roads within the forest zone are paved. Trucking therefore becomes a viable alternative to trekking in the forest zone, and intermediate-distance trucking of cattle within this zone is common.

Rail Shipment.-- Almost all cattle sold in Abidjan arrive by train. Some trek part of the way to Abidjan before boarding the train (e.g., from Mali to Ferkéssédougou); others, particularly those from Upper Volta, travel the entire distance by rail. Rail shipment is more costly per trip than trekking, but allows cattle to be shipped longer distances, particularly during the dry season, than trekking would allow. Rail transport also permits traders to rotate their capital more quickly than trekking does.

Table 13 shows the typical costs (excluding weight losses) of exporting cattle by rail from Ouagadougou to Abidjan in 1976. The table shows that of the total cost of about 14,000 CFA F per animal, over half was attributable to taxes and license fees. By far the largest of these was the Voltaic export tax of 6,519 CFA F per head. Rail transport charges accounted for about 30 percent of the cost of exporting cattle, and other charges made up the remaining 20 percent. Although rail transport costs are not the single most important cost of exporting cattle from Ouagadougou to Abidjan, they are, nonetheless, a crucial determinant of cattle prices in both cities.

There are three major problems with rail shipment of cattle in Ivory Coast and Upper Volta. First, delays in loading, unloading, and en route result in cattle spending a long time in the poorly ventilated rail cars without food or water. For example, the research showed that on the average cattle shipped from Ouagadougou to Abidjan spend 3.5 days between the time they are loaded in the cars in Ouagadougou and the time they are unloaded in Abidjan. During this time they receive neither food nor water. The results are heavy shrinkage and losses due to mortality. The data indicate that cattle shipped from Ouagadougou to Abidjan lose about 9 percent of their original carcass weights en route. Tissue shrinkage

TABLE 13  
 COST OF TRANSPORTING FIFTY HEAD OF CATTLE FROM  
 OUAGADOUGOU TO ABIDJAN BY RAIL (IN CFAF)

Expense	Total Cost	Cost per Animal
1. Marking animals to denote ownership (Ouagadougou)	500	10
2. Landlord's commission in Ouagadougou	12,500	250
3. Payment to herders to watch animals before shipment	7,500	150
4. Export license	4,150	83
5. Veterinary inspection of animals	7,500	150
6. Certificate of origin (100 CFAF per herd)	100	2
7. Salary of drovers 2 @ 5,000 CFAF	10,000	200
8. Food for drovers 2 @ 2,000 CFAF	4,000	80
9. Authorization to export	200	4
10. Voltaic export tax 6,519 CFAF per animal	325,950	6,519
11. Rail transport 2 H12 cars @ 104,666 CFAF	209,332	4,187
Straw for cars	8,000	160
Loading of cars 2 @ 750 CFAF	1,500	30
Unloading of cars 2 @ 500 CFAF	1,000	20
Other charges	0-40,000	0-800
12. Loss of animals 1.6% of 50 animals .8% thrown out for loss of 54,000 CFAF per head	21,600	
.8% sold at an average loss of 27,000 CFAF per head	10,800	
Total loss: mortality	32,400	648
13. Forced Sales 3% of 50 animals at an average loss of 18,000 CFAF per animal	27,000	540
14. Market tax: Abidjan	25,000	500
15. Gift to the landlord	0-5,000	0-100
Total (excluding weight losses)	676,632-721,632	13,533-14,433
Days in transit		2-5

SOURCE: Field study results; Larry Herman, personal communication, and Larry Herman, "Cattle and Meat Marketing in Upper Volta," Report to U.S.A.I.D., (Ann Arbor: 1977), pp. 119-40.

is the single largest cost, excluding export taxes, of shipping cattle between Ouagadougou and Abidjan, costing about 5,700 CFA F per head.<sup>1</sup> Mortality losses and forced sales, while significant, are less important than shrinkage losses, costing about 1,200 CFA F per head. Roughly 1.6 percent of all cattle shipped between Ouagadougou and Abidjan die en route (See Table 14). Mortality losses only become important when cattle spend more than two days in the train cars; therefore, very few cattle shipped by rail within Ivory Coast die en route.

The second major problem of rail shipment is that the cars used by the RAN<sup>2</sup> to ship cattle are boxcar-style wagons with very poor ventilation. As a result, the cars become very hot inside, and this exacerbates the mortality and weight losses en route.

The third problem of rail transport is a seasonal shortage of rail cars during the peak months of the cattle trade (September to February). The shortage often forces merchants to wait a week or more for cars to ship cattle south. The transportation bottleneck not only reduces the number of cattle that can be shipped to Abidjan; it significantly raises the price of moving cattle south, as merchants incur additional costs as their herds wait at the railroad loading points for cars to become available. These costs are estimated at roughly 124 CFA F per animal per day, or 6,200 CFA F per day for a herd of fifty head (27, pp. 225-26 ). The costs are passed on to consumers in the form of higher meat prices. The seasonal shortage of rail cars is due to a slow north-south rotation of cars by the RAN. The rotation is slow because merchants who ship goods north in the cars are reluctant to unload them once they arrive in Upper Volta, due to a lack of warehouse space.

---

<sup>1</sup>Viewed another way, the 9 percent carcass weight loss is the equivalent of losing one out of every eleven animals shipped.

<sup>2</sup>Regie de Chemin de Fer Abidjan-Niger, the railroad linking Ouagadougou and Abidjan.

TABLE 14

ESTIMATED MORTALITY RATES OF CATTLE DURING RAIL SHIPMENT TO ABIDJAN: 1976-77  
(PERCENT)

Point of Departure	Distance from Abidjan (km.)	Average Trip <sup>a</sup> Length (days)	Number of Cars in Survey <sup>b</sup>				Estimated Mortality Rate (Percent)			
			H12	H13	J14	Total	H12	H13	J14	Overall
Upper Volta										
Ouagadougou	1,155	3.5	194	26	137	357	1.3	1.9	1.8	1.6
Koudougou	1,062	3.4	51	1	8	60	1.3	0	2.5	1.4
Bobo-Dioulasso	806	3.1	133	33	21	187	0.9	1.5	2.3	1.2
Ivory Coast										
Ouangolodougou	616	1.7	30	1	1	32	0	0	0	0
Ferkéssédougou	560	1.6	158	8	18	184	0.1	0	0.8	0.1
Tafiré	498	1.6	13	2	0	15	0	0	0	0
Bouaké	326	1.8	14	1	1	16	0	0	0	0

<sup>a</sup>Results from survey. See 27, pp. 239-41 for details.

<sup>b</sup>H12, H13, and J14 refer to different types of cattle cars.

## Conclusions

The data collected during the study indicate that cattle merchants currently rely heavily on trekking because trekking is the cheapest way of moving cattle within the savanna zones. Not only are the cash costs of trekking low; the indirect costs, in terms of mortalities and weight loss en route, also appear low during most of the year. Although it involves a slower rate of capital rotation than trucking or rail transport, trekking remains the most profitable way of moving cattle to market in much of Ivory Coast.

Cattle merchants, however, do not rely exclusively on this method of transport. Merchants are quite sensitive to relative transport costs, and have adopted modern means of transport when it has been profitable to do so. For example, virtually all cattle shipped from Upper Volta to Abidjan travel by rail because the distance involved is great (over 1,100 km. between Ouagadougou and Abidjan) and because trekking in the southern half of Ivory Coast is difficult. Similarly, many merchants who export cattle from Mali to Bouaké trek their animals during the rainy season, but shift to a mixture of trekking and rail transport during the dry season, when the risk of mortalities and weight losses during trekking increase. This sensitivity on the part of merchants to relative transport costs suggest that as roads and rail transport improve and cattle prices rise, merchants will increasingly rely on trains and trucks to ship their cattle to market.

## FACTORS AFFECTING THE LOCATION OF SLAUGHTER

In recent years, governments of the Sahelian countries and donor agencies have promoted the construction of modern abattoirs in the northern livestock-producing areas, with the goal of shipping refrigerated meat to the coastal areas. The Ivory Coast government has followed a similar policy, contracting for the construction of a refrigerated abattoir in Ferkéssédougou, which will ship meat south to Abidjan. Policy

makers see two advantages in slaughtering in the north and shipping the meat south. First, the shrinkage and mortality losses associated with the shipment of live animals would be reduced or eliminated. Second, slaughtering in the north would increase value added in the north.

To date, however, it has remained more profitable to ship live animals south than to ship chilled meat, and as a result, the chilled meat trade has not developed as planners had hoped that it would. Table 15 illustrates the problem, comparing the profits that could have been earned in early 1977 shipping chilled beef to Abidjan from Ferkéssédougou, where the Ivorian government is constructing a new abattoir, with those that could be earned shipping cattle along the same route.<sup>1</sup> Table 15 shows that given the prices and costs prevailing in early 1977, a merchant could have earned nearly twice as much shipping cattle between Ferkéssédougou and Abidjan as he could have earned slaughtering the animals in Ferkéssédougou and shipping the carcasses south. A similar situation prevailed for shipments of cattle and chilled meat to Abidjan from Bamako and Ouagadougou (27, Chapter 7).

One reason it has remained more profitable to export cattle than meat is the high cost of shipping chilled meat in West Africa. Frequent breakdowns of refrigeration equipment (especially of the poorly maintained refrigerated rail cars used to ship meat between Upper Volta and Abidjan) lead to deterioration of the meat, adding significantly to transport costs.

Transport costs, however, are not the only determinants of the relative profitability of cattle and meat exports. The amount of money that can be earned selling the fifth quarter in the north compared to selling it in the south also plays a crucial role. A model presented in the Appendix

---

<sup>1</sup>In Table 15 and in the subsequent analysis in this section it is assumed that the fifth quarters (i.e., all salable offal) of animals slaughtered in the north are sold in the north and are not shipped south. Typically, without processing, offal tend to spoil quickly. Mittendorf (9, p. 16) reports that even when offal are frozen for shipment south, they lose from 25 to 50 percent of their retail value because of West African consumers' preference for fresh offal.



TABLE 15

COMPARISON OF THE PROFITABILITY OF SHIPPING MEAT  
AND CATTLE FROM FERKESSEDOUGOU TO ABIDJAN (IN CFAF)

Expenses/Receipts	Cost per Animal
<b>Meat Shipment</b>	
<b>Expenses</b>	
Purchase of Animal having 160 kg carcass weight in Ferkéssédougou @ 337 CFAF per kg carcass weight	53,920
<b>Slaughter Expenses</b>	
Slaughter tax, veterinary inspection, and cold room fees	2,500
Amortization of butcher's license and union fees	347
Preparation of the carcass for shipment 2 CFAF per kg	320
Loss through seizures (0.5 percent)	282
Sale of fifth quarter in Ferkéssédougou	<u>-5,000</u>
Total Slaughter Cost Minus Value of Offals Sold in Ferkéssédougou	<u>-1,551</u>
Refrigerated Rail Shipment: 23,155 CFAF per ton	3,705
(Refrigerated Truck Shipment: 30 CFAF per kg)	(4,800)
Unloading of Train Car or Truck: 500 CFAF per car of 8 tons (50 carcasses)	10
Veterinary Inspection Tax in Abidjan: 10 CFAF per kg	<u>1,600</u>
Total Expenses: Train	57,684
Total Expenses: Truck	<u>58,779</u>
Weight Loss in Transit: 1.5 percent	2.4 kg
Weight of Meat Arrived in Abidjan	157.6 kg
Sale Price per kg in Abidjan	<u>400 CFAF</u>
Gross Receipts	<u>63,040</u>
Profit per Animal	
Rail Transport	5,356
Truck Transport	<u>4,261</u>

See following page for continuation of Table 15

TABLE 15 - CONTINUED

Expenses/Receipts	Cost per Animal
Live Animal Shipment (25 head)	
<b>Expenses</b>	
Purchase of Animal of 160 kg carcass weight in Ferkéssédougou @ 337 CFAF per kg carcass weight	53,920
Salary of Drover	
5,000 CFAF for 25 head	200
Food for Drover: 1,000 CFAF	40
Return Passage for Drover	--
Round Trip for Owner: 4,000 CFAF	160
Food for Owner in Abidjan: 7 days @ 200 CFAF = 1,400 CFAF	56
Health Certificate: 3,500 CFAF	140
Loss of Animals	--
Forced Sales: 1.5 percent of 25 animals @ 20,000 CFAF loss per animal = 7,500 CFAF	300
Amortization of Cattle Merchants License	242
Rail Transport	
1 H12 car @ 62,558 CFAF	2,502
Straw: 500 CFAF	20
Loading/Unloading: 1,000 CFAF	40
Other: 1,000 CFAF	40
Abidjan Cattle Market Tax	500
Gift to Landlord	0-100
Total Expenses	<u>58,160 to 58,260</u>
Loss of Carcass Weight (2 percent) <sup>1</sup>	3.2 kg
Carcass Weight of Animal in Abidjan	156.8 kg
Sale Price of the Animal per kg Carcassweight in Abidjan	<u>422 CFAF</u>
Gross Receipts	67,738
Profit per Animal	9,458 to 9,558

SOURCE: Staatz, John M., The Economics of Cattle and Meat Marketing  
in Ivory Coast (Ann Arbor: Center for Research on Economic Development:  
1979), pp. 256-57.

shows that under existing conditions, three factors determine whether it is more profitable to export live animals or meat from the north: the price of meat in the south, the price of the fifth quarter in the north, and relative transport costs and shrinkage for cattle and meat. Contrary to a popularly held view, with given transport costs, if the prices of meat and offals in the south rise relative to prices in the north it becomes relatively less, not more, profitable to ship meat than live animals.<sup>1</sup> By slaughtering in the north a merchant forgoes the income he could have earned by selling the fifth quarter in the south, where its price is higher. An increase in meat prices in the south relative to the north will increase the profitability of exporting meat as opposed to live animals only if the price of offals in the south falls relative to the price of meat in the south, a situation unlikely to occur in Abidjan in the next five to ten years. Furthermore, expansion of slaughter in the north in order to increase meat exports would tend to be self-braking. Expanded slaughter in the north would increase the supply of offals in the north, and with no increase in the demand for offals in the north, their price would fall. This would increase the relative profitability of sending the offals south (in the form of a live animal), where their price was higher, rather than slaughtering in the north and selling the offals locally.

The model shows that under conditions likely to prevail during the next five to ten years, the only way in which it could become more profitable to export meat as opposed to live animals would be for the costs of slaughtering in the north and transporting carcasses south to fall relative to the cost of transporting live animals south, or for the price of the fifth quarter in the north to increase relative to the price of meat in the south. Furthermore, if only relative transport costs changed, expansion of slaughter in the north would be self-braking because of a fall in the relative price of offals in the north. Therefore, if export-

---

<sup>1</sup>The absolute profitability of exporting meat increases as the price of meat and offals in the south increases relative to prices in the north, but the relative profitability of meat as opposed to live animal exports falls.

ing meat from the north is to become and remain more profitable than exporting live animals, not only must slaughter costs in the north and the cost of transporting meat fall relative to the cost of transporting live animals, but the price of the fifth quarter in the north must also rise relative to the price of the fifth quarter in the south. One way to increase the demand for the fifth quarter in the north (and hence its price) would be to build processing facilities for offals in the north. Processing would allow northerners to export the fifth quarter to areas where the demand for it is high, rather than being forced to sell it in the north where the demand for it is limited. This, in turn, would increase the relative profitability of exporting meat as opposed to live animals.

#### CATTLE AND MEAT PRICES: THEIR IMPLICATIONS FOR NORTHERN FATTENING PROJECTS

The profitability of most livestock development projects ultimately depends in large part on the retail demand for different types of meat. The nature of this demand is reflected in the prices of different types of cattle and of different cuts of meat. This section uses data on cattle and beef prices and information gathered during interviews with meat consumers to draw inferences about the nature of the demand for beef in Ivory Coast and how it is likely to change in the near future.

#### Types of Markets for Beef in Ivory Coast and Projected Production of Different Grades of Beef

Ivory Coast has two distinct markets for beef: the class 1 market, made up of supermarkets and European-style butcher shops; and the class 2 market, made up of butchers who sell meat in open market stalls. The class 1 market, which caters to the urban elite (expatriates and high-income Africans), handles slightly over 1,800 tons of beef per year, about 4 percent of the total beef consumed in Ivory Coast. Thus, the market for high quality beef in Ivory Coast is small, both in absolute and relative terms.

Projected production of high-quality beef in central West Africa, however, is high. SODEPRA<sup>1</sup> is currently operating a feedlot at Ferkéssé-dougou, and the National Plan projected output from this feedlot would total 16,000 head by 1980, the equivalent of 1,600 tons of fattened rear quarters.<sup>2</sup> The National Plan calls for a second feedlot to be built in 1980, with a capacity of 20,000 head per year, or 2,000 tons of fattened rear quarters. Mali plans to export 19,000 head of fattened cattle per year to Ivory Coast by 1980 (20), the equivalent of 1,900 tons of fattened rear quarters. Three feedlots have been constructed near Banfora in Upper Volta, with a total capacity of over 6,000 head per year (600 tons of fattened rear quarters) (7). The financial success of almost all these projects depends on the ability of the feedlot operators to sell the fattened animals (or the meat from these animals) at a premium on the Ivorian market. The projected production from these feedlots, however, far exceeds the demand for high-quality beef in Ivory Coast. The production of high quality rear quarters is projected at about 6,000 tons in 1980, while the total demand for high quality beef in Ivory Coast is unlikely to exceed 2,000 tons.

The question arises whether alternative markets can be found for this beef. While some markets may exist in other coastal states (particularly Nigeria), many of these states are setting up their own feedlots. It is therefore likely that the bulk of this high-quality beef, if it is produced, will have to be sold on the class 2 market.

#### Demand for Fattened Beef in the Class 2 Market

Data on cattle and retail beef prices collected during the study suggest some preference in the class 2 market for fattier, more tender meat. Cattle prices can be used in two ways to draw inferences about the

---

<sup>1</sup>Société pour le Développement des Productions Animales, the Ivorian government agency in charge of promoting domestic livestock production.

<sup>2</sup>In 1978, however, the feedlot's manager said that production in 1980 would probably total only about 10,000 head (26).

retail demand for tender meat. First, the prices of heavy animals can be compared with those of lighter animals in order to see whether a premium was paid for the larger, generally better-fed animals. Second, the prices of animals of different breeds and sexes can be compared to see if prices are higher for those breeds and sexes reputed to yield fattier meat.

Cattle Prices.-- Data from Bouaké indicate that once the value of the fifth quarter was taken into account, the price per kg carcass weight of zebu males having carcasses 190 kg and heavier was about 1.5 percent higher than the price per kg of males with carcasses of between 130-159 kg.<sup>1</sup> Although such a comparison is hampered by the fact that the weight differences among animals were sometimes due to differences in the frames of the animals, not their degree of finish, it does suggest that class 2 butchers in Bouaké paid a slight premium for fattier, more tender meat.

The preference of consumers, and hence butchers, for fattier meat can be seen more clearly by comparing the prices paid for different breeds and sexes of cattle. Both class 1 and class 2 butchers in Abidjan and Bouaké reported that zebus usually yielded fattier meat than did taurins, and that consumers preferred this fattier meat. Similarly, butchers reported that steers usually yielded fattier meat than either bulls or cows. Table 16 presents average monthly prices in Bouaké of zebu males, zebu-taurin crossbreeds, and taurins during the study period. The table shows that in ten of the thirteen months under consideration the price per kg carcass weight of zebus was above that of taurins and that in nine of the thirteen months the price of zebus was above that of zebu-taurin crossbreeds. For the period as a whole, the price per kg carcass weight of zebu males averaged 369 CFA F, compared with 363 CFA F for zebu-taurin crossbreeds and 351 CFA F for taurins.<sup>2</sup> The higher price per kg carcass weight of zebus reflected the aforementioned preference of consumers, and

---

<sup>1</sup>See 27, p. 336-37 for details.

<sup>2</sup>T-tests indicated that differences were statistically significant (27, pp, 332-37).

hence butchers, for the fattier meat from zebus.<sup>1</sup> As would be expected, the price of per kg of zebu-aurin crossbreeds was intermediate between that of zebus and that of taurins.

The prices for taurins and zebu-aurin crossbreeds shown in Table 16 are not broken down by sex or weight of the animal. It is therefore conceivable that the price differences observed in Table 16 resulted from factors other than breed. An economic model of the demand for slaughter cattle in Bouaké was therefore constructed in order to test for significant differences among the prices of different types of cattle (27, pp.343-53). The model allows comparison of average prices by breed and sex, while holding weight and month of sale constant. Table 17 presents the relative prices per kg. of different types of cattle as estimated by the model.

Table 17 confirms that the price per kg carcass weight of zebus was higher than that of other breeds. It also shows that, as expected, the price per kg of steers was higher than the price per kg of either bulls and cows. This pattern of relative prices strongly suggests that consumers in the class 2 market preferred fattier, more tender meat; as mentioned above, zebus generally yielded meat with a higher fat content than did taurins, and steers yielded fattier meat than did either cows or bulls.

Retail Meat Prices.-- Retail meat prices also suggest that consumers who bought beef on the class 2 market preferred some fat in their diet. Beef is sold on the class 2 market both by weight and in small unweighed piles called tag, which are composed of skeletal meat, offals, fat, and bone. When prices of tag are regressed against the weight of meat, bones, offals, and fat in the tag, the coefficients in the resulting equation

---

<sup>1</sup>This preference was reflected in the retail market by the ease with which a butcher could sell his meat. Butchers reported that when they sold meat from taurins they sometimes had trouble selling all their meat during the morning. They were thus required to either put in longer hours at the market to sell all their meat or sell the meat the next day (or in the evening) at a discount.

TABLE 16  
 AVERAGE MONTHLY CATTLE PRICES IN BOUAKE: JULY 1976-JULY 1977  
 (CFAF per kg carcass weight)

Month/Year	Zebu Males (130-159 kg. carcass weights)	Zebu-Taurin Crossbreeds <sup>a</sup>	Taurins <sup>b</sup>
<b>1976</b>			
July (s.d.) <sup>c</sup> N <sup>d</sup>	344 (28) 23	360 (28) 5	302  1
August (s.d.) N	359 (34) 17	330 (27) 6	335 (27) 6
September (s.d.) N	344 (37) 25	321 (22) 2	342 (21) 10
October (s.d.) N	343 (28) 32	356 (58) 15	334 (30) 10
November (s.d.) N	340 (31) 45	336 (28) 20	329 (34) 4
December (s.d.) N	395 (45) 46	383 (29) 33	360 (40) 4
<b>1977</b>			
January (s.d.) N	366 (29) 42	364 (37) 40	326  1
February (s.d.) N	382 (27) 58	370 (32) 29	380 (39) 10
March (s.d.) N	377 (28) 34	381 (30) 22	324 (28) 2
April (s.d.) N	382 (33) 41	389 (34) 32	391 (44) 11

Table 16 continued on next page.



TABLE 16 - CONTINUED

Month/Year	Zebu Males (130-159 kg. carcass weights)	Zebu-Taurin Crossbreeds	Taurins
May	381	376	392
(s.d.)	(25)	(30)	(21)
N	34	28	2
June	406	382	372
(s.d.)	(35)	(31)	(26)
N	21	18	16
July	376	371	382
(s.d.)	(25)	(33)	(27)
N	8	5	4
Average <sup>e</sup>	369	363	351

<sup>b</sup>The average carcass weight of the 255 zebu-taurin crossbreeds in the sample was 144 kg.

<sup>b</sup>The average carcass weight of the 81 taurins in the sample was 126 kg.

<sup>c</sup>Standard deviation.

<sup>d</sup>Number of observations.

<sup>e</sup>Unweighted average of monthly prices.

TABLE 17

RELATIVE PRICES PER KG. OF DIFFERENT TYPES OF CATTLE  
SOLD IN BOUAKE, 1976-77  
(percent of price per kg of zebu steers)<sup>a</sup>

Breed	Steers	Bulls	Females
Zebus	100.0	96.8	98.9
N'damas	95.9	92.7	94.8
Baoulés	98.3	95.1	97.2
Zebu-Taurin Crossbreeds	99.0	95.8	97.9

<sup>a</sup>See 27, pp.352-53 for details of how these prices were calculated.

represent the implicit prices per kg of each of those constituents. Comparing these implicit prices yields insight into how much consumers value each of these items in their diets.

Analysis of data from Bouaké indicate that for large tas the implicit prices per kg in 1976-77 were the following: skeletal meat -- 438 CFA F; offals -- 371 CFA F; fat -- 286 CFA F; and bone -- 290 CFA F.<sup>1</sup> The fact that the implicit price of fat in the tas was nearly 300 CFA F per kg strongly suggests that Ivorian consumers desire some fat in their diet.

Factors Limiting the Effective Demand for Fattened Beef

Although consumers in the class 2 market prefer fattier, more tender meat, the degree to which this preference translates into higher prices for well-fed animals is limited by three factors: consumers' dislike for meat that is "too fat," traditional eating habits, and low consumer incomes.

<sup>1</sup>See 27, pp.441-44 for details. Because of strong intercorrelation ( $r = .85$ ) between the amount of meat and the amount of bone in the tas, the implicit price of bone was probably overestimated and that of meat underestimated.

Ivorian consumers apparently like some fat in meat, but they complain if beef is "too fat," i.e., if the carcass is covered by a thick layer of fat. Consumers interviewed in Bouaké often cited this as a reason for their not buying imported frozen beef, even though the frozen meat was cheaper than locally slaughtered beef. Traditional eating habits also limit the effective demand for tender meat. Traditionally, meat is consumed in West Africa as part of a sauce that is boiled for several hours. Given this method of preparation, there is little reason to pay a premium for especially tender meat. The effective demand in the class 2 market for tender meat is further limited by the low income of most consumers. Most consumers who buy meat on the class 2 market have little income left to pay a premium for tender meat after meeting their basic needs. Demand for tender meat can be expected to grow, however, as incomes increase. With higher incomes and greater employment possibilities outside the home for women, the opportunity cost of the long time spent preparing meals by traditional methods will increase. Consumers will therefore shift to more rapid means of preparing meat, such as grilling, for which the tenderness of the meat is an important consideration.

What consumers in the class 2 market currently are looking for, then, is meat from a well-fleshed, but not a finished, animal. Butchers who sell on the class 2 market therefore pay slightly more (up to about 7 percent more per kg carcass weight) for animals yielding fattier meat than for lean animals. Effective demand for well-fleshed animals in the class 2 market is probably not high enough, however, to absorb at a premium price all the fattened cattle scheduled to be produced from northern feedlots in the next few years.

### CONCLUSIONS AND POLICY RECOMMENDATIONS

The major conclusions and policy recommendations of the study fall under seven headings: 1) the changing Ivorian market for beef; 2) the organization of cattle and meat marketing; 3) market infrastructure needs; 4) problems of transporting cattle; 5) the location of slaughter;

6) the nature of demand for beef in Ivory Coast and the implications of this demand for northern cattle fattening projects; and 7) general recommendations for marketing policy in the future.

### The Changing Ivorian Market for Beef

A crucial question facing Ivory Coast and its northern neighbors is the following: during the next few years, how dependent will Ivory Coast be on cattle imports from the Sahelian countries? The question is especially important to the Sahelian countries in light of three recent changes that have reduced the importance of imported cattle as a source of protein in the Ivorian diet:

1) Ivorian consumers have increasingly substituted fish for beef in their diets as the price of beef has risen relative to fish;

2) Ivory Coast's imports of cattle from the Sahelian countries have fallen, and since 1975 they have been replaced in part by imports of frozen beef from non-West African suppliers; and

3) the Ivorian government has launched a series of projects aimed at increasing domestic livestock production (especially poultry and pork production) in order to reduce Ivory Coast's reliance on imports.

In spite of the decreased importance of livestock imports in recent years, Ivory Coast will probably continue to rely on them for a large part of its animal protein supply during the next five years. Prices on the world beef market were usually low during 1975 and 1976, when Ivory Coast first began importing large quantities of frozen beef, and are likely to rise substantially at least through 1980 (27, pp. 447-48). Therefore, even though the Ivorian market for beef is now integrated with the world market, increasing prices for beef on the world market may discourage Ivory Coast from importing beef from non-West African suppliers. The price of fish imported into Ivory Coast is also increasing, and importer contacted in Ivory Coast expected it to continue to increase during the next few years.<sup>1</sup> Therefore, it is unlikely that consumers will

---

<sup>1</sup> Imported frozen fish, which makes up the bulk of Ivory Coast's fish supply, increased in price about 10 percent between 1977 and 1978 (1).

continue to substitute fish for beef in their diets to the degree to which they did between 1970 and 1975. Domestic Ivorian production of poultry and pork has increased in recent years, as has consumption of these substitutes for beef. Per capita consumption of poultry and pork, however, remains much lower than beef consumption, and data on consumer preferences (4) suggest that it would take a large change in relative prices to effect widespread substitution of pork and poultry for beef in the diet. Such changes seem unlikely in the next five to ten years.

Ivory Coast's continued reliance on the Sahelian countries for the bulk of its beef supply has important implications, both for the Sahelian countries and for Ivory Coast itself. The Sahelian countries should realize that Ivory Coast will continue to be an important market for their livestock exports, but not on the same terms as prior to 1975. Ivory Coast has already met many of the fixed costs of importing non-West African frozen meat (e.g., it has contacted exporters, constructed cold storage facilities, and introduced consumers to the product); therefore, it will be relatively easy for Ivory Coast to enter the world market when the world price of beef is below the West African price. It is therefore in the Sahelian countries' interest to facilitate the flow of cattle southward to Ivory Coast (e.g., by improving livestock transport and simplifying export procedures) in order to improve the competitive position of the Sahelian countries vis-à-vis non-West African meat exporters. Ivory Coast will probably remain an important export market for the Sahelian countries, particularly for Mali and Upper Volta, but it is not a market that can be taken for granted.

The world price of beef will probably rise markedly in the next five years; therefore, Ivory Coast's continued reliance on the world market for a large part of its beef supply may prove very costly. It is therefore also in Ivory Coast's interest to facilitate the flow of livestock south from the Sahelian countries, e.g., through improved trekking routes. By making it easier and cheaper for northern livestock merchants to ship their animals south, Ivory Coast can help assure that at least part of the increase in demand for animal protein that will result from the country's population growth, urbanization, and growth in per capita income will translate into an increase in meat consumption, not just an increase in prices.

### The Organization of Cattle and Meat Marketing

The research showed that the traditional cattle and meat marketing system is fairly efficient, given the physical infrastructure constraints under which it operates. Market concentration is typically low to moderate, collusion to restrict sales in order to raise prices seems rare, and the profit margins of cattle merchants and butchers do not appear exorbitant. In short, the marketing system for cattle and beef seems to be fairly competitive.

One reason that the market is fairly competitive and net margins are modest is the relative ease of entry into the cattle and meat trades. Since it is fairly easy to enter the trade, there are many buyers and sellers in major markets, and competition among them holds down profit margins. Most plans put forward by government officials for reorganization of the cattle and meat trades involve restricting the number of people involved in the trade, either through strict licensing or by replacing certain market agents by state agencies. While officials may feel that strict licensing requirements would allow the government a higher degree of control over cattle and meat marketing, officials should also realize that by restricting access to the trade, licensing reduces competition and usually leads to higher meat prices. Indeed, the main effect of limiting the number of butchers' licenses issued in Bouaké and Abidjan has been to create a black market in licenses that has made it difficult and expensive for young butchers to enter the trade.

The traditional marketing system is labor-intensive, using little capital other than the cattle sold. Most plans for market reorganization and abattoir improvement involve replacing some of the labor involved in marketing with imported capital equipment. Such plans also would usually disrupt the indigenous training system for butchers and traders. When planning marketing projects, officials should carefully consider the employment effects of these projects. They should also realize that it may not always be appropriate to adopt European or North American models of slaughter and livestock and meat marketing in Ivory Coast because the economic parameters upon which these models are based (e.g., the relative prices of capital and labor) are different in Ivory Coast than in Europe or North America.

Finally, the study has shown that even though butchers in Abidjan and Bouaké ignore official price controls, butchers' net margins are quite low. This implies that the butchers' trade is competitive enough to prevent price-gouging by butchers even without price controls. Removing retail price controls on beef in Abidjan and Bouaké therefore probably would not lead to a rapid increase in prices.

### Market Infrastructure Needs

The research showed that much of the market infrastructure provided by recent livestock marketing projects does not contribute to increased market efficiency and usually remains unused by butchers and cattle traders. There are areas, however, where new market infrastructure could contribute substantially to improved cattle and meat marketing. The Abidjan abattoir, for example, is in very poor condition, and rebuilding it would be justified on grounds of both public health and the safety of those who work in it. The lack of grazing space around the Abidjan abattoir and cattle market represents another critical infrastructure constraint to cattle marketing in Ivory Coast. The lack of grazing prevents butchers and cattle merchants from holding a buffer stock of animals as a hedge against supply fluctuations. The lack of a buffer stock combines with irregular arrivals of cattle by rail to result in highly fluctuating supplies in Abidjan and hence highly fluctuating cattle prices. Since Abidjan absorbs about 40 percent of all beef consumed in Ivory Coast (27, p. 58 ), price instability in Abidjan represents a major problem for cattle merchants and butchers in Ivory Coast. Until the cattle market-abattoir complex in Abidjan is moved to an area with adequate grazing or until means are found to provide forage to the cattle at the present location economically, traders will continue to demand a high risk premium to ship cattle to Abidjan and the high rate of default on debts by Abidjan butchers will likely continue.

In providing new market infrastructure, planners should keep three principles in mind. First, the technology adopted should be in line with local, not overseas, costs of capital and labor. In developed countries capital is relatively cheap and labor is relatively expensive, while in West Africa just the reverse is true. By adopting infrastructure (e.g., abattoirs) designed for price conditions in developed countries, planners in West Africa risk replacing cheap local labor with expensive imported capital. Planners should therefore try, wherever possible, to adapt European or North American infrastructure plans to local price conditions. The second point is that the equipment adopted should be simple and easy to repair. All equipment breaks down eventually, and in general, the more complicated the equipment, the more likely it is to break down, especially given heavy use by relatively untrained personnel. Equipment is most likely to be repaired quickly if parts are available locally at low cost. If expensive spare parts have to be imported, the equipment may be out of service for a long time, leading to serious bottlenecks in marketing or slaughtering. The third point is that it often may be much cheaper to use locally produced, rather than imported materials for infrastructure construction. For example, it may prove cheaper to construct the enclosures in cattle markets with locally produced cement bricks (as was done in Abidjan and Bouaké) than with imported steel pipe (as was done in Man). Use of local materials has the added benefit of generating local employment in the manufacture of these items.

#### Problems of Cattle Transport

The research showed that trekking is usually the least expensive way of moving cattle within the Sudanese and Guinea savanna regions and that trucking is the most expensive. Trucking is expensive because truck rental rates per animal are high (due to the low weight-to-volume ratio of cattle as compared with other cargoes) and because truckers and merchants are forced to pay substantial unofficial costs en route (e.g., bribes). Therefore, if Ivorian officials want to hold down meat prices in the cities, it would be inadvisable at this time to force merchants



to truck their cattle to market. Merchants, who are quite sensitive to relative transport costs, will shift to long-distance trucking when it becomes profitable for them to do so. The widespread use of trucking within the forest zone indicates that merchants are not opposed to trucking per se; they are only opposed to trucking when more economical means of transport are available. As roads improve and cattle prices rise, the relative profitability of long-distance trucking will increase, leading merchants to ship their cattle by truck.

For the next several years, however, trekking will probably remain the most profitable way of transporting cattle within the savanna zones. Trekking costs could be reduced by the establishment within Ivory Coast of clearly marked cattle trails along which cattle would have right-of-way. Such trails, like those that exist in Upper Volta, would facilitate the flow of cattle southward, reduce the possibility of imported cattle spreading disease to domestic livestock (by restricting imported cattle-specified routes), and lower the incidence of crop damage by trade herds. Trekking losses could be reduced by constructing a few dipping tanks along these trade routes (to reduce weight losses and mortalities resulting from tick-borne diseases) and by providing dry-season watering facilities.

The research showed that the cost of crop damage caused by trade herds is very low when expressed in terms of cost per animal trekked. The problem is that the cost is borne by only a few people, the farmers whose fields are damaged. Although the creation of clearly marked cattle trails in Ivory Coast would reduce the incidence of crop damage, it probably would not eliminate it. One way to handle the problem of compensating farmers for crop damage would be to levy a small tax, e.g., 25 to 30 CFA F per head, on all cattle trekked within the country.<sup>1</sup> The proceeds of this tax would go into a fund administered by the Ministry of Agriculture to compensate farmers whose crops had been damaged by trade herds. Even if the cost of administering the fund were substantial, this solution would be much cheaper for the country than forcing merchants to truck their

---

<sup>1</sup>This tax could be collected by veterinary agents when they issue a health certificate (laissez-passer sanitaire) to the herd.

cattle, the cost of which would be reflected in higher meat prices and seasonal transportation bottlenecks.

Rail transport will continue to be an important means of moving cattle to market, particularly to Abidjan. The cost of shipping cattle by rail, however, is high, especially in terms of the shrinkage and mortality losses en route and the costs of waiting several days in the north for train cars to become available. The RAN should act to reduce the time cattle spend in transit by assuring that trains carrying livestock are given priority over trains carrying other merchandise. The RAN should also consider creating express trains for livestock, either separately or as part of passenger trains. Typically, when cattle are shipped by rail, during much of the time the animals are in the cattle cars, the train is not moving. Three delays are especially important: after the cattle have been loaded in Upper Volta but before the train leaves the station (this delay averages about eight hours in Ouagadougou); at the Voltaic-Ivorian border; and in Abidjan at the Treichville train station, before the cattle are shipped the eight kilometers to the cattle market at Port Bouët (this delay often lasts ten to twelve hours). These delays add significantly to the mortality and weight losses of the cattle during shipment; therefore, the RAN should work with Voltaic and Ivorian customs officials and Abidjan market officials to reduce these delays to a minimum. For example, if the unloading facilities at the Abidjan market were improved and merchants were allowed to pay their RAN bills in advance or as soon as the train arrived in Abidjan, cattle could be unloaded in Abidjan at night, often cutting ten to twelve hours off the time the animals spend in the cattle cars.

In the long run, the RAN should consider replacing its poorly-ventilated cars with open-slatted cattle cars, which would further reduce shrinkage and mortalities en route. The RAN should also study the possibility of feeding and watering cattle en route, either in the cars or at rest stops where the cattle would be unloaded.

The seasonal shortage of rail cars that forces merchants to wait a week or more in the north for cars could be lessened by a change in the RAN's rate structure. If the RAN were to sharply increase the daily rental rate charged for unloaded cars sitting on sidings, merchants who ship

goods north would be induced to unload the cars quickly, leading to a more rapid rotation of these cars. Data presented elsewhere (27, pp. 190-96) indicate that during the 1976-77 the rate of rotation of cars used to ship cattle south was very low, and that a faster rotation of cars could go a long way to reduce the seasonal transportation bottleneck.

### The Location of Slaughter

The research showed that given 1977 prices, it was more profitable to ship live animals south for slaughter than to slaughter them in the north and ship their carcasses south. Furthermore, unless large changes occur both in relative transport costs for livestock and meat and in prices of meat and offals in the north and the south, it is likely to remain more profitable to ship live animals south than to ship meat. Planners therefore should not expect much expansion in the chilled meat trade between the north and the south unless they take actions both to reduce transport costs for meat relative to livestock and to change the prices of meat and offals in the north relative to the south.

The model presented in the Appendix shows that the value received for the fifth quarter plays a crucial role in determining the relative profitability of meat versus live animal exports. Unprocessed offals cannot be shipped easily by refrigerated transport, and if there is little demand for them at the point of slaughter, it usually is more profitable to ship the entire animal south, where the price of the fifth quarter is higher, than to slaughter in the north and ship only the carcass south. If planners want to expand the chilled meat trade between the north and south they should therefore take measures that will increase the value of the fifth quarter in the north, e.g., by establishing processing facilities for offals that will allow offals to be exported to areas of high demand. If planners only worry about the problem of "disposing" of the fifth quarter in the north, and not of generating effective demand for offals in order to boost the price of the fifth quarter in the north, it will probably remain more profitable to export live animals to the south than to export meat.

The Nature of Demand for Beef in Ivory Coast: Implications for Fattening Projects

Data collected during the study indicate that production of high quality beef in central West Africa is likely to far exceed demand for this beef by 1980. The profitability of many of the feedlots being established in the area is premised on their ability to sell their animals for a premium on the Ivorian market. The projected supply and demand figures suggest, however, that by 1980 there may be such a surplus of fattened beef on the market that class 1 retailers will not have to pay a premium for this beef. The data show that consumers in the class 2 market prefer fattier, more tender meat, and that the class 2 market could absorb some of the animals from these feedlots. The degree to which the preference of consumers in the class 2 market for fattier, more tender meat will translate into higher prices for these animals, however, will be limited by consumers' dislike of meat that is "too fat," by traditional eating habits, and by low consumer incomes.

The preceding paragraph suggests that some of the fattening projects in the north should be directed away from their current four- to six-month fattening period towards shorter fattening periods aimed at producing well-fleshed, but not fat animals. There is some room for replacing currently imported high quality beef with locally produced beef, but the market for high quality beef is small. The bulk of the beef sold in Ivory Coast will continue to go to the class 2 market, where the demand for higher quality meat is limited. This market could absorb more well-fed animals from short-term (one to three months) fattening schemes, but in planning such programs two points should be kept in mind. First, the projects should be based on a low-cost technology because the class 2 market offers only small premiums for fattened animals. Most of the profit in such projects will have to be made on the weight gain of the animal, not on a premium price paid for higher quality meat. Second, the growth of demand for higher quality meat in class 2 market will be contingent on the growth of per capita incomes in Ivory Coast. Demand for higher quality beef is therefore likely to grow only at a modest pace, and planners should be careful not to expand fattening projects

so fast that the market is flooded with more well-fed cattle than it can absorb at prices that make the fattening projects profitable.

### General Considerations to Guide Marketing Policy

An efficient cattle and meat marketing system is one that transforms cattle into meat and distributes the cattle and meat over time and among regions while minimizing the gross marketing margin. By minimizing the cost of performing the tasks of distribution, storage, and transformation, an efficient marketing system benefits both producers and consumers. Producers receive higher prices for their animals and consumers pay lower prices and receive larger quantities of meat than they would with an inefficient marketing system (29, pp. 120-24). Improving market efficiency therefore contributes directly to the stated goal of development policy in Ivory Coast, the improvement of the welfare of the individual.

The problem facing planners and donor agencies in Ivory Coast (and in all of West Africa) is how to reduce the gross marketing margins for cattle and meat in the least costly manner, given the tasks of distribution, storage, and transformation that the marketing system must perform. Two types of solutions have been proposed. The first, typified by the CEBV accords (5), calls for large-scale restructuring of the traditional marketing system, in the hope of assuring more government control over the market. Ghana has gone further than any other country in restructuring the trade, replacing the traditional marketing system with a state monopoly. The other type of solution involves working to relieve the transportation and infrastructure constraints in the current marketing system, in the hope that once these constraints are lessened, competition within the traditional marketing system will drive down gross margins.

The results of this study strongly suggest that the second approach is much more likely to succeed, and in the long run would be much cheaper than trying to totally restructure the marketing system. The research shows that while gross margins in the cattle and meat trades are high,

net margins are modest. This implies that the marketing system is competitive and efficient given the infrastructure and transportation constraints under which it operates. The main reason why gross margins are high is because cattle merchants have high costs (e.g., in terms of mortality and shrinkage losses en route and high export taxes), not because merchants earn monopoly profits.

For the livestock and meat trade to expand in order to meet the needs of Ivory Coast's rapidly growing population, the transportation and infrastructure bottlenecks facing livestock marketing will have to be overcome, whether or not the trade is drastically reorganized. The real question facing Ivory Coast, then, is the following. Should Ivory Coast use its valuable resources (including its scarce veterinary and administrative personnel) to try to totally restructure livestock marketing while at the same time trying to relieve the transportation and infrastructure constraints, or should it concentrate its resources on relieving the transportation and infrastructure constraints, and let the traditional marketing system handle the tasks of distributing cattle and transforming cattle into meat?

Extensive reorganization of the marketing system would involve a very heavy cost in terms of the time of the government personnel who would be called upon to run the new system or enforce the new regulations. It would probably be a more efficient use of government resources for the government to work jointly with traditional cattle traders and butchers, most of whom are highly experienced and have a detailed knowledge of the cattle trade, to develop mutually acceptable improvements in the marketing system, rather than working against these marketing agents in an attempt to completely restructure the trade. Ivory Coast's only attempt to date to set up an alternative cattle marketing system, SODEPRA's Service de Commercialisation, has not been encouraging. Research shows that despite the expenses the state incurred in setting up and running the new marketing agency, the agency did not achieve its primary goal of offering northern Ivorian cattle producers prices that were significantly higher than those offered by traditional merchants (27, pp. 299-302). Certainly Ghana's recent experience with its state cattle marketing agency, the Ghana Meat Marketing

Board, should serve as a warning to planners about the difficulties of trying to replace the traditional marketing system with a state monopoly.

Working with the traditional marketing system does not mean the government will be without a role in cattle and meat marketing. The government has important roles to play in insuring the health of imported and domestically produced animals, safeguarding public health by insuring proper sanitation in the abattoirs, and improving the transportation and market infrastructure for cattle and meat. The government should not use its power, however, to restrict entry into the cattle and meat trades unless there is strong justification, e.g., in terms of maintaining public health. Restricting entry (usually through limiting the number of licenses issued) typically reduces competition, drives up marketing margins, and results in producers receiving lower prices for their animals and consumers paying higher prices for their meat.

A shift in government policy away from trying to totally restructure cattle marketing to an attempt to improve infrastructure and guarantee the competitiveness of the traditional marketing system implies a major change in the way in which livestock marketing projects are designed and implemented. In the past, donor organizations and government planners have typically designed marketing projects without consulting butchers, traders, or intermediaries about these market participants' perceptions of the major problems of cattle and meat marketing. Market participants were usually contacted (if at all) only after the project had been planned, in order to tell them what their new obligations would be as a result of the project. Seldom have planners tried to tap merchants' and butchers' knowledge of the trade when designing projects, nor have they often tried to design projects to respond to what the market participants feel are the major problems of cattle and meat marketing. As a result, many butchers and traders regard the government as an adversary, interested mainly in taxing them to finance projects they feel are unnecessary.

If livestock and meat marketing in Ivory Coast are to be improved efficiently and effectively, there needs to be more contact and two-way communication between market participants and the government officials and donor agencies in charge of planning market improvements. Market

participants should be contacted early in the design stage of projects so that the projects can be modified to respond to what these marketing agents perceive as major problems in the trade. Certainly planners should not feel obligated to do everything the butchers and cattle traders suggest, but it would be equally unwise for planners to totally ignore these market participants when designing projects. Not only do butchers and traders have knowledge of the market that can be extremely useful in designing projects, but by involving the market participants in project design, planners can help assure that butchers and traders will cooperate in project implementation. It is also important that before planners advocate widespread changes in the marketing system, they understand why market participants behave as they do; often behavior that appears irrational at first glance is based firmly on economic principles.



APPENDIX TO CHAPTER 3

MEAT VERSUS LIVE ANIMAL SHIPMENTS<sup>1</sup>

This appendix presents a model that specifies the conditions under which it is more profitable to slaughter cattle in the north and ship their carcasses south than to ship the cattle south for slaughter. The model shows that the factors that determine whether it is more profitable to slaughter in the north than in the south are:

- (a) shrinkage during shipments of live animals and meat;
- (b) prices of meat and fifth quarter in the north and the south; and
- (c) transfer costs for cattle and meat between the north and the south.

In the analysis it is assumed that the fifth quarters of animals slaughtered in the north are sold in the north and are not shipped south. Typically, slaughterhouses in the north do not export offals (other than hides) because without processing, offals tend to spoil quickly.

The profit from slaughtering an animal in the north and shipping the meat south to Abidjan is given by the equation:

$$M_M = DW_{LN} (1-L_M) P_{MA} + F_N P_{FN} - W_{LN} P_{LN} - C_M \quad (1)$$

$$\left[ \begin{array}{l} \text{Margin earned} \\ \text{shipping meat} \end{array} \right] = \left[ \begin{array}{l} \text{Receipts from} \\ \text{meat sold in} \\ \text{Abidjan} \end{array} \right] + \left[ \begin{array}{l} \text{Receipts from} \\ \text{fifth quarter} \\ \text{sold in north} \end{array} \right] - \left[ \begin{array}{l} \text{Purchase price} \\ \text{of animal} \end{array} \right] - \left[ \begin{array}{l} \text{Slaughter} \\ \text{and transfer} \\ \text{costs} \end{array} \right]$$

where

- $M_M$  = net margin earned in shipping the meat to Abidjan;
- $D$  = dressing-out proportion of the animal (the carcass weight divided by the liveweight);
- $W_{LN}$  = liveweight of the animal in the north;
- $L_M$  = shrinkage of the refrigerated carcass during transit, expressed as a proportion of the original carcass weight;
- $P_{MA}$  = wholesale price per kg of meat in Abidjan;
- $F_N$  = weight of the fifth quarter in the north;

---

<sup>1</sup>The author is grateful to Edgar Ariza-Nino for help in developing the model presented in this Appendix.

$P_{FN}$  = average price per kg of the fifth quarter in the north;

$P_{LN}$  = price per kg liveweight of the animal in the north; and

$C_M$  = costs of slaughtering the animal in the north and shipping the meat to Abidjan.

Equation (1) states that the margin earned from shipping meat is equal to the value of the meat that arrives in Abidjan [ $DW_{LN} (1-L_M) P_{MA}$ ] plus the value of the fifth quarter sold in the north [ $F_N P_{FN}$ ] minus the purchase price of the animal in the north [ $W_{LN} P_{LN}$ ] and the costs incurred in slaughtering the animal and shipping the carcass to Abidjan [ $C_M$ ].

Similarly, the profit margin earned by shipping a live animal south to Abidjan is given by the equation:

$$M_L = DW_{LN} (1-L_L) P_{MA} + (1-L_L) F_N P_{FA} - W_{LN} P_{LN} - C_L \quad (2)$$

$$\left[ \begin{array}{c} \text{Margin earned} \\ \text{shipping} \\ \text{live animal} \end{array} \right] = \left[ \begin{array}{c} \text{Receipts from sale of} \\ \text{animal in Abidjan} \end{array} \right] - \left[ \begin{array}{c} \text{Purchase price} \\ \text{of animal} \end{array} \right] - \left[ \begin{array}{c} \text{Transfer} \\ \text{costs} \end{array} \right]$$

where

$M_L$  = net margin earned shipping the animal to Abidjan;

$L_L$  = shrinkage of carcass and fifth quarter during shipment to Abidjan, expressed as a proportion of the original weights of the carcass and the fifth quarter [N.B. the percentage shrinkage is assumed to be the same for the carcass and the fifth quarter];

$P_{FA}$  = average price per kg of the fifth quarter in Abidjan;

$C_L$  = transfer cost of exporting the animal to Abidjan; and

$D$ ,  $W_{LN}$ ,  $P_{MA}$ ,  $F_N$ , and  $P_{LN}$  are as defined earlier.

Equation 2 states that the margin earned exporting an animal from the north to Abidjan is equal to the amount received in Abidjan for the animal's carcass [ $DW_{LN} (1-L_L) P_{MA}$ ] and for its fifth quarter [ $(1-L_L) F_N P_{FA}$ ]<sup>1</sup> minus the purchase price of the animal in the north [ $W_{LN} P_{LN}$ ] and the costs incurred in exporting the animal to Abidjan [ $C_L$ ].

It will be more profitable to slaughter in the north and ship the meat to Abidjan than to ship live animals to Abidjan when  $M_M - M_L > 0$ .

Combining equations (1) and (2) it can be shown that:

$$M_M - M_L = DW_{LN} P_{MA} (L_L - L_M) - F_N [P_{FA} (1 - L_L) - P_{FN}] - (C_M - C_L) \quad (3)$$

$$\left[ \begin{array}{l} \text{Gain from} \\ \text{slaughter} \\ \text{in north} \end{array} \right] = \left[ \begin{array}{l} \text{Gain in meat value} \\ \text{from reduced} \\ \text{shrinkage} \end{array} \right] - \left[ \begin{array}{l} \text{Loss in receipts from} \\ \text{fifth quarter} \end{array} \right] - \left[ \begin{array}{l} \text{Increase in} \\ \text{slaughter and} \\ \text{transport costs} \end{array} \right]$$

Equation 3 states that the difference between the margins earned shipping meat and shipping live animals depends on three elements. The first, represented by the term  $DW_{LN} P_{MA} (L_L - L_M)$ , is the value gained due to the reduced amount of carcass shrinkage in meat shipments as compared to live animal shipments. The second element, represented by the term  $F_N [P_{FA} (1-L_L) - P_{FN}]$ , is the value lost by selling the fifth quarter in the north rather than in Abidjan, where its price is higher. The final element,  $C_M - C_L$ , is the difference between the per animal transfer costs of chilled carcasses and live animals.

If one assumes that the weight of the fifth quarter is some constant percentage,  $y$ , of liveweight (i.e.,  $F_N = yW_N$ ), one can state the conditions under which it will be more profitable to ship meat than to ship live animals. Substituting the new assumed value of  $F_N$  into equation (3) and letting  $X$  equal the ratio of the price of the fifth quarter in

Abidjan to the price of meat in Abidjan (i.e.,  $X = \frac{P_{FA}}{P_{MA}}$ ), equation (3)

can be expressed in slightly different terms:

$$M_M - M_L = W_{LN} P_{MA} [D(L_L - L_M) - yX(1 - L_L)] + yW_{LN} P_{FN} + C_L - C_M \quad (3a)$$

<sup>1</sup>In practice, the seller receives a single amount for the live animal that includes both the value of the carcass and the value of the fifth quarter.

Equation 3 will be greater than zero (i.e., it will be more profitable to ship meat than live animals) when:

$$W_{LN} P_{MA} (L_L - L_M) > y W_{LN} [X P_{MA} (1 - L_L) - P_{FN}] + C_M - C_L \quad (4)$$

$$\left[ \begin{array}{c} \text{Value of meat "saved"} \\ \text{due to reduced} \\ \text{shrinkage} \end{array} \right] > \left[ \begin{array}{c} \text{Receipts foregone by} \\ \text{selling fifth quarter in} \\ \text{north where its price is} \\ \text{lower} \end{array} \right] + \left[ \begin{array}{c} \text{Increase in} \\ \text{slaughter and} \\ \text{transport costs} \end{array} \right]$$

Relationship (4) states that it will be more profitable to ship meat than live animals whenever the value of the meat "saved" due to the lower carcass shrinkage involved in meat shipments more than offsets the income foregone in selling the fifth quarter in the north rather than in the south, and the increase in slaughter and transport costs involved in shipping meat as opposed to live animals. Rearranging terms in relationship (4) and dividing through by  $W_{LN}$ , the liveweight, leads to the statement that it will be more profitable to ship meat than live animals ( $M_M - M_L > 0$ ) when:

$$P_{FN} > \frac{P_{MA} [yX(1-L_L) - D(L_L - L_M)]}{y} + \frac{\bar{C}_M - \bar{C}_L}{y} \quad (5)$$

where

$$\bar{C}_M = \frac{C_M}{W_{LN}} = \text{slaughter and transfer costs of meat, expressed in terms of cost per kg. original liveweight; and}$$

$$C_L = \frac{C_L}{W_{LN}} = \text{per kg. transfer costs of live animals.}^1$$

Relationship 5 states that the relative profitability of exporting meat as opposed to live animals will increase only if one or a combination of the following things happen:

---

<sup>1</sup>Since many of the costs of shipping of both cattle and meat ( $C_L$  and  $C_M$ ) are proportional to the animals' weights (e.g., the number of animals or carcasses shipped per train car depends on their weights),  $\bar{C}_L$  and  $\bar{C}_M$  vary little with respect to the weight of the animal shipped.

- 1) the price of offals in Abidjan falls relative to the price of meat in Abidjan;
- 2) the average dressing percentage increases;
- 3) the amount of carcass shrinkage during meat shipments falls relative to the carcass shrinkage experienced in shipping live animals;
- 4) the price of the fifth quarter in the producing areas increases relative to the price of meat in Abidjan;
- 5) the costs of slaughtering in the north and transporting carcasses south fall relative to the costs of transporting cattle south.

From a policy perspective, the following factors in relationship (5) are of greatest importance because of their variability and their susceptibility to government policy management:

- 1) the price of meat in Abidjan,  $P_{MA}$ ;
- 2) the price of the fifth quarter in the north,  $P_{FA}$ ; and
- 3) slaughter and transport costs for cattle and meat,  $\bar{C}_L$  and  $\bar{C}_M$ .

The ratio of the price of offals in Abidjan to the price of meat in Abidjan,  $X$ , is also of critical importance, but as explained below, it is likely to remain fairly stable in the next ten to fifteen years, and therefore can be regarded as nearly constant. Similarly, the average dressing percentage,  $D$ , is unlikely to change markedly in the coming years.<sup>1</sup> It is also unlikely that  $L_M$ , the percentage carcass shrinkage during meat shipments, will fall relative to  $L_L$ , the percentage carcass shrinkage during shipments of live animals.<sup>2</sup>

Before considering the four crucial policy variables,  $P_{MA}$ ,  $P_{FN}$ ,  $\bar{C}_M$ , and  $\bar{C}_L$ , it is first necessary to explain why  $X$ , the offal/meat price ratio in

---

<sup>1</sup> Furthermore, relationship (5) is not very sensitive to changes in  $D$  as  $D$  takes values from .4 to .6 (the maximum likely range of variation in  $D$ ).

<sup>2</sup> There is much more room for reducing carcass shrinkage during cattle shipments than during meat shipments, particularly for cattle shipped by rail. Speeding up transit time (e.g., by reducing the amount of time spent on sidings) could lead to a reduction in weight losses of cattle and would increase the profitability of shipping live animals as opposed to meat. Therefore, in the following analysis, the possibility of lowering shrinkage during meat shipment relative to shrinkage during live animal shipments is ignored.

Abidjan, is likely to remain fairly stable in the near future. The price ratio is a function of consumer preferences and incomes in Abidjan (i.e., the shape of the demand functions for offals and meat in Abidjan), and might be expected to change as incomes and the absolute price of meat change. Data presented elsewhere (27, Chapter 12) indicate a strong consumer preference for meat as opposed to offals; therefore, as real incomes rise, one might expect demand for meat to increase faster than the demand for offals, leading to a decline in X, the offal/meat price ratio. Whether X decreases as incomes rise, however, depends on several factors, including whether consumers of protein other than meat and offals (e.g., fish) begin consuming offals as their incomes rise.<sup>1</sup>

---

<sup>1</sup>It can be shown that X will decline as incomes rise when

$$P_{FA} > \frac{F_{FA}}{F_{MA}} \cdot \frac{\eta_{YFA}}{\eta_{YMA}} \cdot P_{MA} \quad (6)$$

where

- $P_A$  = original price of offals in Abidjan;
- $F_{FA}$  = price flexibility of demand for offals in Abidjan (approximately equal to the inverse of the price elasticity of demand for offals)
- $F_{MA}$  = price flexibility of demand for meat in Abidjan;
- $\eta_{YFA}$  = income elasticity of demand for offals in Abidjan;
- $\eta_{YMA}$  = income elasticity of demand for meat in Abidjan; and
- $P_{MA}$  = original price of meat in Abidjan.

If, as seems reasonable,  $\eta_{YMA} > \eta_{YFA}$ , and  $|F_{FA}| > |F_{MA}|$ , then whether inequality (6) holds depends on the absolute magnitude of these parameters and on the size of  $P_{MA}$  and  $P_{FA}$ . If, however, as incomes rose, there were a large shift in consumption from fish to offals (i.e., if  $\eta_{YFA}$  were greater than  $\eta_{YMA}$ ), then inequality (6) would be unlikely to hold. The experience of developed countries, however, suggest that in the long run, as incomes rise, the offal/meat price ratio falls.

How the offal/meat price ratio, X, will behave as the absolute price of meat in Abidjan increases depends on the size of the own-price elasticity of demand for offals and the cross-price elasticity of offals with respect to meat. If the cross-elasticity is equal to the own-price elasticity, then X will remain unchanged as the price of meat increases. If the cross-elasticity is greater than the own-price elasticity, then X will increase as the price of meat increases.<sup>1</sup> It is likely that in Abidjan the cross-

<sup>1</sup>Let  $P_{MA}$  = original price of meat in Abidjan;  
 $P_{FA}$  = original price of offals in Abidjan;  
 $X = P_{FA}/P_{MA}$

X is unchanged when  $P_{MA}$  increases when:

$$\frac{dX}{dP_{MA}} = 0 = \frac{P_{MA} \frac{dP_{FA}}{dP_{MA}} - P_{FA}}{(P_{MA})^2} = \frac{1}{P_{MA}} \left[ \frac{dP_{FA}}{dP_{MA}} - \frac{P_{FA}}{P_{MA}} \right] = 0$$

Solving for  $\frac{dP_{FA}}{dP_{MA}}$  yields  $\frac{dP_{FA}}{dP_{MA}} = \frac{P_{FA}}{P_{MA}}$ . Using the chain rule,

$$\frac{dP_{FA}}{dP_{MA}} = \frac{dP_{FA}}{dP_{FA}} \cdot \frac{dQ_{FA}}{dP_{MA}} = \frac{P_{FA}}{P_{MA}}, \quad \text{or} \quad \frac{dQ_{FA}}{dP_{MA}} \cdot \frac{P_{MA}}{P_{FA}} = \frac{1}{\frac{dP_{FA}}{dQ_{FA}}}$$

$$\therefore \frac{dQ_{FA}}{dP_{MA}} \cdot \frac{P_{MA}}{P_{FA}} \cdot \frac{P_{FA}}{Q_{FA}} = \frac{1}{\frac{dP_{FA}}{dQ_{FA}}} \cdot \frac{P_{FA}}{Q_{FA}}$$

$$\eta_{FMA} \approx \eta_{PFA}$$

where

$Q_{FA}$  = quantity of offals demanded in Abidjan;

$\eta_{FMA}$  = cross-elasticity of demand for offals with respect to meat in Abidjan; and

$\eta_{PFA}$  = price elasticity of demand for offals in Abidjan.

If  $\eta_{FMA} > \eta_{PFA}$ , then  $\frac{dX}{dP_{MA}} > 0$ , i.e., the offal/meat price ratio increases as the price of meat increases.

elasticity of offals with respect to meat is fairly high because meat purchases represent an important part of consumers' food budgets and as the price of meat increases, consumers shift from buying more preferred to less preferred types of animal protein. For a large part of the Abidjan population, such a shift corresponds to buying more offals and less skeletal meat. If this shift were large enough (i.e., if the cross-elasticity were high enough) the offal/meat price ratio could even increase as the price of meat increases.

The preceding discussion suggests that in the near future, decreases in the offal/meat price ratio due to income effects may be offset by increases in the ratio due to price effects. In the following analysis,  $X$  (the price ratio) is taken as a constant, although later it is allowed to vary.

If shrinkage during transit, dressing percentages, and the offal/meat price ratio in Abidjan remain unchanged, the future profitability of the meat trade compared with the live animal trade will depend only on changes in the wholesale price of meat in Abidjan ( $P_{MA}$ ), the wholesale price of the fifth quarter in the producing regions ( $P_{FN}$ ), and the relative transfer costs ( $\bar{C}_M$  and  $\bar{C}_L$ ). Relationship 5 states that given transfer costs, if the price of offals in the exporting region exceeds a certain percentage of the price of meat in Abidjan, it becomes profitable to export meat. If the price of the fifth quarter in the north is fairly high relative to the Abidjan price, the merchant loses comparatively little by selling the fifth quarter in the north rather than shipping it on to Abidjan (in the form of a live animal) where its price is higher. He more than makes up this loss by the meat he "saves" due to the lower carcass shrinkage in meat shipments. Relationship 5 further states that if meat prices in Abidjan increase relative to fifth quarter prices in the producing areas and the offal/meat price ratio in Abidjan remains unchanged, it becomes less, not more, profitable to ship meat south. As the meat price in Abidjan rises, so does the price of the fifth quarter in Abidjan, and it becomes increasingly profitable to send both the meat and the fifth quarter south in the form of live animals. Relationship 5 implies that unless means are found to increase the demand for fifth quarter products in the producing areas (e.g., through processing and export of offals) expansion of meat exports from these areas



may be self-braking. Expanding slaughter in order to export meat from the producing zones will lead to increased supplies of offals in these areas. Without an increase in demand for fifth quarter in the producing areas, the price of the fifth quarter there will fall relative to Abidjan, and the profitability of live animal shipments relative to meat shipments will increase.<sup>1</sup>

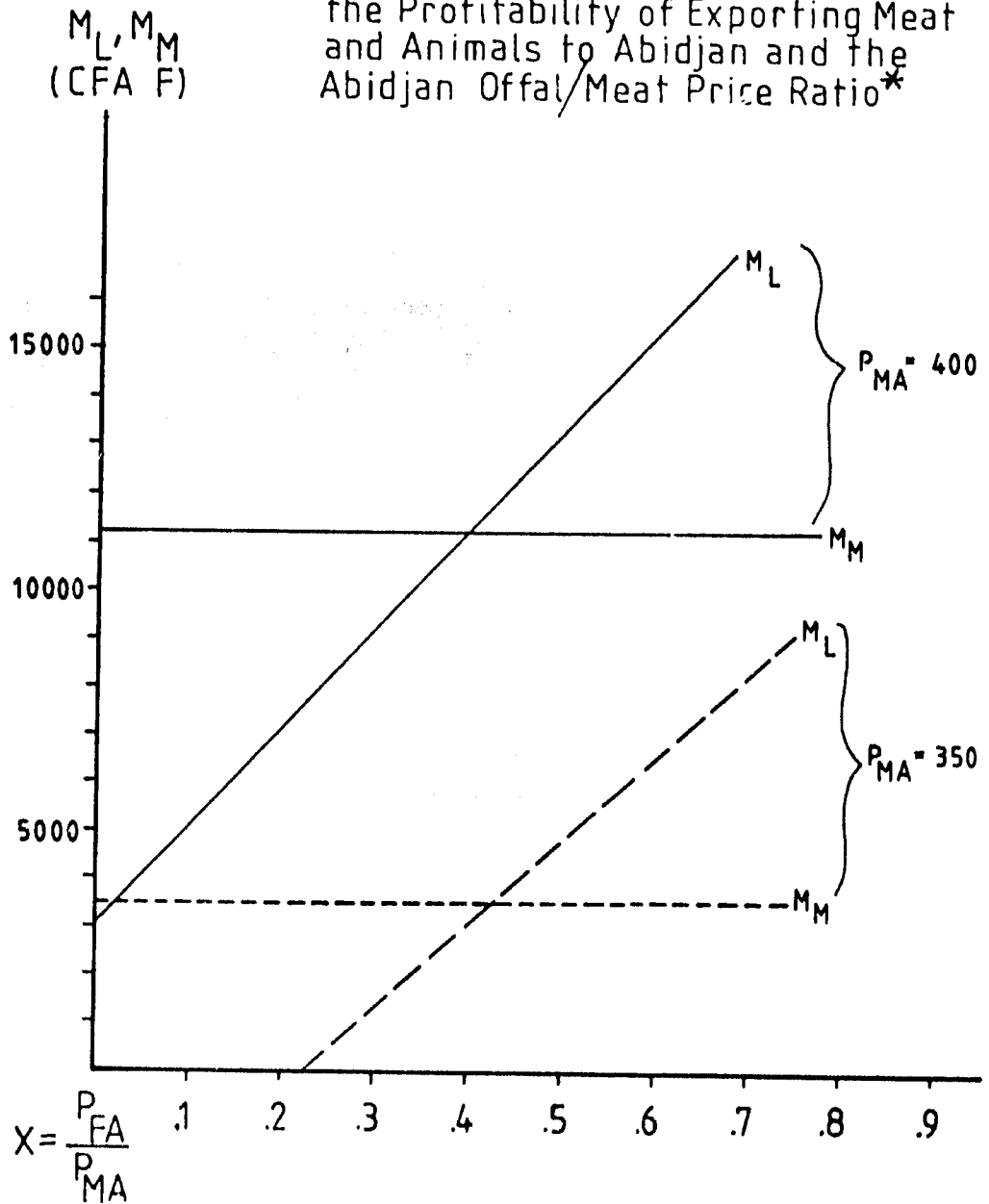
The absolute profitability of meat shipments depends on the price of meat in Abidjan compared to the price of meat in the north. The relative profitability of meat versus live animal shipments, however, depends not only on relative prices in the north and the south, but also on the ratio of the price of offals in Abidjan to the price of meat in Abidjan. This is shown in Figure 1, which shows how the margins earned shipping meat and live animals to Abidjan,  $M_M$  and  $M_L$ , vary as  $X$ , the Abidjan offal/meat price ratio varies. Figure 1 is drawn using the values for  $D$ ,  $L_L$ ,  $L_M$ , and  $y$  corresponding to cattle and beef shipped from Ouagadougou to Abidjan by rail in early 1977 (namely  $D = .49$ ,  $L_L = .09$ ,  $L_M = .04$ ,  $= .55$ , and  $y = .175$ ), and assuming two different meat prices in Abidjan.<sup>2</sup> In both cases, when (the Abidjan offal/meat price ratio), exceeds about .4, it becomes more profitable to ship live cattle than to ship meat. In early 1977,  $X$  was about .55; therefore, little chilled meat was shipped to Abidjan from the north. Given the prices in early 1977, it was only profitable to ship high quality meat from the north to Abidjan. High income consumers in Abidjan paid a premium for this meat, therefore the offal/meat price ratio for this meat

---

<sup>1</sup>Expanded meat shipments to Abidjan would also increase the supply of meat relative to the supply of offals in Abidjan, leading to an increase in the offal/meat price ratio in Abidjan. This would further increase the relative profitability of shipping live animals rather than meat.

<sup>2</sup>See 27, p. 267 for details of how these values for  $D$ ,  $L_L$ ,  $L_M$ ,  $X$  and  $y$  were calculated. A constant cattle price of 250 CFA F per kg carcass weight is assumed for Ouagadougou, so the two different prices shown in Abidjan represent two different relative north-south prices.

FIGURE 1: Relationship Between the Profitability of Exporting Meat and Animals to Abidjan and the Abidjan Offal/Meat Price Ratio\*



\*  $X = \frac{P_{FA}}{P_{MA}}$  where  $P_{MA}$  = wholesale price of beef in Abidjan

$P_{FA}$  = wholesale price of the fifth quarter (offals) in Abidjan

$M_M$  = margin earned exporting meat to Abidjan

$M_L$  = margin earned exporting live animals to Abidjan

The figure is drawn using the parameters described in the text and assuming a cattle price in the north of 250 (CFA F per kg. carcass weight).

was low.<sup>1</sup> For ordinary quality meat no premium was paid, and the only way in which shipments of ordinary quality meat could have become more profitable than shipments of live animals given the prevailing prices would have been for changes to occur in the relative transfer costs ( $C_M$  and  $C_L$ ) or in the shrinkage rates for meat and live animals ( $I_M$  and  $I_L$ ).

Three policy implications follow from this discussion. First, given current prices, exporting meat from the north will remain less profitable than exporting live animals unless processing and transportation costs for meat and shrinkage of meat en route ( $C_M$  and  $L_M$ ) fall relative to transportation costs and shrinkage for live animals ( $C_L$  and  $L_L$ ). Second, an increase in the price of meat in Abidjan alone will not make it more profitable to ship meat than to ship live animals. In fact, if the price of meat and fifth quarter in Abidjan rises relative to the price of the fifth quarter in the north, the profitability of shipping chilled meat will decline relative to that of shipping live animals. Third, the value of the fifth quarter plays a crucial role in determining whether it is more profitable to ship live animals or meat. For meat exports to become and remain more profitable than shipments of live animals, not only must transportation costs for meat decline relative to those for animals, but means must also be found to increase the demand for the fifth quarter in the north. Processing and export of offals may be one way of doing this.

---

<sup>1</sup> Stated another way, it was profitable to ship high quality meat because the value of the meat "saved" because of reduced shrinkage in carcass shipments was very high, and more than offset the loss incurred in selling the fifth quarter in the north were its price was lower than in Abidjan.

LIST OF REFERENCES

1. AGRIPAC, unpublished data.
2. Bain, Joe S., Industrial Organization, Second Edition (New York: John Wiley and Sons, 1968).
3. Bureau National d'Etudes Techniques et de Développement (BNETD), Recensement du cheptel zébu du Côte - d'Ivoire (Abidjan: 1975).
4. Bollinger, D., Le marché Ivoirien des volailles, des oeufs, des porcs, et de la charcuterie, study done for République de Côte d'Ivoire, Ministère de la Production Animale (Suresnes, France: IDET-CEGOS, S.A., 1975).
5. Conseil de l'Entente, Communauté Economique du Bétail et de la Viande, "Accord portant organisation et réglementation des professions touchant au commerce du bétail et de la viande dans les états de la communauté" (Ouagadougou: 1974).
6. Herman, Larry, "Cattle and Meat Marketing in Upper Volta," Report to U.S.A.I.D. (Ann Arbor: 1977).
7. \_\_\_\_\_, personal communication.
8. Lacrouts, M., "Considerations sur l'approvisionnement en viandes de la Côte-d'Ivoire," report for the République de Côte-d'Ivoire, Ministère de la Production Animale by the Bureaux Nationaux d'Etudes Techniques et de Développement (BNETD) and the Institut d'Elevage et de Médecine Vétérinaire des Pays Tropicaux (IEMVT) (n.p.: 1975).
9. Mittendorf, H.J., "Factors Affecting the Location of Slaughterhouses in Developing Countries," World Animal Review, no. 25 (1978), pp. 13-17.
10. Mr. Motenez, Planning Ministry, Abidjan, personal communication.
11. République de Côte-d'Ivoire, Ministère du Plan, La Côte d'Ivoire en chiffres, Edition 76 (Abidjan: 1976).
12. \_\_\_\_\_, \_\_\_\_\_, "Objectifs du plan 1976-1980: secteurs élevage et pêche: tableaux," Document No. DDP/PP-1 (Abidjan: 1977).
13. \_\_\_\_\_, \_\_\_\_\_, Projet de plan quinquennal de développement économique, social et culturel 1976-1980 (Abidjan: 1976).
14. \_\_\_\_\_, Ministère de la Production Animale, unpublished data.
15. \_\_\_\_\_, \_\_\_\_\_, Bureau des Projets, L'élevage en Côte-d'Ivoire: programme de développement (Abidjan: 1976).
16. \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, "Tableau des effectifs des espèces animales: bovins, ovins, caprins, porcins: 1<sup>er</sup> trimestre 1977," (Abidjan: 1977).

17. \_\_\_\_\_, Ministère de la Production Animale and Ministère de l'Agriculture, Etude des possibilités d'embouche bovine en Côte-d'Ivoire. Study carried out by Henri Serres, Klaus Hübl, and Werner Roider (Eschborn, Germany: Office Allemand de Cooperation Technique, in collaboration with the Institute d'Elevage et de Médecine Vétérinaire des Pays Tropicaux and République Française, Ministère de la Coopération, 1975).
18. République Française, Secrétariat d'Etat aux Affaires Etrangères, and République de Haute-Volta, Ministère de l'Agriculture et de l'Elevage, Essais d'embouche de zébus en Haute-Volta, study by J. Cabaret (Maisons-Alfort: Institut d'Elevage et de Médecine Vétérinaire des Pays Tropicaux, 1973).
19. République de Haute-Volta, Direction des Services de l'Elevage et des Industries Animales, Statistiques, various issues.
20. République du Mali, Ministère du Développement Rural, Office Malien du Bétail et de la Viande, unpublished data.
21. SETEC International, unpublished data.
22. Sleeper, Jonathan Arthur, An Economic Analysis of the Role of Ox-Plowing and Cattle-Feeding in the Stratification of West African Livestock Production. Working Paper #4, Entente Livestock Project, (Ann Arbor: Center for Research on Economic Development, and USAID, 1979).
23. Société d'Etudes pour le Développement Economique et Social (SEDES), Approvisionnement en viandes de l'Afrique centre - ouest (Paris: 1969).
24. \_\_\_\_\_, Recueil statistique de la production animale, study done for République Française, Ministère de la Coopération (Paris: 1975)
25. Société Ivoirienne de Gestion, d'Etudes et de Services (SIGES), Aspects de la commercialisation du bétail sur pied et de la viande de boucherie en Côte-d'Ivoire (Abidjan: 1971).
26. Société pour le Développement des Productions Animales (SODEPRA), Projet d'Embouche Bovine de Ferkéssédougou, unpublished data.
27. Staatz, John M., The Economics of Cattle and Meat Marketing in Ivory Coast (Ann Arbor: Center for Research on Economic Development, and USAID, 1979).
28. Stryker, J. Dirck, "Livestock Production and Distribution in the Malian Economy," report prepared for the U.S. Agency for International Development (1973).
29. Tomek, William G. and Kenneth L. Robinson, Agricultural Product Prices (Ithaca, N.Y.: Cornell University Press, 1972).

CHAPTER 4

PROSPECTS FOR THE DEVELOPMENT OF CATTLE PRODUCTION  
ON MIXED FARMS IN THE PASTORAL ZONE OF NIGER:  
A SUMMARY

by Edward D. Eddy, III

TABLE OF CONTENTS

	<u>Page</u>
<b>List of Tables</b> . . . . .	230
<b>List of Illustrations</b> . . . . .	231
<b>Research Objectives</b> . . . . .	232
<b>Introduction to the Research Site</b> . . . . .	234
Location of the Research Site: <b>The Pastoral Zone and</b> the Azawak Region . . . . .	234
Climate . . . . .	234
People and Production Systems . . . . .	240
History . . . . .	241
<b>Research and Analytical Methodology</b> . . . . .	243
Sample Selection . . . . .	243
Survey Techniques . . . . .	244
Populations Covered by the Survey . . . . .	245
Analytical Methodology . . . . .	245
Applicability of Results . . . . .	246
Monetary Units . . . . .	247
<b>Comparison of Production Systems Surveyed</b> . . . . .	247
Labor Patterns and Availability . . . . .	248
Land Use and Grain Output . . . . .	258
Livestock Output . . . . .	263
Consumption of Grain and Livestock Products . . . . .	270
<b>Relative Ability of Production Systems Surveyed to Expand</b> Cattle Production . . . . .	272
<b>Average Seasonal Labor Requirements of Bush Tuareg</b> <b>Agricultural Enterprises</b> . . . . .	273
Millet . . . . .	274
Sorghum . . . . .	277
Goats . . . . .	280
Mixed Herd of Cattle and Goats . . . . .	283
<b>Analysis of Bush Tuareg Agricultural Production</b> . . . . .	285
The Model . . . . .	285

	<u>Page</u>
Simulated Effect of Increasing Herd Size . . . . .	291
Simulated Effect of Decreasing Grain Prices . . . . .	299
Simulated Effect of Increasing Milk Output . . . . .	303
Summary of Major Results . . . . .	308
Social Costs Associated with Current Production	
Patterns in the Pastoral Zone . . . . .	308
The Individual Farmer's Reluctance to Abandon Grain	
Cultivation and Specialize in Cattle Production . . . . .	311
Policy Recommendations . . . . .	313
Increasing the Relative Profitability of Cattle Production . . . . .	314
The Extension of Seasonal Enforcement of Property Rights	
to Livestock Producers . . . . .	315
Associated Land Tenure Reforms . . . . .	318
Labor-Augmenting Change in Grain Production Technology . . . . .	319
Developing the Market as an Alternative to Household Grain	
Production . . . . .	320
The Development of Goat Production . . . . .	321
Conclusions. . . . .	322



CHAPTER 4 - LIST OF TABLES

<u>Table</u>	<u>Page</u>
1. Labor Availability, Area Planted and Grain and Milk Production . .	249
2. Millet Production Statistics by Subsample . . . . .	260
3. Sorghum Production Statistics by Subsample . . . . .	261
4. Expected Value of Output per U.B.T. of Goats . . . . .	269
5. Expected Value of Output per U.B.T. From the Combined Herd of Cattle and Goats . . . . .	269
6. Consumption of Grain and Livestock Products . . . . .	271
7. Grain Production Statistics and Value Coefficients for Model Grain Technologies . . . . .	288
8. Annual Returns to Labor and Livestock from Model Livestock Activities . . . . .	289
9. Effect of Decreasing Grain Prices on Land Use, Goat Herd Size, and the Net Value of Output for the Average Bush Tuareg Household.	300
10. Effect of Decreasing Grain Prices on Land Use, Herd Size, and the Net Value of Output for the Large Bush Tuareg Household . . .	302
11. Effect of Increasing Milk Yields on Land Use, Goat Herd Size, and the Net Value of Output for the Average Bush Tuareg Household . .	305
12. Effect of Increasing Milk Yields on Land Use, Herd Size, and the Net Value of Output for the Large Bush Tuareg Household . . . . .	306



CHAPTER 4 - LIST OF ILLUSTRATIONS

<u>Figure</u>	<u>Page</u>
1. Agricultural Production Zones in Niger . . . . .	235
2. Mean Monthly Minimum and Maximum Temperature: Tahoua, Niger, 1960-1976 . . . . .	237
3. Isohyets of Average Annual Rainfall, Niger, 1960-74 . . . . .	238
4. Kao: Total Annual Rainfall, 1960-76 . . . . .	239
5. Mean Hours Allocated to Crops and Livestock and Total Labor by Fortnight: Bush Tuareg Subsample . . . . .	251
6. Mean Hours Allocated to Crops and Livestock and Total Labor by Fortnight: Village Tuareg Subsample . . . . .	254
7. Mean Hours Allocated to Crops and Livestock and Total Labor by Fortnight: Haussa Subsample . . . . .	256
8. Percentage Allocation of Labor to Agricultural Production . . . .	257
9. Milk Production per Animal Unit from an Average Goat Herd . . . .	266
10. Milk Production per Animal Unit from a Mixed Herd of Cattle and Goats . . . . .	267
11. Agricultural Calendar for Millet: Haussa Subsample . . . . .	276
12. Labor Requirements by Activity for Average Yield Sorghum Technology . . . . .	278
13. Labor Requirements by Activity for High Yield Sorghum Technology .	279
14. Agricultural Calendar for an Average Goat Herd . . . . .	282
15. Agricultural Calendar for Mixed Cattle and Goat Herd . . . . .	284
16. Substitution Relationship Between Grain and Livestock Production with Varying Goat Herd Size: Average Bush Tuareg Household . . .	293
17. Effect of Expanding Goat/Cattle Herds on Land Use and Total Value of Output for Large Bush Tuareg Households . . . . .	296

## CHAPTER 4

### PROSPECTS FOR THE DEVELOPMENT OF CATTLE PRODUCTION ON MIXED FARMS IN THE PASTORAL ZONE OF NIGER: A SUMMARY

by Edward D. Eddy, III

#### Research Objectives

This paper draws on the results of a survey conducted by the author in and around a small market town on the southern edge of the Sahara Desert in western Niger. The survey ran from June 1976 to June 1977 and involved intensive interviewing among forty-five Haussa and Tuareg mixed farm households.<sup>1</sup>

From a national viewpoint, the area covered by the survey appears to be better adapted to livestock production than the production of grain. In particular, extensive grain cultivation in such an arid area can eliminate the permanent vegetative cover. This expedites the process of desertification.

For these and other reasons to be explained below, many development planners believe that residents of the pastoral zone, which would include the survey area and similar areas, should be forced or encouraged to specialize in cattle production. Nonetheless, grain production persists along the southern edge of the pastoral zone, and the cattle herds of mixed farmers are quite small. It appears that most residents of the southern pastoral zone prefer to combine millet and sorghum crops with goat production rather than cattle.

To investigate some of the factors behind the current production patterns, a linear programming model of a representative Tuareg mixed farming system is developed. The model is then applied to simulate the effects of three major policy options intended to promote the expansion of livestock production at the expense of grain crops. The policy options in question are: 1) grants of cattle to mixed farmers (herd reconstitution programs); 2) decreases in the price of grain, with the nominal value of livestock output remaining constant; and 3) technological innovations which would increase milk yields. The results of the analysis

---

<sup>1</sup>In this context, "mixed farm" refers to producers of both grain and livestock.

suggest that, given 1976 prices and the set of assumptions underlying the model, none of the above interventions are likely to induce even the best endowed Tuareg mixed farms to abandon grain production and devote all available resources to the production of cattle.

This implies that development planners must reconsider strategies currently proposed for the pastoral zone. As an alternative to such strategies, several policy recommendations are put forward. Such schemes might relieve the major labor constraints restricting crop and livestock production, as well as provide a means of protecting the southern pastoral zone from further desertification.

The first section of the paper introduces the reader to the environment within which the research was conducted and to which the results of the analysis might be applied. It is followed by a brief description of the methodology employed for the survey and the ensuing analysis. The third section describes and compares the three production systems covered by the survey (Bush Tuareg, Village Tuareg, and Haussa). The use of inputs (labor, land, and livestock) and the magnitude and patterns of disposal of agricultural output are discussed in this section. The fourth section contains a description of the average seasonal labor requirements of Bush Tuareg agricultural enterprises, broken down by the major activities associated with each enterprise. The fifth section contains the analysis of Bush Tuareg agricultural production, this system having been chosen as the most representative of the majority of residents of the southern pastoral zone. The final sections of the paper present the conclusions which may be drawn from the analysis and a discussion of the policy recommendations mentioned above. For a more exhaustive treatment of the topic, the reader is referred to the research monograph on which this paper is based.<sup>1</sup>

---

<sup>1</sup>Eddy, Edward D., Labor and Land Use on Mixed Farms in the Pastoral Zone of Niger, Center for Research on Economic Development, University of Michigan, and USAID, 1979.

## Introduction to the Research Site

Location of the Research Site: The Pastoral Zone and The Azawak Region.-- The location of the pastoral zone in Niger is indicated by the dotted area in Figure 1. The pastoral zone is defined as the area where cattle production is possible in all seasons of the year (SEDES, 1973). This corresponds to the area proposed for the specialized livestock production zone, as described above. It also roughly corresponds to an eco-climatic zone variously defined as the northern Sahel or sub-desert. Average annual rainfall within this zone varies from 150 mm in the north to 350 mm in the south.

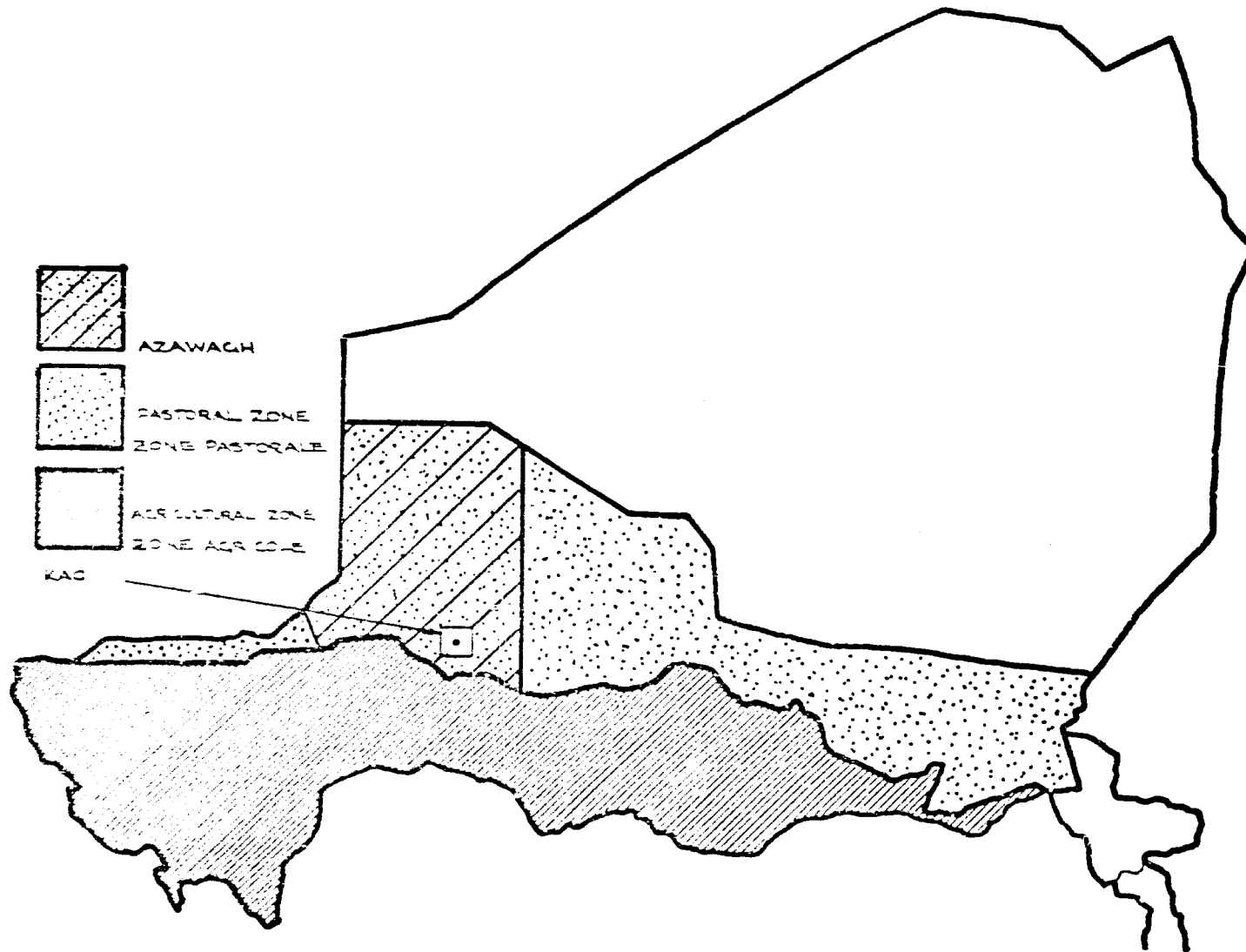
The pastoral zone forms a fragile buffer between the more densely populated grain-producing areas to the south and the practically uninhabited desert to the north. There is enough rain in the area to support grasses, but rarely enough, even on the southern fringe, to support rain-fed agriculture. With little interference from grain fields in most areas and adequate water supplies for livestock throughout the year, the open rangeland of the pastoral zone appears well suited for extensive livestock production.

Most of the western portion of the pastoral zone lies within a region known traditionally as the Azawak (see Figure 1). The research site is located in the southern portion of this region and along the southern edge of the pastoral zone. The populations covered by the survey inhabited a 900 square kilometer area, indicated in Figure 1, centered about the market town of Kao in the political subdivision known as the Tchín-Tabaraden Arrondissement (Tahoua Department).

Climate.-- Areas in the southern pastoral zone have one rainy season during the year, which usually runs from June to September. The rainy season is followed by a hot/wet season, which lasts until the dry winds blowing off the desert descend to the lower atmospheres in November. The desert winds mark the advent of the cold season, which lasts from November to March and is characterized by perpetual dust storms. As the area is desiccated by the desert winds, temperatures rise, reaching their annual maxima during the hot/dry season which lasts from March until the early rains in June.

FIGURE 1

AGRICULTURAL PRODUCTION ZONES IN NIGER



Average maximum and minimum temperatures during these seasons are indicated in Figure 2. The cold season at the beginning of the year is the time when the daily temperature differential is the greatest. During this season, air temperature may drop by as much as 17° C between late afternoon and nightfall.

The area along the southern edge of the pastoral zone, to which the results of the following analysis may be expected to apply, lies between the 300 and 350 mm isohyets of average annual rainfall, as indicated in Figure 3. As suggested above, the 350 mm isohyet roughly marks the southern boundary of the pastoral zone. Kao, the center of the survey area, received an average of 323 mm of rainfall annually during the period for which the isohyets in Figure 3 have been calculated.

However, average annual rainfall is an illusory statistic. The intertemporal and interspatial distribution of rainfall in such northern areas of West Africa is marked by extensive variability. Figure 4 indicates the extent of such variability over the seventeen-year period preceding the survey, during which annual rainfall at Kao ranged from 185 to 475 mm.

Figure 4 also suggests the importance of deviations from the mean level of precipitation. Mean annual rainfall for the first half of the period was well above the overall mean, whereas the mean for the second half was well below. The second half of the period was the time of the well-publicized Sahelian drought. Although the recent drought was not without precedent, it was unusual in that it was exacerbated by historical factors, to be described below.

Deviations from trend are as important for monthly or even daily variations in rainfall as for annual variations. The timing of the rains are as important as the amount, since the timing determines the composition of grasses on the range and may determine whether or not a crop yields anything at all. Heavy early rains, for instance, will favor rapidly maturing grasses, whereas deficit rainfall towards the end of the rainy season may eliminate some varieties from the range by preventing late-maturing grasses from bearing seed. The timing of the rains also influences labor patterns, as will be illustrated below.

FIGURE 2:

MEAN MONTHLY MINIMUM AND MAXIMUM TEMPERATURE:  
TAHOUA, NIGER, 1960-1976

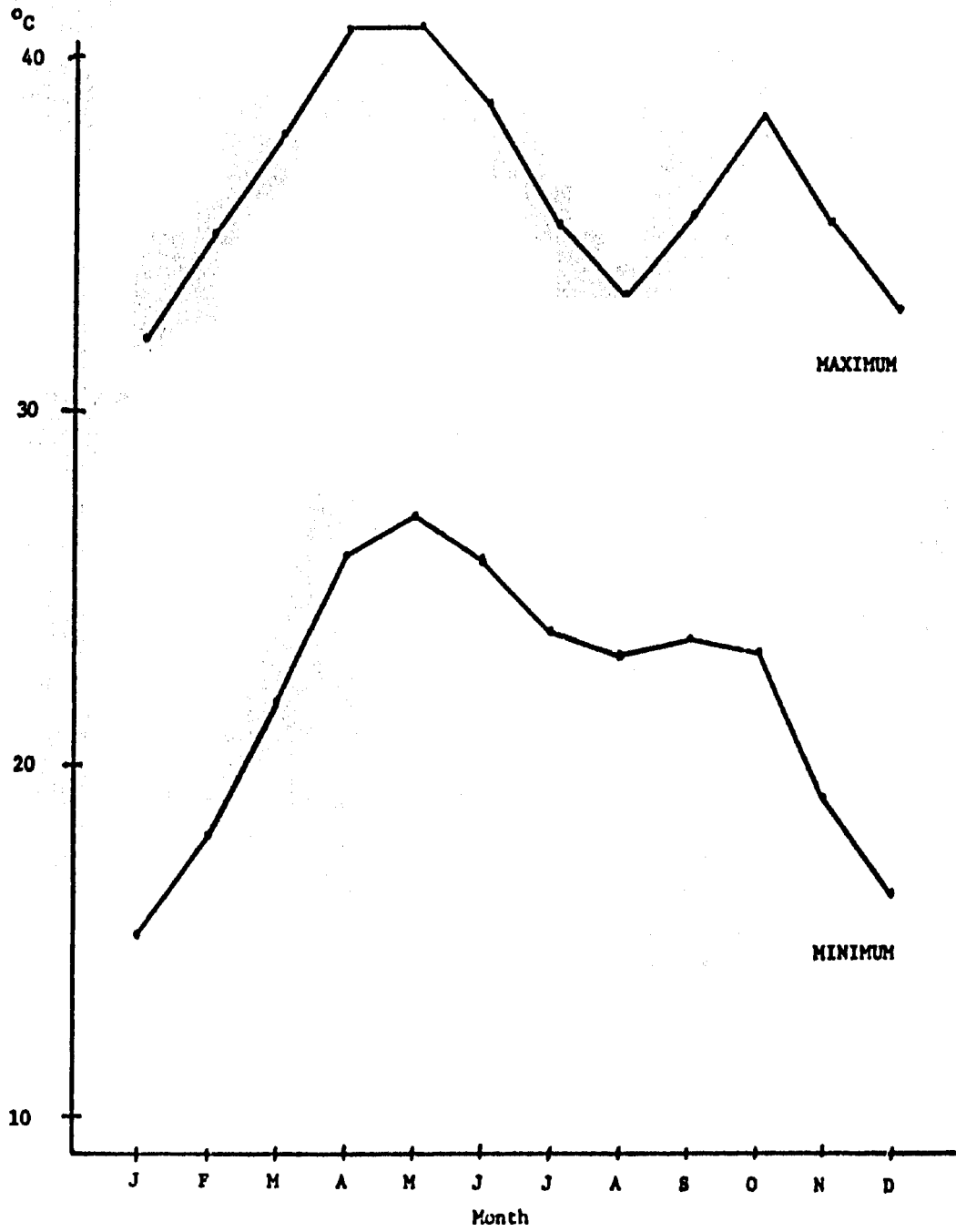


FIGURE 3: Isohyets of Average Annual Rainfall,  
NIGER, 1960-74 (mm)

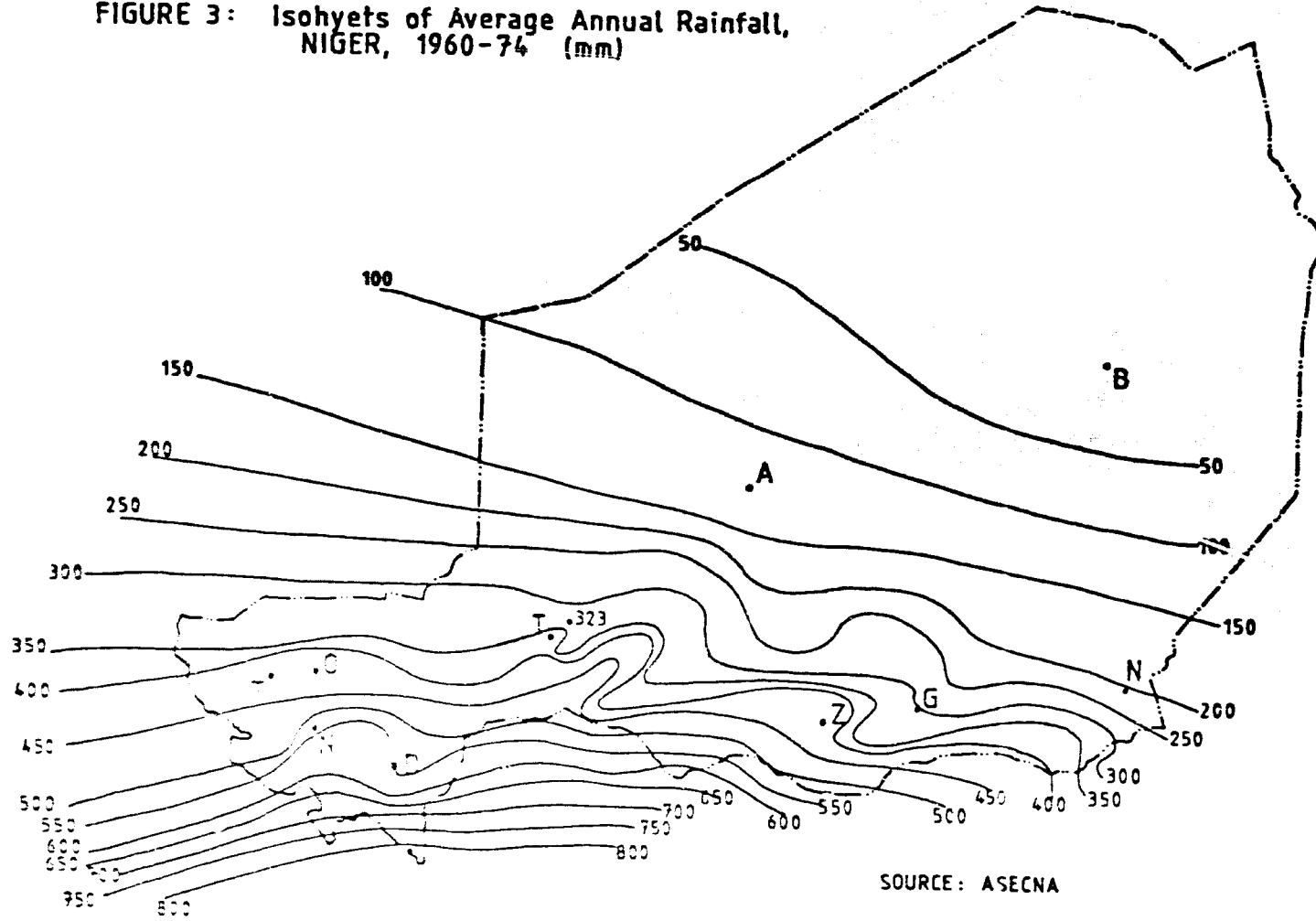
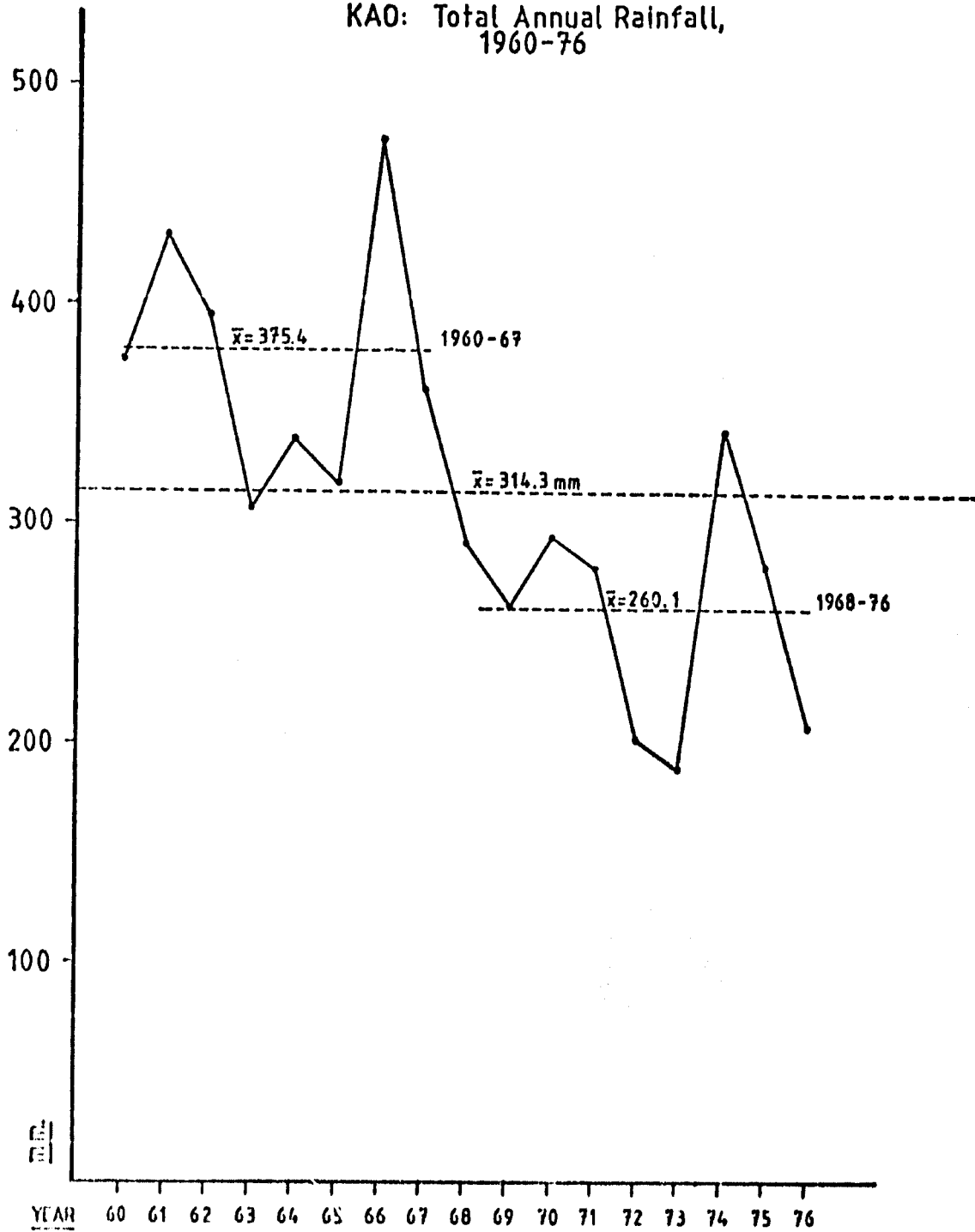




FIGURE 4:  
KAO: Total Annual Rainfall,  
1960-76



A comparison of the monthly distribution of rainfall at Kao since 1960 with that of the survey year suggests that the survey year may have been peculiar in two respects. First, heavy rains continued to fall later into the year than they had in the previous sixteen years, enabling some farmers to get a second sorghum harvest. Second, no useful rain fell during the last week of June and the first three weeks of July. This month-long drought occurred at the end of May and June plantings, and it devastated the millet crop. These peculiarities, combined with the unpredictability of precipitation in any year, make it difficult to extend the results of the production analysis described below to years other than the survey year.

People and Production Systems. -- Three major ethnic groups populate the Azawak: Tuareg, Haussa, and Fulani. In this context, ethnic affiliation is defined by the household's primary language, be that Haussa, Tamasheq, or Fulfulde. Unfortunately, it is impossible to say with any certainty in what proportion these ethnic groups are represented in the population of the Azawak. The purpose of the latest population census prior to the survey was to determine tax obligations, and therefore, the information collected is of dubious quality. Furthermore, inhabitants of the "nomad zone", which embraces the pastoral zone and the desert, are registered according to "nomad group" and "tribe" rather than place or region of residence. Thus, it is difficult to arrive at quantitative descriptions of the population, other than to say that the vast majority are Tuareg and that, in the southern portion of the region, Haussa households make up the next largest segment of the population.

The mixed farming systems covered by the author's survey could be divided into three groups: Haussa, Village Tuareg, and Bush Tuareg. The attributes of these three "production systems" are compared and contrasted in the third section of this paper. In addition to the mixed farming systems covered by the author's survey, the other major category of agricultural production systems in the pastoral zone could be characterized as nomadic pastoralism. The nomadic pastoralists do specialize in livestock production, relying on markets along the southern fringe of the pastoral zone for grain to supplement their diets. The pastoralists may not be present in areas such as the survey area throughout the year. During the

rainy season, they will move to the north to avoid conflicts with farmers over crop damages. During the dry season, they will move south to more permanent water sources and better dry season pastures. Generally, the pastoralists and their herds are in transit through the southern pastoral zone at the beginning of the rainy season and again during the hot wet season which follows the end of the rains.

The category of nomadic pastoralists can be further subdivided to distinguish Tuareg and Fulani livestock producers. The former raise primarily camels and small ruminants. They spend the greater part of the year in the northern pastoral zone. Traditionally, they are members of the more privileged classes of Tuareg society.

Fulani pastoralists produce cattle primarily, often in herds combined with sheep. Based on occasional interviews and time spent among Fulani households, the author determined that during the survey year, the typical household managed a herd of approximately fifty head of cattle. Usually this includes some animals which have been confided to the care of a member of the household, so that the number of animals managed does not always coincide with animal ownership by the household. Although this study does not deal directly with Tuareg or Fulani pastoralists, information concerning their production patterns is introduced where relevant to the analysis.

History. -- Prior to colonization, the Azawak was ruled by Tuareg warlords of the Iwillmeden Confederation, who apportioned the lands of the Azawak among themselves. Each warlord controlled the grazing and water rights in his allotted portion and further subdivided his fiefdom among the vassals and slaves subject to his rule. It was during this period that the ancestors of most of the Bush Tuareg households covered by the survey settled in the survey area to produce grain and pasture their herds. Although nominally they were members of the slave caste (Iklay), they were a relatively independent group who owned and managed the productive resources from which they derived their livelihood, subject to the occasional payment of tribute to the aristocracy, a tribute which continues to be exacted to this day. In the pre-colonial era, these households planted

some grain by broadcasting seeds on the sides of the dunes, but devoted most of their efforts to livestock production. During the growing season, they would evacuate their animals to northern regions to participate in the salt cure and to allow pastures in the southern pastoral zone to grow out, a practice which has been abandoned in more recent years due to the influx of producers competing for the use of the range.

The Tuareg warlords were subdued by the French Army during the colonial struggle, and their system of land tenure was dissolved. Their subjugation cleared the way for a northward migration of Hausa grain producers into the pastoral zone during the period of abnormally high rainfall from 1948 to 1968. The village of Kao was settled during this period. The migrant Hausa grain producers introduced more intensive techniques involving the clearing of trees and grasses, and as the higher rainfall made grain production more profitable, the area planted to grain expanded rapidly.

During the same period, mechanized deep-bore water pumping stations were opened throughout the pastoral zone. The opening of the pumping stations, combined with the pacification of the Tuareg warlords, attracted a larger number of Fulani herds than the area had supported previously. These herds also grew more rapidly following the implementation of cattle vaccination programs.

Thus, prior to the 1968-1973 drought, the Azawak was subjected to an influx of Hausa grain producers and Fulani cattle herders, whose herds were growing at a greater rate due to the suppression of certain endemic diseases. These developments contributed to the devastating effects of the drought on the people, the animals, and the land resources of the pastoral zone. For example, many of the households designated as Village Tuareg had worked for members of the Tuareg aristocracy as herders prior to the drought. However, their patrons suffered substantial losses of animals during the drought, and those households were forced to move to villages such as Kao, which functioned as emergency food distribution centers. To support themselves, Village Tuareg households turned to commerce or work as laborers for Hausa households, who also had come to rely more heavily on trade as a source of income.

This tendency was furthered by the growth in the importance of Kao and similar villages in the southern pastoral zone as livestock markets. With the reduction in the supply of animals as a result of the drought, continued growth in demand for meat in coastal cities, and the commensurate rise in animal prices in the Sahel, livestock merchants moved to markets further north in the pastoral zone in an effort to obtain more advantageous prices. Thus, the chain of primary animal collection markets serving the pastoral zone has shifted north in recent years. This chain of events can be generalized as follows: (1) pacification of the pastoral zone by colonial forces; (2) the northward migration of grain producers into the pastoral zone during the two decades of abnormally high rainfall which preceded the recent drought; (3) greater growth in the cattle population due to the opening of mechanized water pumping stations and the elimination of endemic diseases; and (4) the emergence of market villages along the southern fringe of the pastoral zone. From this brief introduction to the environment within which the research was conducted, we move to a description of the survey methodology.

### Research and Analytical Methodology

Sample Selection. -- The research team, including the author, lived at Kao throughout the course of the survey. The team consisted of three enumerators, a translator whose family lived with the author's family at the research site, two clerks, and several part-time assistants and consultants. The team arrived in Kao after completing the government clearance process in May 1976. At that time, a census of the village and surrounding Tuareg and Fulani encampments was conducted. The census was required to construct a proper sampling frame since, as mentioned above, reliable alternatives were available. To assist with the census and ensure the accuracy of the results, community leaders accompanied the research team.

For the purposes of the census and the survey, a "household" was defined as a group of people who eat out of the same pot. In the case of the populations covered by the survey, this definition delineated a management unit within which all members worked the same fields and tended the

same animals. Based on the results of the census, sixty-five such households were selected at random at a public drawing: forty-four from the village and twenty-one from a group of Tuareg encampments approximately five kilometers from the village. Of these sixty-five households, seventeen moved out of the survey area during the course of the survey and had to be dropped from the sample.

Survey Techniques.-- The basic work of the survey consisted of regular twice-weekly interviewing with each sample household. During these interviews, the enumerators collected information on the activities of each household member during the twelve daylight hours of each day, household cash flows during the relevant three or four-day period, exchanges in kind, production of agricultural commodities, and consumption of grain, meat, and milk. The enumerators then coded this information, using a coding system which was devised during the first month of the survey. Coding was verified weekly. The data then were punched directly from the questionnaires onto computer tape.

Each of the plots planted by sample households during the 1976 growing season was measured. The resulting angle/distance measurements were then spot-checked and coded by the author, so that the area of each plot could be calculated by computer. The results were returned to the author so that fields could be remeasured as necessary.

The measurement of agricultural output was based on local units of measure. For instance, since the grain harvest is stored on the head in bundles, the output from each field was marked down in bundles. Then, a representative sample of bundles of each type of grain was obtained from a number of households and the grain was removed from the head using the local processing methods. The bundle was weighed on a spring scale prior to processing, and the resulting quantity of grain was weighed on a balance scale.

Finally, market surveys were conducted to determine the prices at which to evaluate output. A sample of retail quantities of grain was purchased at each weekly market, then each purchase was weighed on a balance scale to determine the price per kilogram. Also, one or two enumerators remained in the livestock market throughout the day and, for as many

transactions as possible, recorded the purchase price, age, sex, breed, origin and destination of the animal, and occupations of the buyer and seller. These data were compiled and coded on market survey schedules, and, again, keypunching was done directly from these schedules.

Populations Covered by the Survey.-- As mentioned in the first section, the survey was restricted to mixed farm households. Some qualitative interviewing was conducted by the author at traditional gatherings of nomadic pastoralists in or around the survey area. However, such research was really tangential to the main survey.

The main survey covered the three types of mixed farm households discussed above: Haussa, Village Tuareg, and Bush Tuareg. In addition, the sample contained three Fulani households. However, since this subsample was too small and the households within it were not found to be representative of any major production system, these three households have been dropped from the subsequent analysis. The forty-five households remaining represented the three types of production systems in the following proportions: (1) Haussa: sixteen households; (2) Village Tuareg: seventeen households; and (3) Bush Tuareg: twelve households.

Analytical Methodology. -- The linear programming model presented in the sixth section of this paper applies directly to the production system represented by the twelve households in the Bush Tuareg subsample. From among the populations covered by the survey, the model was designed to represent the production system of Bush Tuareg households, for several reasons. First, Bush Tuareg households relied most heavily on household production as a source of food for subsistence needs. Second, from among the three subsamples, they derived the largest proportion of their cash income from agricultural enterprises, as opposed to commerce or wage labor, during the survey year. Third, Bush Tuareg households devoted the largest proportion of available labor resources to agricultural enterprises. Fourth, they relied least on hired labor to supplement household labor resources. These characteristics will be illustrated in the comparative analysis of the three production systems following this section. Finally, and most impor-

antly, based on the author's travels and life in the southern Azawak, on what little population data were available, and on secondary sources, the author concluded that the households in the Bush Tuareg subsample were the most representative of the largest segment of the population of mixed farmers in the southern Azawak. This segment could be characterized as semi-sedentary Tuareg subsistence crop and livestock producers, most of whom are of the iklan social class.

The model allows for selection among millet, sorghum, goat, and mixed goat and cattle enterprises, subject to labor, land, and subsistence constraints and certain other behavioral assumptions to be specified below. The model is then used to determine optimal enterprise combinations for both the average and large Bush Tuareg households. Separate solutions are obtained for the larger households, since only the larger households were engaged in cattle production during the survey year. In determining optimal enterprise combinations, the model is used to test the effect of the three policies mentioned above, all of which are designed to encourage specialization in cattle production. The results suggest that such policies would not be wholly effective without complementary policies which would relieve labor constraints in the harvest and pre-harvest periods and which would preserve the value of forage resources during the rainy season, thus preventing the permanent degradation of the range. One such complementary policy, that of protected forage cultivation, is discussed in the final section of the paper.

Applicability of Results. -- The analysis applies directly to a cross-section of Bush Tuareg mixed farm households in the southern Azawak in a year in which, in addition to the other parameters in the model, the amount and distribution of rainfall was as observed during the survey year. This latter consideration is particularly important, since varying amounts and spatial and temporal patterns of rainfall would alter the labor requirements and possibly the relative profitability of agricultural enterprises. Thus, the model is useful for cross-sectional comparisons, but given the extensive variability of rainfall patterns in the southern pastoral zone, the model could not be used reliably to predict or explain behavior over time.



The model assumes perfect foresight on the part of producers, who base their decision-making on known prices, labor requirements, and risk parameters. In actuality, producers probably select the size and combination of agricultural enterprises on the basis of expectations formulated from experience over a number of years, not simply one year. The following interpretation of the model assumes that producer expectations concerning the parameters of the model did not deviate substantially from estimates of the parameters derived from data collected by the research team during the survey year. Only if it can be assumed that such expectations are constant over time, which is doubtful, could the model be used successfully for intertemporal comparisons. A more realistic formulation, which could explain behavior over time, would be to assume that expectations vary in some predictable fashion based on variations in rainfall patterns. The author hopes to test this formulation in future research.

Monetary Units. -- The unit of account throughout this report is the franc CFA (designated as FCFA), the official currency of much of former French West Africa, including Niger. The franc CFA is supported by the French banking system and guaranteed parity with the French franc at a rate of 100 (CFA) to 1 (French). During the survey year, the official exchange rate for the franc CFA varied from 222 to 246 F CFA per dollar.

#### Comparison of Production Systems Surveyed

This section of the report compares the agricultural enterprises undertaken by the three major subsamples: Haussa, Bush Tuareg, and Village Tuareg. Although most of the subsequent analysis dwells on Bush Tuareg households, information on other households is presented here by way of contrast since such households do form a significant proportion of the population of the southern pastoral zone, although they are not in the majority. Statistics relevant to the three Fulani households in the survey sample also are presented, but these statistics will not be discussed herein, and the reader is cautioned that such statistics may not be representative of most of the Fulani households in the pastoral zone. In comparing the three

major production systems, the following discussion dwells on labor patterns and availability, land use, livestock management, and the output and consumption of agricultural products.

Labor Patterns and Availability.-- Table 1 presents summary statistics by subsample on labor availability, area planted, and grain and milk production. Labor availability, presented as the number of working resident equivalents, signifies that one household member of at least eight years of age was present in the household for the entire year. Thus, a working household member who was present in the household for only nine of the twelve survey months would register as .75 resident equivalents. The conversion to resident equivalents was found to be desirable since individuals travel extensively in the pastoral zone and there was a great deal of movement into and out of households.

As Table 1 indicates, the twelve households in the Bush Tuareg subsample had, on the average, the greatest number of family members of working age residents in the household. In contrast, Village Tuareg households had the least amount of working age labor available. Ten of the seventeen Village Tuareg households had less than three resident equivalents during the survey year, whereas only four Haussa and four Bush Tuareg households fell within that category. On the average, including children under eight years of age, household size varied among the three subsamples from five to seven resident equivalents of all ages. Haussa households had the greatest number of children under eight years of age in residence.

The outstanding characteristic of the statistics presented in Table 1 is that, as the ranges indicate, the underlying distributions display an enormous degree of dispersion. Curiously, an analysis of the data indicated that variations in grain and milk production are not highly correlated with variations in labor availability. This suggests that other factors, such as access to land and the use of hired labor, must be considered in explaining variations in agricultural production.

The statistics in Table 1 also suggest that Village Tuareg households were not only relatively smaller than households in the other subsamples, but they were also the least successful agricultural producers. They planted

TABLE 1  
LABOR AVAILABILITY, AREA PLANTED AND GRAIN AND MILK PRODUCTION<sup>a</sup>

Statistic	Units	Hausa	Village Tuareg	Bush Tuareg	Fulani
Labor Availability	resident equiv./household				
Range		1.37 - 8.33	1.83 - 3.82	1.94 - 7.74	1.89 - 7.66
Mean		3.82	2.74	4.27	4.14
Area Planted	ha /household				
Range		2.29 - 49.62	.82 - 5.31	.96 - 13.90	1.36 - 8.52
Mean		8.67	2.74	5.18	4.25
Grain Production	kg /household				
Range		33 - 2912	0 - 481	0 - 16,250	0 - 104
Mean		580	164	2348	45
Milk Production	liters/household				
Range		0 - 379	0 - 988	70 - 2465	0 - 1045
Mean		56	170	761	599

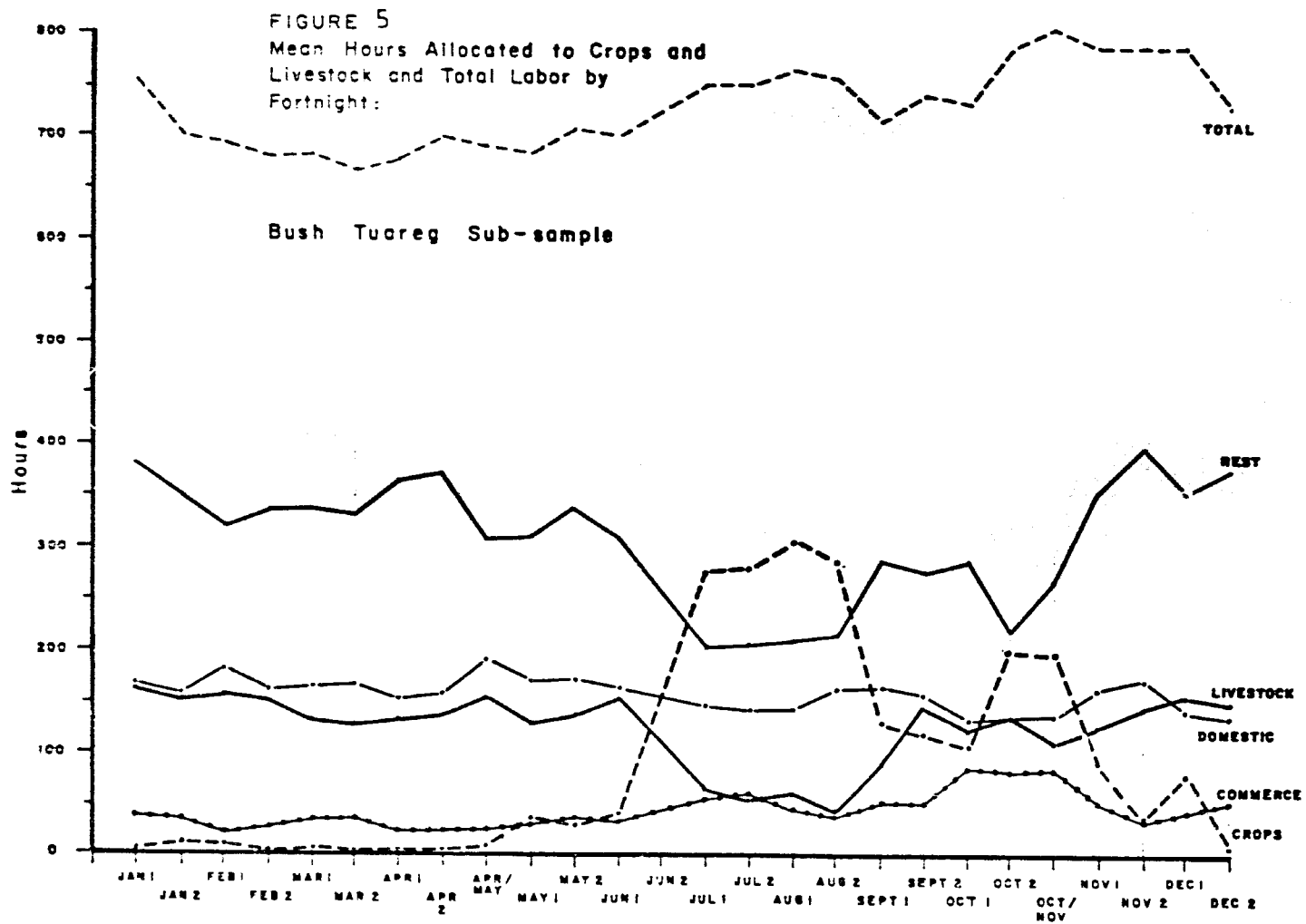
<sup>a</sup>Data from Appendix IV, Eddy monograph

less land and harvested less grain than either of the two major subsamples. Hausa households planted the greatest land area to grain, but they were not on the average the most successful grain producers. Most of the land planted to grain by Hausa households was upland soil planted to millet. In contrast, most of the area planted by Bush Tuareg households was in the lowlands and was planted to sorghum. Bush Tuareg households were the most successful grain producers, partially because sorghum was a more successful crop than millet during the survey year.

The figures on the following pages show a breakdown for each subsample of the allocation of labor throughout the year by five major activity groupings: crops, livestock, commerce, domestic work, and rest. Labor use in each category is measured by the average number of hours per fortnight (two-week period) allocated to each category by working household members. The total amount of labor available, on the average, for each fortnight is indicated by the top line of each graph. In calculating labor availability, it is assumed that household members will work up to a maximum of twelve hours per day.

Figure 5 gives the breakdown of labor use by Bush Tuareg households. The most noticeable seasonal difference in labor use is the drop in labor allocated to livestock during July and August, which is the growing season for grains. During the same period, labor allocated to crops increases sharply, and household members take less than an average of three hours of rest during the daylight hours of each day. Labor allocated to crops rises again during the harvest season in October, a time when the amount of labor allocated to livestock has also increased relative to the growing season. The total amount of labor available rises slightly during the growing season and the harvest season.

The labor patterns of a representative Bush Tuareg household can be summarized as follows: In the dry season, which runs through the first five months of the year, there are four people of working age present in the household: an adult male and female and a younger girl and boy. The woman and the young girl each spend six hours a day on domestic tasks. The man and the young boy tend the animals for five or six hours of every day, and once a week the entire family visits the weekly market.



Labor in the fields begins in late April, and the entire family devotes correspondingly less time to rest and to the animals. A male family member returns to the household in June as the rains begin and as crop production begins in earnest. During July and August, the animals are left to the young boy, who devotes four hours a day to their care. The women continue with the domestic work, but in addition, they assist the men for two hours a day in the fields, as does the young boy when he is not working with the animals. Each of the men devotes an average of eight hours a day to crop production at this time. This combination of activities leaves just enough time during the daylight hours of each day for the family to eat their meals. In order to free up more time for social activities, the household may hire labor to assist with the work in the grain fields.

After the final weeding is completed in the grain fields in late August, one of the adult household members travels to visit a relative. The adult male devotes more time to assisting the young boy with the animals, since extra care is required at this time in order to keep the animals away from the enticing heads of grain.

As the harvest begins, each of two household members must continue to spend six hours per day with the animals in order to keep them out of the fields, and each of the two women still are confined to six hours a day of domestic chores. Commercial activities take up another three hours a day of the family's available labor time in addition to the time spent in the weekly market, since the supplemental income derived from crafts is required to finance grain purchases at a time when stocks are low. Each family member requires three hours each day to eat his meals. This leaves approximately fourteen hours each day for harvesting from the household's entire available stock of labor of sixty hours per day. In some cases, that fourteen hours - amounting to only two or three hours labor per day per working household member - is not enough labor to evacuate the grain to storage areas before animals, birds or rodents reach it. The problem is further exacerbated by herds returning from the north who are anxious to rejoin their dry season pastures. By November, the harvest is completed, and as visitors leave the household in late December, the household returns to its more regular dry season labor schedule.

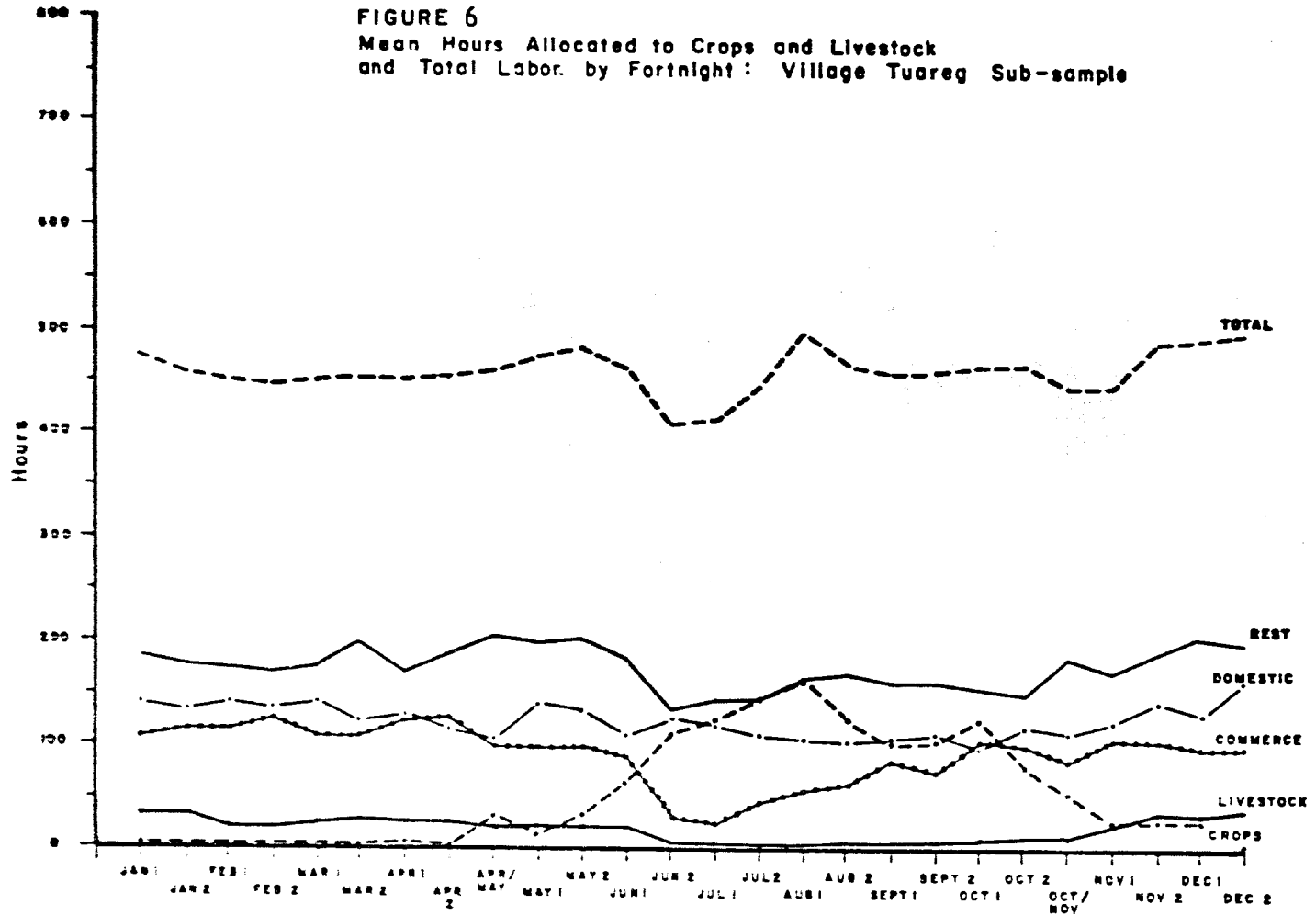
Figure 6 indicates the patterns of labor allocation for the average Village Tuareg household. The most obvious difference between this and the previous graph is that, relative to Bush Tuareg households, Village Tuareg households have much less available labor. An additional difference is that the average Village Tuareg household devotes more time to commerce, which includes time spent on crafts, on sales, and on wage labor. Time devoted to commerce declines as time devoted to crop production increases during the growing season, indicating the same sort of trade-off as exists between crop and livestock activities at that time among Bush Tuareg households.

Village Tuareg households devoted very little time to livestock enterprises. Only three of the seventeen households in the subsample owned and managed animals throughout the survey year. These households also devoted relatively little time to crop production. The main source of their livelihood was income derived from sales of crafts and services. Thus, aside from commerce and domestic activities, little time was left over for agricultural enterprises.

Labor allocation in a representative Village Tuareg household may be described as follows. A typical household has five full-time members: an elder man and woman, teenage child, and two younger children. During the dry season, which spans the first five months of the year, the woman and the teenage child each spend four to five hours per day on domestic chores. The man spends two hours each day tending animals owned by wealthier village residents. During this period, the man and woman each spend four hours of every day working as hired laborers, tending small stands in the marketplace, or making crafts for sale to supplement the household's income.

In late April, the woman takes time away from domestic work to assist the man in planting the small millet field which has been loaned to them by more wealthy Hausa village residents. As the rains begin in June and crop production activities pick up, time allocated to commerce declines and remains at a low level until late July. From late July through August, the man undertakes work in the fields owned by Hausa village residents while continuing to work on his own fields. In October, as the harvests come in, the woman once again takes time away from domestic work to assist with the transport of the grain. While he is harvesting his own fields, the man de-

**FIGURE 6**  
**Mean Hours Allocated to Crops and Livestock**  
**and Total Labor. by Fortnight: Village Tuareg Sub-sample**



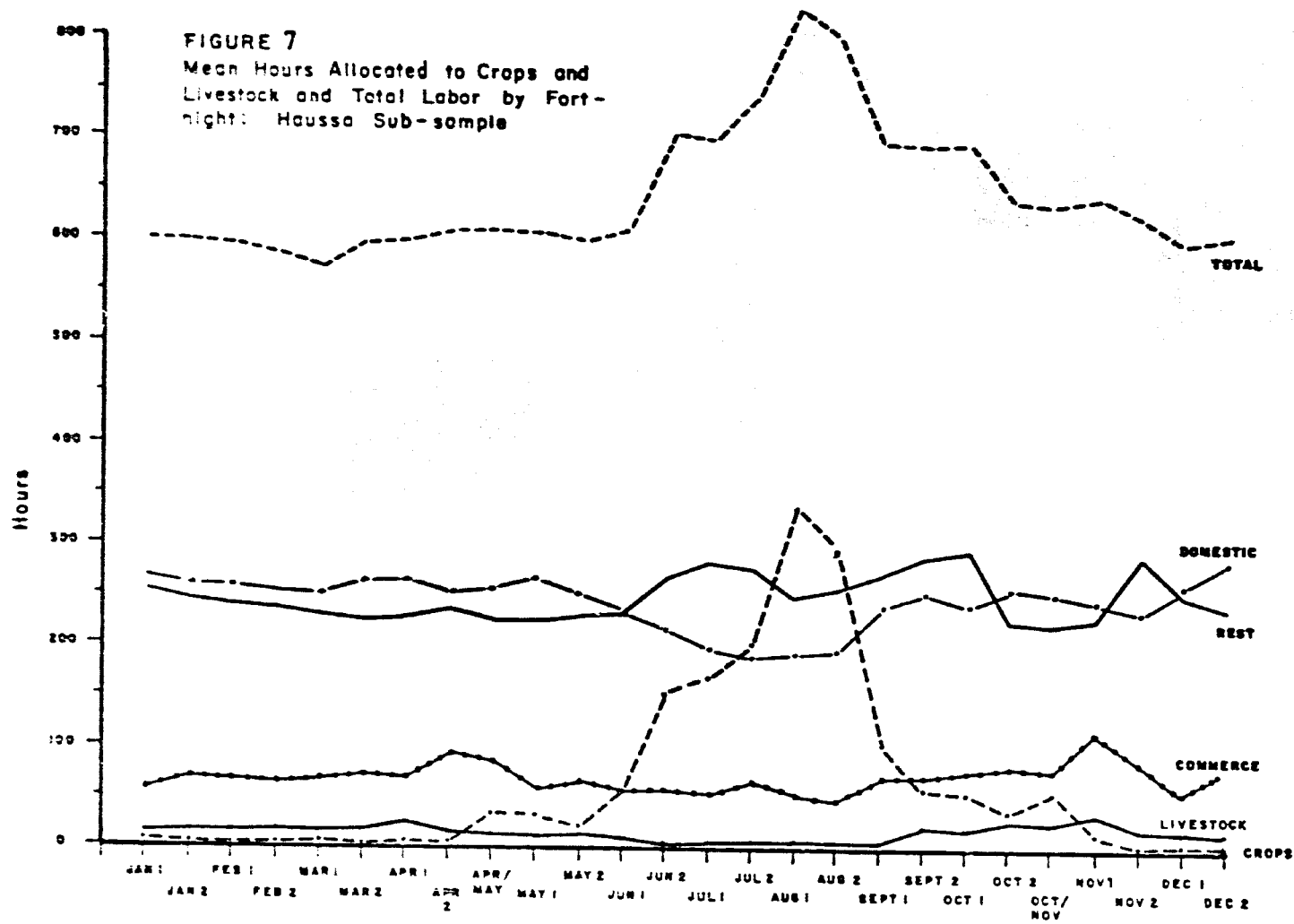


votes more time to commerce during a period when the markets are active. As the harvest is completed in November, the dry season work patterns are resumed.

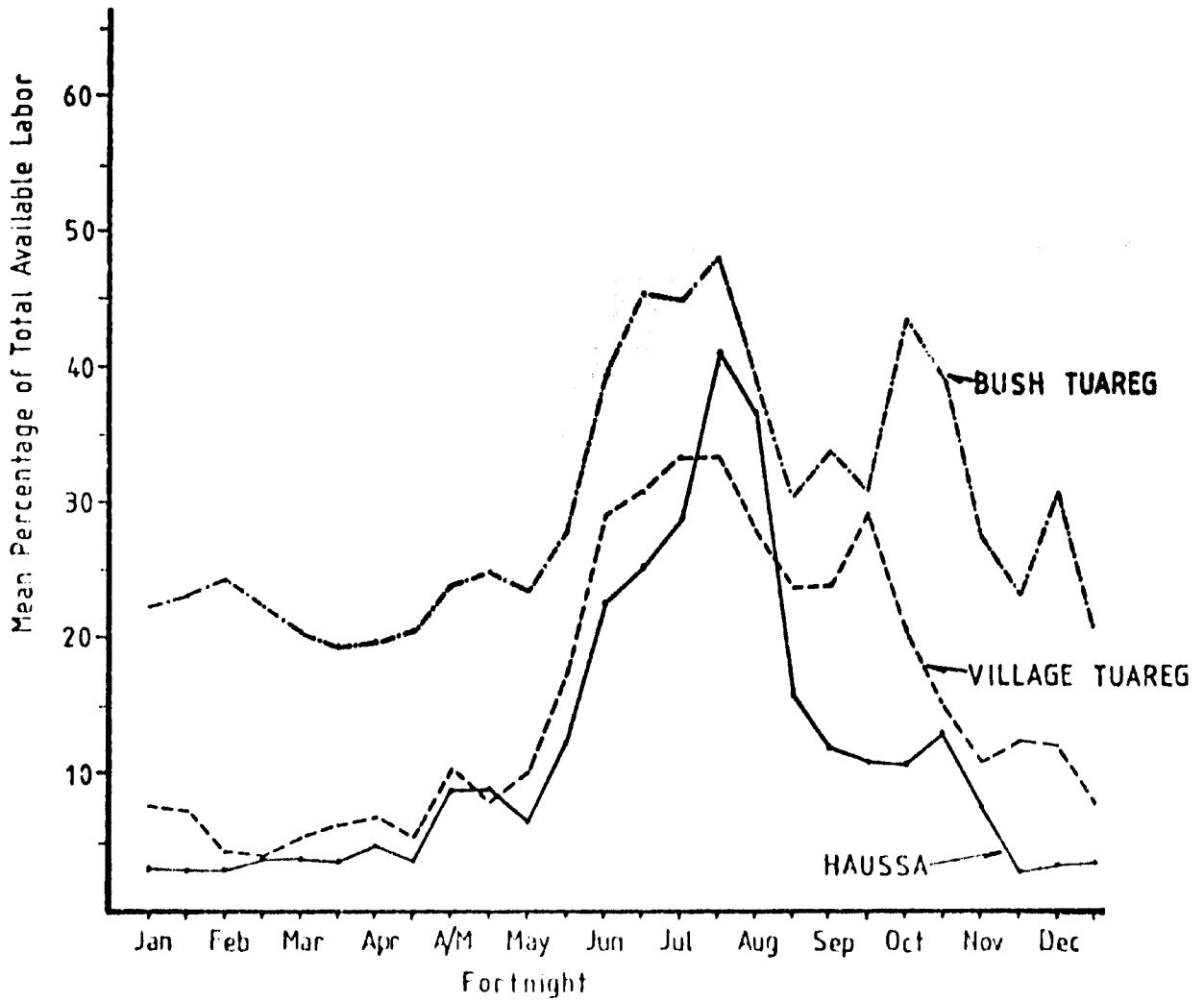
Figure 7 illustrates the average labor patterns of Hausa households. The distinctive feature of the Hausa production system as regards the labor input is that seasonal crop production activities do not detract significantly from time spent on any other productive work category. This is because the hiring of labor relieves any possible constraint due to crop production activities during the June through August period. This is evidenced by the sharp increase in total labor availability during that period. During July, households in the Hausa subsample hired an average of twenty hours per week of labor services. The amount of labor hired rose to seventy-five hours per week during August, which was the month when the maximum amount of rain fell and crop weeding labor requirements were at their peak. The household also was assisted during the crop cycle by the return of the young men who had sought work in urban centers during the dry season. Furthermore, the increase in water sources during the rainy season enabled household members to spend less time on domestic work and more time assisting laborers in the fields. The combined additions to the household labor force provided sufficient labor for crop production so that other activities could continue uninterrupted. Working household members were able to engage in non-productive social activities for an average of at least 4.5 of the twelve daylight hours of every day throughout the growing season.

Having assisted their families with the most arduous crop production tasks (weeding), the young men began to leave the village again in early October as the harvest period started. Hausa households also reduced the amount of labor hired at this time. There was a resultant drop in labor availability, but during the survey year, Hausa households had an average sufficient labor to cover harvest activities and the increase in commercial activities prompted by the active November markets without hiring additional labor or reducing rest activities below a level which allowed for an average of over four hours of rest daily per working household member.

Figure 8 indicates the percentage of available labor allocated to agricultural production in each fortnight of the year by each subsample. As



**FIGURE 8 :** Percentage Allocation of Labor to Agricultural Production



suggested by the above analysis, activities related to agricultural production were most important among households in the Bush Tuareg subsample. The average Bush Tuareg household devoted between 20 and 50 percent of available labor to agricultural production throughout the year. This was not the case among village residents (Haussa and Village Tuareg subsamples) who devoted less than 10 percent of available household labor to agricultural production outside of the June to October crop cycle. This is consistent with the description of Bush Tuareg households as subsistence producers who devoted more time to agricultural enterprises, in contrast to Village Tuareg and Haussa households, whose members devoted relatively more time to commerce and relatively less to either crop or livestock production.

Land Use and Grain Output. -- The only officially recognized form of private ownership of land by the individual household in the southern pastoral zone is the right of the grain producer to recover compensation for damages inflicted by herds trespassing on plots planted to grain. No similar individual rights in land are extended to the livestock producer. The land input to livestock production is a public resource and pasture is therefore available on a "first come, first served" basis. Despite a 1961 law which was intended to discourage grain production in the pastoral zone, grain producers still are able to obtain private rights in the land by clearing a plot and planting it to grain. The effect of these policies is to encourage the individual to make improvements in the land which enhance its quality as an input to grain production, but no similar incentive exists for the individual to improve the land for use as an input to livestock production. Furthermore, the recognition of private property rights in land allocated to grain production, but not in land allocated to livestock production, probably encourages the expansion of grain cultivation.

Since land available as an input to livestock production is open to the public, it is difficult to estimate the quantity of the land input to livestock enterprises. However, the research team did obtain measurements of all plots planted to grain by sample households during the survey year. Each household planted from one to four plots, and each plot contained millet, sorghum, or some combination of the two. In addition to the two

major grain types, some households also intercropped cowpeas or gumbo (okra). This was particularly true of households in the Hausa subsample, but intercropping was not practiced by Bush Tuareg households. Since the quantities and value of the cowpea and gumbo harvests were insignificant relative to the grain harvest during the survey year, the following analysis considers only the production of the two major grain types.

Production statistics for millet and sorghum are presented in Tables 2 and 3. Millet was grown as a rain-fed crop and was planted primarily in upland, sandy soils. In contrast, most of the sorghum crop was planted in the alluvial, predominantly clay soils in the runoff channels which carry water from the surrounding hills. The tables indicate that millet cultivation was less labor-intensive than sorghum. For all three major subsamples, the mean number of hours applied per hectare to millet fields was approximately half the per-hectare labor input to sorghum fields.

Millet production per household varied widely. During the survey year, households in the Hausa subsample appeared to be more successful millet producers than other households, particularly those of the Bush Tuareg subsample. Mean millet production per Hausa household was 189 kilograms, whereas only one of the twelve Bush Tuareg households harvested any millet, and that harvest amounted to only 90 kilograms.

Although Hausa households appeared to be more successful millet producers, the statistics in Table 2 suggest that Bush Tuareg households were the most successful sorghum producers. The twelve households in that subsample accounted for 78 percent of total sorghum production by the forty-five sample households. One Bush Tuareg household produced an extraordinary harvest of over sixteen metric tons of sorghum. Average sorghum production among the other nine households in that subsample who had some harvest was 1,315 kilograms. This was more than twice the average production by Hausa sorghum-producing households and ten times the average production by the Village Tuareg households which planted sorghum.

The median area planted per household to all crops was approximately three hectares, and the median area per plot was between 1.0 and 1.5 hectares. This excluded four households which planted over ten hectares each; these four households included three successful Hausa merchants and a Tuareg camp chief.

TABLE 2

MILLET PRODUCTION STATISTICS BY SUBSAMPLE

Statistic (Per Household)		Haussa (n=16)	Subsample	
			Village Tuareg (n=17)	Bush Tuareg (n=12)
Total Area Planted (Ha.)	Mean	7.40	2.15	2.99
	Range	.74 - 47.30	.19 - 4.05	.32 - 6.88
Total Labor (Hours)	Mean	1224	833	498
	Range	408 - 3020	36 - 2467	136 - 1097
Total Grain Produced (Kg.)	Mean	189	73	7
	Range	0 - 604	0 - 248	0 - 90
Hours/Ha.	Mean	258	436	212
	Range	64 - 589	60 - 1132	54 - 734
Kg./Hour	Mean	.13	.10	.01
	Range	.00 - .34	.00 - .29	.00 - .08
Kg./Ha.	Mean	46	39	1
	Range	0 - 136	0 - 159	0 - 17

SOURCE: Appendix V, Labor and Land Use on Mixed Farms in the Pastoral Zone of Niger, Center for Research on Economic Development and USAID, 1979.

TABLE 3

SORGHUM PRODUCTION STATISTICS BY SUBSAMPLE<sup>a</sup>

Statistic (Per Household)		Subsample		
		Haussa (n=14)	Village Tuareg (n=12)	Bush Tuareg (n=12)
Total Area Planted (ha.)	Mean	1.38	.75	2.26
	Range	.20 - 3.34	.13 - 1.68	.31 - 7.90
Total Labor (Hours)	Mean	579	544	1592
	Range	163 - 1365	24 - 1821	297 - 3670
Total Grain Produced (Kg.)	Mean	444	128	2341
	Range	0 - 2066	0 - 435	0 - 16250
Hours/Ha.	Mean	413	765	895
	Range	105 - 792	154 - 1917	412 - 2137
Kg./Hour	Mean	1.08	.22	1.02
	Range	.59 - 1.51	.00 - .66	.00 - 4.43
Kg./Ha.	Mean	373	146	731
	Range	0 - 637	0 - 345	0 - 2057

SOURCE: Appendix V, Labor and Land Use on Mixed Farms in the Pastoral Zone of Niger, Center for Research on Economic Development and USAID, 1979.

<sup>a</sup>Statistics based on data for those households which cultivated sorghum, as indicated by the subsample size.

It is possible that the four households planting abnormally large plots were encouraged to do so by the prevailing system of land tenure. As mentioned above, individual property rights vested when an area was cleared and planted to grain. Such rights enabled the owner to bring suit against the herder whose animals had encroached upon the field. These rights could be defeated only by failure to plant the field in subsequent years.

Crop damage suits were brought before the local Hausa village chief, a forum which was generally unfavorable to the herder. If the Hausa village chief finds for the grain producer, as is the outcome in most such cases, he then awards damages based on the number and type of animals that are found to have entered the field and whether the animals are found to have entered during the daytime or at night. Judgments are enforced by armed nomad guards who are stationed in villages such as Kao during the growing season.

When a satisfactory conclusion is not reached at the village level, the suit may be referred to the office of the Sous-Préfet, or regional governor. The influence of Hausa merchants with the regional administration and the predominance of Hausa civil servants in the government also provides a favorable atmosphere for the crop producer in the event of a referral.

Property laws in Niger, as they were explained to this author by a local government official, also recognize a more permanent interest in land than that mentioned above, once a household has planted a given plot to grain for three consecutive years. The ability to acquire a more permanent vested interest in land merely by continuing to plant grain is an additional incentive to continue grain cultivation, even though the producer may have an alternative source of income from trade which makes the cultivation of grain for subsistence unnecessary. The rights accompanying this interest may be defeated by failure to plant during each successive growing season, but there is no requirement that the individual asserting these rights continue to cultivate the entire field through to harvest in order to maintain his rights to the entire parcel. The condition that the owner continue to plant may be fulfilled by hiring laborers to plant and weed for the first few months of the season, thus avoiding the need to allocate



household labor to these tasks. Then, once the plants have sprouted, the farmer can abandon the field altogether while maintaining his interest in the land and his right to an action for damages if trespassing herds encroach upon it.

The combined effect of these practices is to encourage the expansion of grain cultivation without stimulating either grain or livestock producers to improve the land or to prevent environmental degradation. Furthermore, the current system for enforcing the limited private property rights that exist appears to favor the grain producer at the expense of the livestock producer. These problems will be discussed further at the conclusion of this paper.

Livestock Output. -- Several types of animals are raised in the southern pastoral zone, including goats, cattle, donkeys, horses, camels and sheep. In addition, many families living in villages raise poultry as a supplemental source of protein. Poultry production was not a common activity among households living outside of the village.

Donkeys are used as work animals, primarily for hauling water, grain and firewood. In addition, they are the southern pastoral zone's most popular form of personal transport. They are considered to be versatile and hardy animals, withstanding the harshest of environments. Donkeys are particularly indispensable to households living outside of the village, such as those of the Bush Tuareg subsample. Accordingly, within the survey sample, donkey ownership was concentrated among Bush Tuareg households.

Camels also are used for transport, but they are more expensive animals, and their ownership is the prerogative of wealthier households. Camels also are raised for their milk. Although not as hardy as donkeys, they do have a wider range of grazing options in that they can browse the tops of trees as well as low brush.

Horses, like camels, are a more prestigious form of personal transport reserved for wealthier households. Only the six most affluent households in the survey sample owned horses.

Among sample households, sheep were raised primarily for meat. Most often they were raised for slaughter at special occasions, such as marriages, baptisms, and other festivals. Sheep production was most concentrated

among members of the Hausa subsample. None of the sheep herds held by sample households included more than ten head.

Goats were the animals most commonly held in sample members' herds. In terms of number of head, they far outnumbered any other animal type in all but the smallest of herds managed by sample households. There are several reasons why sample households -- and Tuareg households in particular -- preferred goats over other animal types: like donkeys, goats are resistant to climate stress; goats are easy to manage and entail less risk than the larger animals; and goats are less expensive to acquire. Furthermore, the rapid growth rate of the herd relative to other animal types means that less time is required to build up a herd which is of sufficient size to provide milk and meat for the household. In the survey sample, goats were held by all of the Tuareg households which owned any animals. Goats were the primary source of milk and meat for these households.

Cattle were the second most important source of milk for household consumption. However, less than one-third of the households in the survey sample owned or managed cattle at some point during the survey year, and the largest of these herds was only ten head. Although cattle do supply substantial quantities of milk, they are more costly animals, and greater risk is involved in their management. For this reason, Tuareg households prefer to build up and maintain a subsistence herd of at least twenty goats before diversifying into cattle production.

Of the types of animals owned by sample members, the remainder of this paper concentrates on goats and cattle, since these animals figured most prominently in sample members' herds. These two animal types were especially important among the herds of Bush Tuareg mixed farmers, the target group of the Linear programming analysis. In addition to their importance in numbers, cattle and goats provided most of the milk and meat consumed by sample households. Although camels were an alternative source of milk, only five sample households were engaged in camel production during the survey year. Sheep were an alternative source of meat, but, as indicated above, their ownership was restricted to Hausa households, which had small herds held mainly for slaughter at festivals.

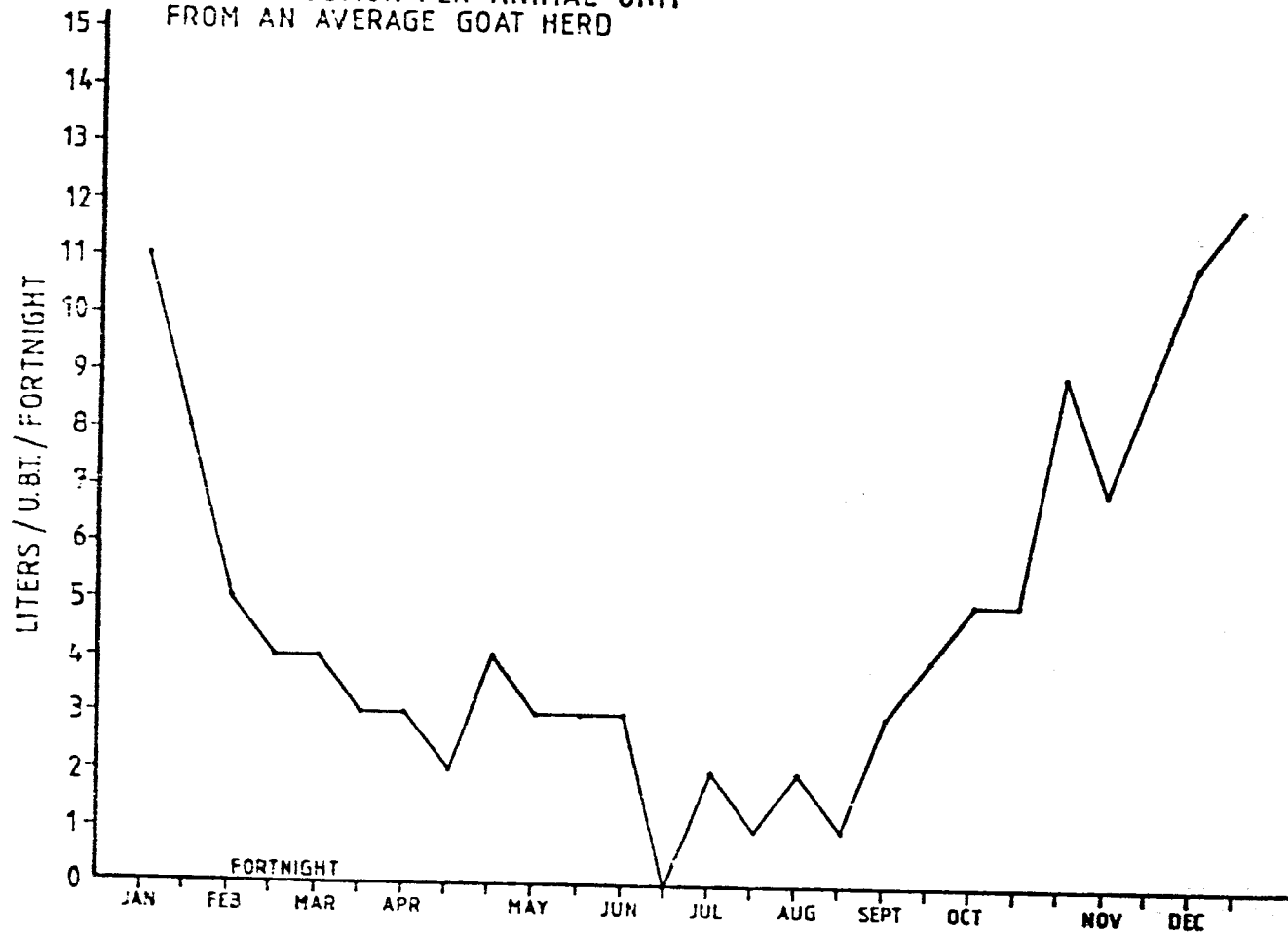
For the purposes of the linear programming analysis, two livestock production activities are considered. The first involves raising goats alone, and the second combines cattle with goats. Cattle production is not considered as an independent activity, since all sample households which produced cattle also produced goats, and the labor inputs to the production of one animal type were inseparable from inputs to the production of the other.

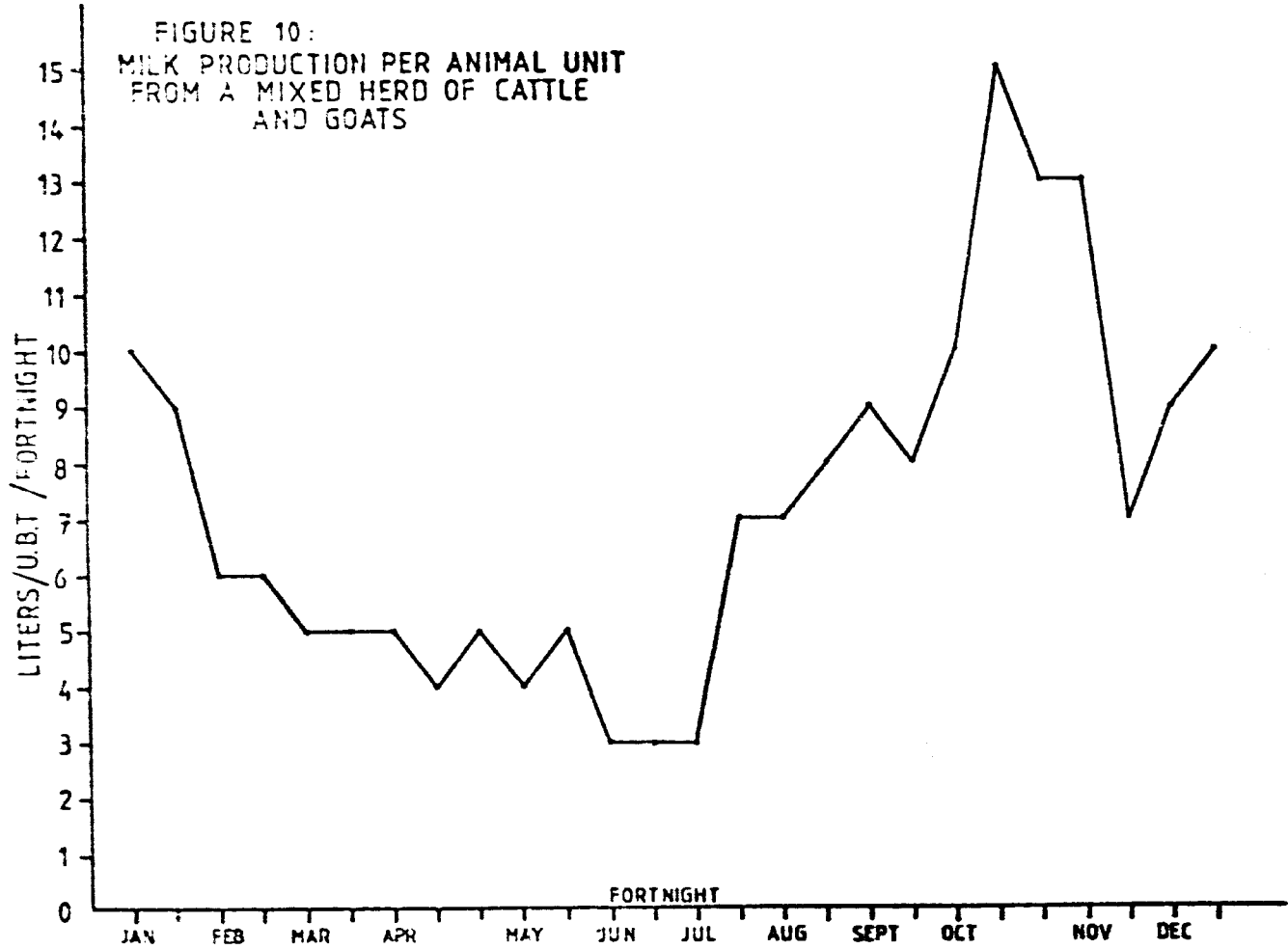
A standard animal unit was used as a basis for comparing the goat herd and the combined herd in terms of labor requirements and output. The unit employed was the Tropical Bovine Unit (Unité Bovine Tropicale, or U.B.T.), which is roughly equivalent to an animal with a live weight of 250 kilograms. Thus, either 5 goats or 1.2 head of cattle constitute one U.B.T.

For sample households, milk production was the most important output from livestock enterprises, and in terms of milk production, the diversified herd of cattle and goats has several advantages over a herd containing goats alone. The average patterns of milk production per fortnight and per animal unit for a sample of four goat herds and a sample of four mixed herds of cattle and goats are shown in Figures 9 and 10. Milk production for the average goat herd is lowest during the rainy season (June through September). This is because females come into heat at the beginning of the rainy season, kid at the end of the rainy season, and produce milk until the onset of the hot, dry season (late February). Although this reproductive cycle is convenient for survival of the young, the timing of milk output provides a complementary food source to graze when it is least needed. Most females reach the peak of their lactation cycle just at the end of the grain harvests, when grain is most plentiful. However, during the growing season, when grain stocks are low and energy expenditure by the household is high, milk production from the goat herd drops to its annual low.

In contrast to this pattern, the mixed herd of cattle and goats produces more milk per animal unit throughout the year and reaches peak production during the time when milk is most needed as a complementary food source. During August, when grain stocks are lowest and the amount of human energy required for crop production is highest, a mixed herd consisting of seven animal units (eighteen goats and four head of cattle)

FIGURE 9 :  
MILK PRODUCTION PER ANIMAL UNIT  
FROM AN AVERAGE GOAT HERD





would provide at least three liters of milk per day to the household. Since the goats come into milk as milk production from the cattle component of the herd begins to drop off, the mixed herd could provide more than three liters per day to the household for at least half the year (mid-July to mid-January).

In contrast, a comparable level of production could be sustained by a herd of seven animal units of goats (thirty-five goats) during only three months of the year (November through January). Furthermore, the total amount of milk output from the mixed herd is approximately 50 percent greater per animal unit than that from the goat herd. Average annual milk production from the four mixed herds of cattle and goats was 189 liters, whereas the four herds containing only goats produced an average of 124 liters per animal unit.

In order to estimate the producer's expected return to his annual labor input to livestock production, two types of "output" must be evaluated in addition to the value of milk output. The first is the appreciation in value of animals held in the herd. The second is the value of young born alive into the herd during the year and surviving at the end of the year. The result is a more accurate measure of the expected return to labor than would be provided by profits from animal sales alone.

The appreciation in value of an animal held in the herd is measured by the change in the market price of the animal as a result of its growing one year older. The prices used to evaluate this component of livestock output are discussed in subsequent sections of this paper. To estimate the expected return, the gain represented by change in price must be discounted by the risk that the animal will die or otherwise be lost from the herd during the year in question. Similarly, the value of young born into the herd must be discounted by probabilities of survival.

The results for the two types of livestock production activities (goats and cattle combined with goats) are presented in Tables 4 and 5. The cost per animal unit of salt purchased during the year has been deducted, salt having been the only purchased input of significant magnitude. The results show that the expected return from holding animals in the herd is much lower than either the value of surviving young or the

TABLE 4  
 EXPECTED VALUE OF OUTPUT PER U.B.T. OF GOATS

<u>Item</u>	<u>F CFA</u>
Value Added by Animals Held in Herd:	
Males	1,076
Females	<u>1,122</u>
Total	2,198
Value Added by Surviving Young Born into Herd	4,176
Value of Milk Production	6,200
Cash Costs (Salt Purchases)	<u>-250</u>
TOTAL	12,324

TABLE 5  
 EXPECTED VALUE OF OUTPUT PER U.B.T. FROM  
 THE COMBINED HERD OF CATTLE AND GOATS

<u>Item</u>	<u>F CFA</u>
Value Added by Cattle Held in the Herd	
Males	975
Females	1,468
Total	2,443
Value Added by Surviving Calves Born into the Herd	1,574
Value Added by Goats Held in the Herd	
Males	538
Females	561
Total	1,099
Value Added by Surviving Kids Born into the Herd	2,088
Value of Milk Production	9,450
Cash Costs (Salt Purchases)	<u>-250</u>
TOTAL	16,404

value of milk production. The low annual return to animals held is due to the risk parameters, as reflected in the survival probabilities. This suggests that improvements aimed at decreasing risk might have an important impact on the relative profitability of livestock production.

For either activity, milk production accounts for over half of the expected value of output net of cash costs. This reinforces the claims of sample households that milk was the most important output from livestock enterprises. It also suggests that technological improvements which affect milk production would have a greater impact on the relative profitability of livestock enterprises than would marketing interventions which affect the structure of animal prices. The effects of these and other policy initiatives will be examined using the linear programming model.

Consumption of Grain and Livestock Products.-- A summary of the estimated per capita consumption of the major grains and livestock products is provided in Table 6. Calorie requirements are based on the age and sex composition of the average household in each subsample. As indicated, consumption of the two major grains fulfills more than half of the requirement for each subsample. Given the inability of the present distribution system to provide markets in the southern pastoral zone with a steady supply of high-quality grain, the importance of grain in the household diet is an additional incentive to continue grain cultivation.

The high proportion of calorie requirements derived from millet and sorghum consumption by Hausa households is somewhat disturbing. There are several possible explanations. First, the number of people consuming grain prepared by Hausa households may have been underestimated in that the presence of guests who visited the household only at mealtime was not recorded during the survey. Second, Hausa households may have consciously exaggerated grain consumption in the hope of obtaining additional food aid from government programs. Third, it could be that meat, milk, and sugar consumption were much more important sources of calories and protein among Tuareg households than among Hausa households. Tea and



TABLE 6  
CONSUMPTION OF GRAIN AND LIVESTOCK PRODUCTS

Subsample	Estimated Daily Per Capita Consumption								Total Contribution to Calorie Requirements (%) <sup>a</sup>
	Grain				Livestock Products				
	Millet (kg)	Sorghum (kg)	Total Caloric Value	Proportion of Requirement (%)	Meat (g.)	Milk (ml)	Total Caloric Value	Proportion of Requirement (%)	
Hausa	.99	.26	2549	99	39	84	110	4	103
Village Tuareg	.44	.31	1482	58	21	213	181	7	65
Bush Tuareg	.28	.48	1450	51	13	351	272	10	61

<sup>a</sup>Proportion of calorie requirements derived from grain and livestock products.

sugar consumption probably provided most of the calories required by Tuareg households beyond those supplied by the consumption of grain and livestock products. Therefore, the high proportion of calories derived from grain consumption by Haussa households may indicate that such households had fewer and less important alternative sources of calories other than grain.

Livestock products definitely were a more important element of the household diet among Tuareg sample households than among households in the Haussa subsample. Bush Tuareg households in particular consumed an average of more than four times the daily per capita consumption of milk by Haussa households. On the other hand, Haussa households consumed an average of three times as much meat per capita as did Bush Tuareg households, but the quantity of meat consumed in general was quite small relative to milk consumption. This was particularly true of Tuareg households, which further corroborates the notion that animals that are held in Tuareg herds are kept primarily for their milk rather than for their meat.

Relative Ability of Production Systems Surveyed to Expand Cattle Production.-- As is apparent from the data presented in this section, there was a great deal of variation among households within each subsample. However, it is possible to generalize concerning the relative ability to expand cattle production. Of the three systems surveyed, those households classified as Bush Tuareg appear to have the greatest immediate interest in expanding self-managed herds. Relatively more of their income and food needs are derived from livestock production, in which all such households are currently engaged.

In contrast, Haussa households appear to be reluctant to rely on cattle, or livestock in general, as anything but a supplemental source of food and income, although they do see cattle as a preferred form of investment. However, even when acquired as an investment, Haussa households rarely manage the animals themselves and prefer instead to confide them to hired herders who do not live in the immediate vicinity of the household's abode.

Although Village Tuareg households may wish to join their Bush Tuareg neighbors tending cattle outside of the village, most households currently are unable to do so. They presently eke out an existence based on income derived from wage labor and small-scale retail trade, supplemented by grain produced on sub-marginal fields. Whenever some of their income can be set aside after fulfilling their immediate needs, they invest in small ruminants, but neither their small ruminant herds nor their other assets have expanded to the point where they could reasonably consider managing large ruminants such as cattle. The requisite initial investment, the time required to manage the cattle herd, and the risk involved currently are prohibitive for such households.

Thus, of the pastoral zone mixed farming systems which were considered by the survey, the Bush Tuareg system is the most likely to benefit directly from expanded cattle production. For this reason, as well as other reasons mentioned in this paper, the detailed analysis of alternative agricultural development policies is confined to the Bush Tuareg group.

#### Average Seasonal Labor Requirements of Bush Tuareg Agricultural Enterprises

This section describes the labor requirements of the six agricultural enterprises included in the linear programming analysis of the section which follows. These include: millet production, three sorghum production technologies with varying returns to land, goat production, and the production of goats combined with cattle.

Labor requirements are based on the average hours allocated to each by the groups of households defined below. For the four grain enterprises, labor requirements are measured in hours per hectare for each fortnight. To elaborate on the type of work undertaken within each fortnight, labor allocated to each grain production activity has been divided into five work categories: land preparation, planting, weeding, guarding the fields, and harvesting.

The average labor requirements for the two livestock enterprises are measured in hours per animal unit (U.B.T.). Once again, to illustrate

the nature of the work, labor allocated to each of the two enterprises has been further divided into three work categories: pasture (grazing), watering, and milking.

As part of the linear programming analysis of the following section, it is assumed that labor requirements per hectare and per animal unit are fixed in each fortnight. This assumption is justified for the livestock production activities in that grazing, milking, and watering the animals must be carried out on a daily basis. It is also justified for the grain production activities, in that the timing of work associated with grain production is highly dependent on rainfall patterns. Thus, for a given temporal distribution of rainfall, labor requirements are fairly inflexible between fortnights.

Along the same lines, it is important to remember that the labor requirements specified below are strictly valid only for a given area in a given year. This is because changes in rainfall patterns over space and time would alter the labor requirements and the relative profitability of the various activities. Thus, the results given by the model described in the following section must be interpreted in light of rainfall patterns during the survey year. As indicated in the first section of this paper, rainfall patterns at the research site during the survey year were unusual because heavy rains fell late into the year, producing a second sorghum harvest, and there was a thirty-day drought during the early part of the growing season which crippled the millet crop.

Millet.-- The labor requirements of the millet technology included in the model are based on the average hours per hectare devoted to millet by the households in the Hausa subsample. The Hausa millet technology was selected, since it was the most productive of the millet technologies observed among the three production systems. Since only one Bush Tuareg household was able to produce any millet at all during the survey year, the observed Bush Tuareg millet technology could not provide an adequate explanation of why Bush Tuareg households engaged in millet enterprises. Thus, the selection of the Hausa millet technology is predicated on the assumption that in making planting decisions for the coming crop cycle,

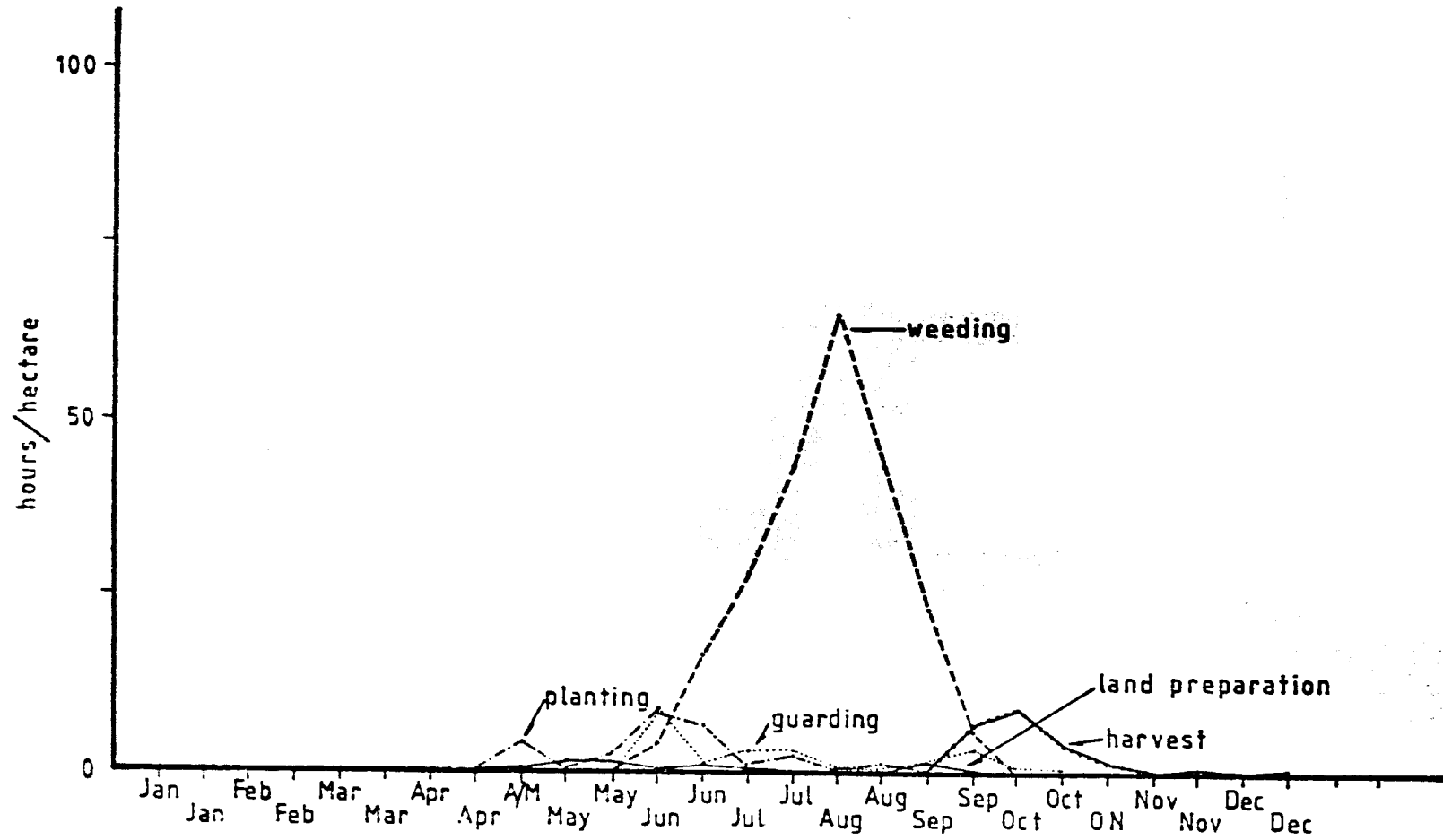
Bush Tuareg households strive to emulate the best locally available technology for any particular enterprise. Indeed, this is the way in which sample members themselves characterized their decision-making: Tuareg households engaged in millet production under the assumption that they would be able to achieve the yields obtained by relatively more successful Haussa millet producers. For similar reasons, the most productive sorghum technologies have been selected for inclusion in the model, these being the technologies adopted by Bush Tuareg households during the survey year.

Average labor requirements for each work category in each fortnight are indicated in Figure 11. As the graph suggests, labor inputs to millet production were concentrated in the June through October period, which is the rainy season. The major activity during that period was weeding, which was probably the most critical task and certainly the most demanding physically. Haussa households met the weeding labor requirement by hiring additional labor, particularly during August, the month of heaviest rainfall. The hiring of labor enabled Haussa producers to spend roughly equal amounts of time per hectare on weeding millet and sorghum fields during the critical period of heavy rainfall.

Discretionary income derived from sales of livestock and livestock products contributed to the ability to hire labor during this period. Hired labor accounted for one-third of the total labor allocated to weeding grain fields by the fourteen sample households which produced both large and small ruminants. In contrast, in seventeen sample households which had no animals, hired laborers contributed only 5 percent of total labor allocated to weeding. For some Tuareg households, the lack of discretionary income with which to hire labor forced them to choose between weeding millet or sorghum fields during the critical period of heavy rainfall. The resulting concentration of weeding labor on sorghum fields obviously contributed to the failure of the millet crop for these households.

Millet was grown mostly on upland, sandy soils for which very little preparation was required prior to planting. The first planting took place in early May, before the rains began. Fields were subsequently replanted as necessary during the early part of the rainy season.

FIGURE 11: Agricultural Calendar for Millet: Haussa Sub-sample



Guarding the millet fields, like land preparation, occupied relatively little time. Most of the labor allocated to guarding the fields was intended to protect the crop from herds in transit through the area. Thus, fields had to be guarded at the beginning and end of the rainy season when herds were in transit to and from northern pastures.

The harvest began in late September and continued through October. Since the herds of nomadic livestock producers were returning from northern pastures during this period, the ripened grain had to be evacuated rapidly to storage areas to avoid damage to the crop. Despite this time constraint, neither the harvesting activities nor any of the other three activities mentioned above constituted as large a proportion of the total labor requirement of the millet enterprise as did labor required for weeding during the rainy season.

Sorghum.-- The labor requirements of the three sorghum technologies included in the model are based on the average hours per hectare devoted to sorghum in each fortnight by each of three groups of households within the Bush Tuareg subsample. The three groups were distinguished on the basis of varying yields (averages of 350, 850 and 1,160 kg /ha ). The average labor requirements, broken down by activity, for the two groups achieving greater per hectare yields are illustrated in Figures 12 and 13.

The most distinctive difference between the labor requirements for sorghum and those for millet is that sorghum is a much more labor-intensive enterprise, requiring a greater labor input per hectare for all five work categories. In particular, land preparation, planting, and guarding take on greater importance. Also, the harvest labor requirement during October and November is of comparable magnitude to the weeding labor requirement in July and August.

Significant amounts of land preparation are required for sorghum. Possibly as a result of the land preparation requirement, planting did not begin until late June, which was after the early rains. Additional plantings in late July were required to replace plants killed off in the thirty-day drought at the beginning of the rainy season.

FIGURE 12 : Labor Requirements by Activity  
for Average Yield Sorghum Technology

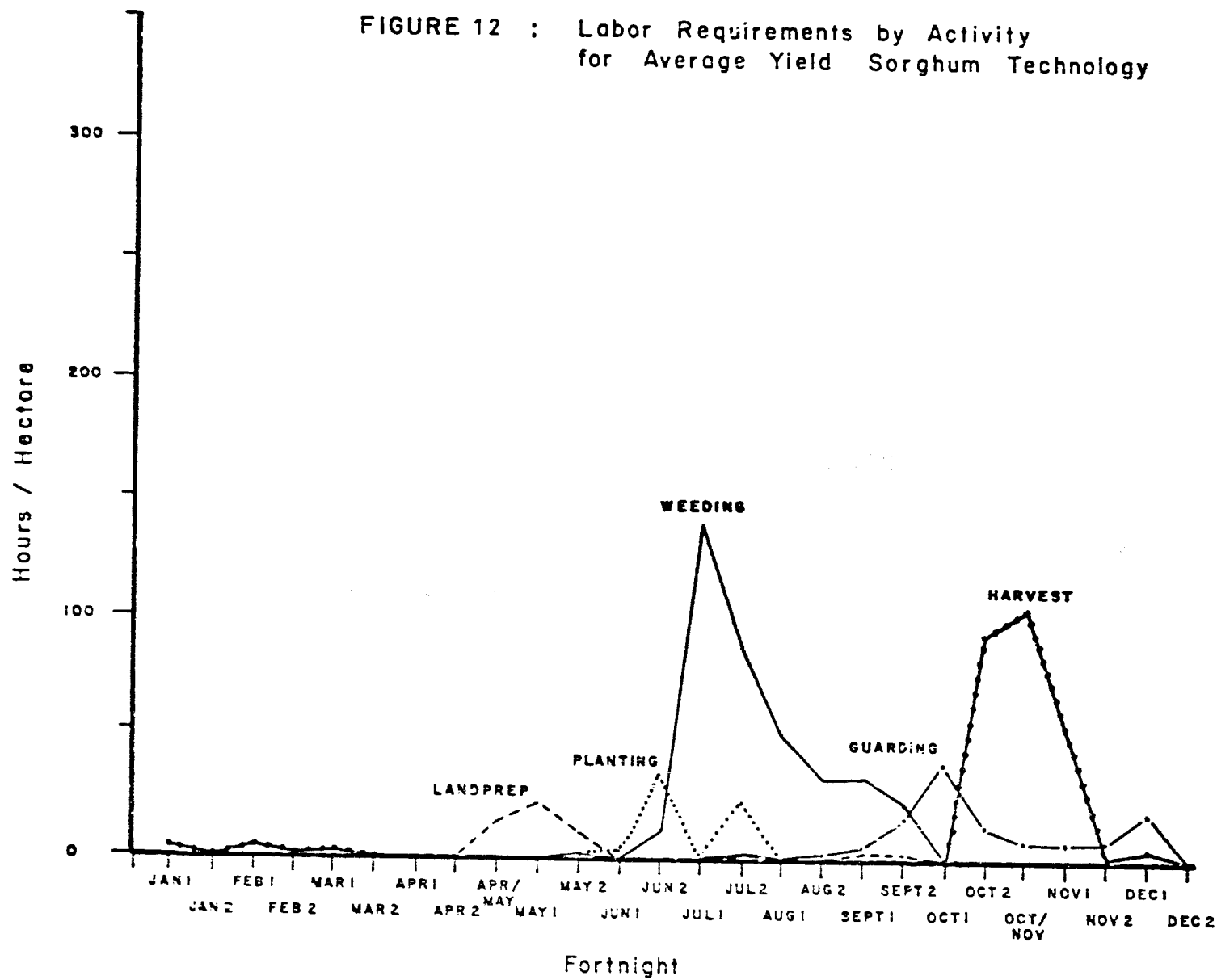
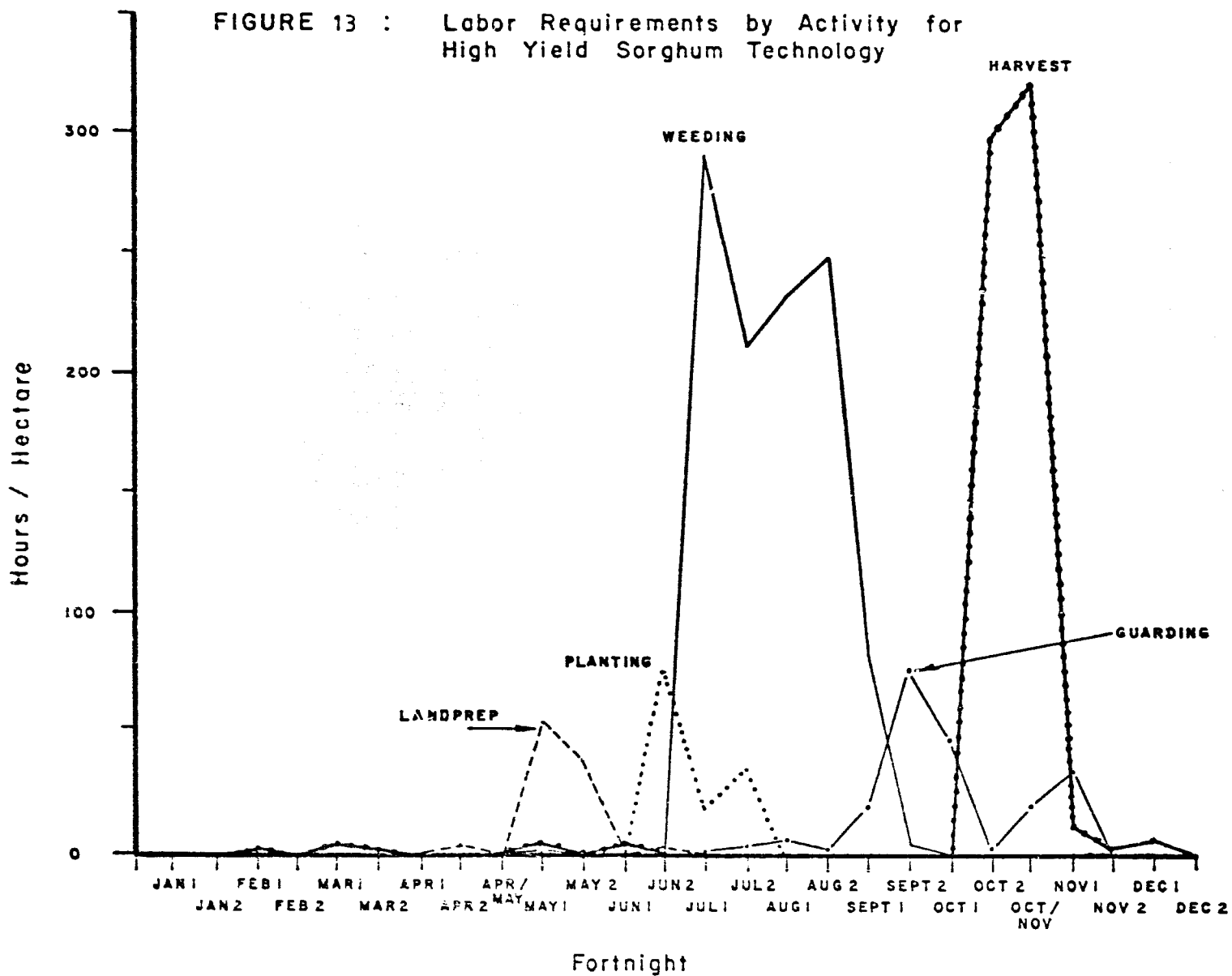




FIGURE 13 : Labor Requirements by Activity for High Yield Sorghum Technology



Unlike the Hausa millet technology, the peak requirement for labor allocated to weeding sorghum occurred in early July rather than August. A further difference is that the sorghum harvest began in earnest in late October, in contrast to the millet harvest, which commenced a month earlier. The later sorghum harvest meant that more labor had to be allocated to guarding the fields to prevent incursions by animals. The threat of trespassing animals was particularly acute at this time, since many animals were in transit through the area. Also, the heavy rains had stopped, and less pasture was available, making the ripening grain more attractive to transhumant herds. Finally, much of the pre-harvest labor in the grain fields had ceased, since the plants were already well established and the rains no longer made it necessary to continue intensive weeding. This meant that fewer people were regularly present in the grain fields, so there was a greater risk that animals would encroach upon unattended fields. As indicated by the timing of livestock labor requirements, the need to guard fields during this period may be an important constraint to agricultural production among mixed farmers.

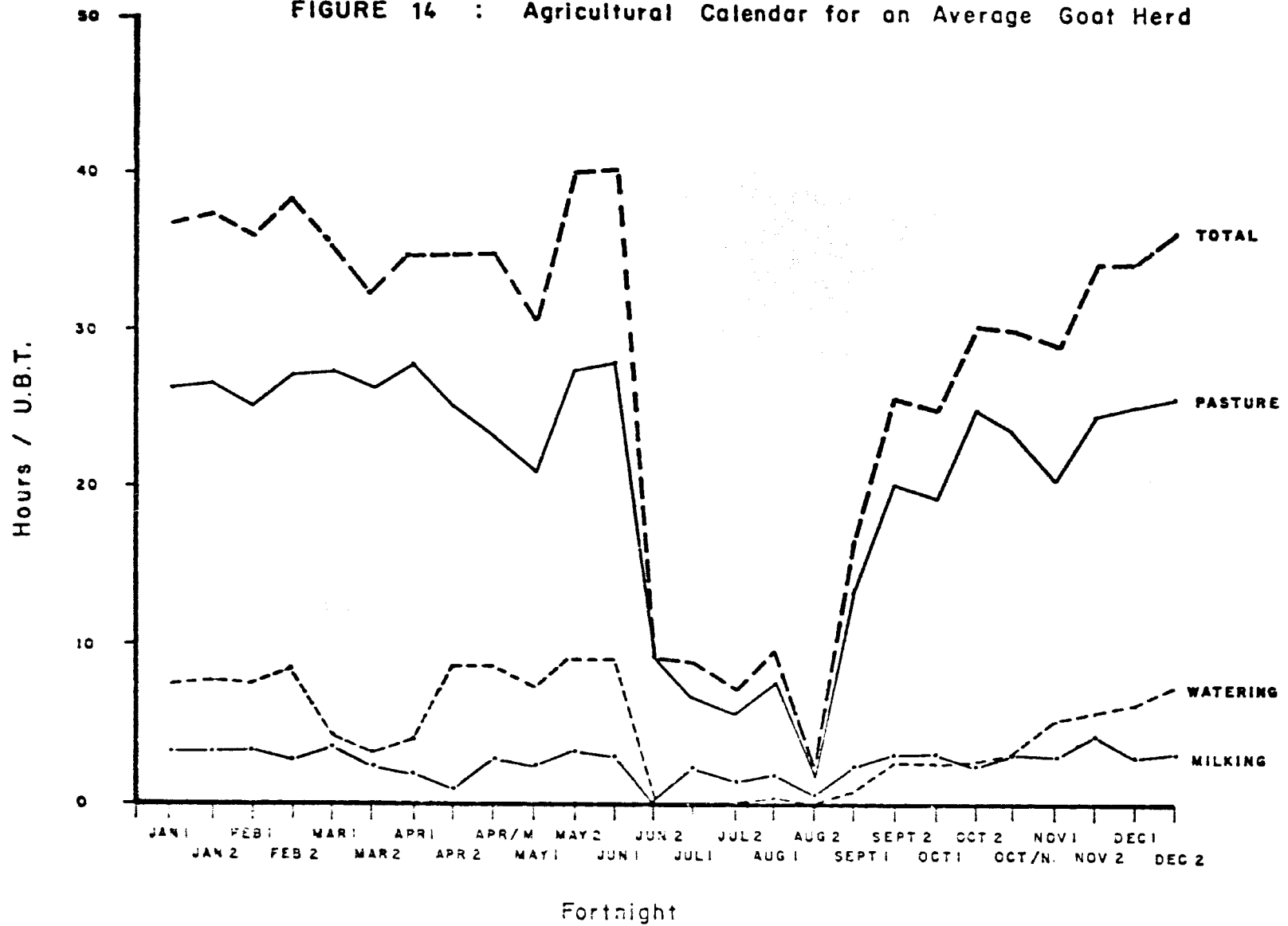
Goats.-- As indicated in the previous section, the livestock production options under consideration are limited to goats and cattle combined with goats, since these two types of herds were the most common among sample households. Furthermore, as indicated above in the subsection of livestock output, cattle were never raised independently of goats, since grain and livestock-producing households preferred to build up a subsistence herd of at least twenty goats before diversifying into cattle production. Before discussing the mixed herd option, the present subsection looks at the labor requirements of the basic goat herd, which contains twenty to twenty-five goats. As in the above discussion of livestock output, labor requirements for the goat herd and the mixed herd are given in terms of a standard unit (U.B.T.) which is equivalent to 5 goats or 1.2 head of cattle.

The breakdown of average labor requirements per animal unit for a sample of four Bush Tuareg goat herds is indicated in Figure 14. The most outstanding characteristic of the labor flows is the sharp drop in labor requirements from mid-June through August. This was the period during the rainy season when water and pasture were plentiful.

This was also the period when crops were in the ground and were developing. However, most crop producers were in their fields either planting or weeding at this time, so there was relatively little danger of animals wandering into the grain fields unobserved. Thus, during the height of the rainy season, the animals could be left to wander on their own in search of relatively abundant pasture and water, and more household labor could be devoted to grain production. For this reason, goat production labor requirements dropped to their annual low in late August when the combined requirements for weeding in both millet and sorghum fields were at an annual peak.

By September, the weeding of the grain crop was completed, and activities in the sorghum fields dropped off until the harvests began in October. As indicated above, the grain fields were vacant at this time (with the exception of those guarding the fields), and as the grain ripened, it became more attractive to the herds. As a result, the herds had to be placed under more regular surveillance to prevent them from entering the fields and damaging the grain crop. Thus, labor requirements rose sharply between August and September and increased more gradually throughout the harvest period as more labor was devoted to keeping the herds away from the ripening grain. At the same time, the amount of labor required for watering was increasing as surface water supplies dried up and herders had to begin watering their animals from the wells. The time required for milking also increased during this period since more animals in the herd were coming into milk. Thus, around the time of the grain harvest, sorghum and goat-producing households were faced simultaneously with rising demands for harvest labor and rising demands for labor allocated to all three major goat production activities. In contrast to the sharp dip during the rainy season, labor requirements were fairly stable throughout the cold season and hot dry season.

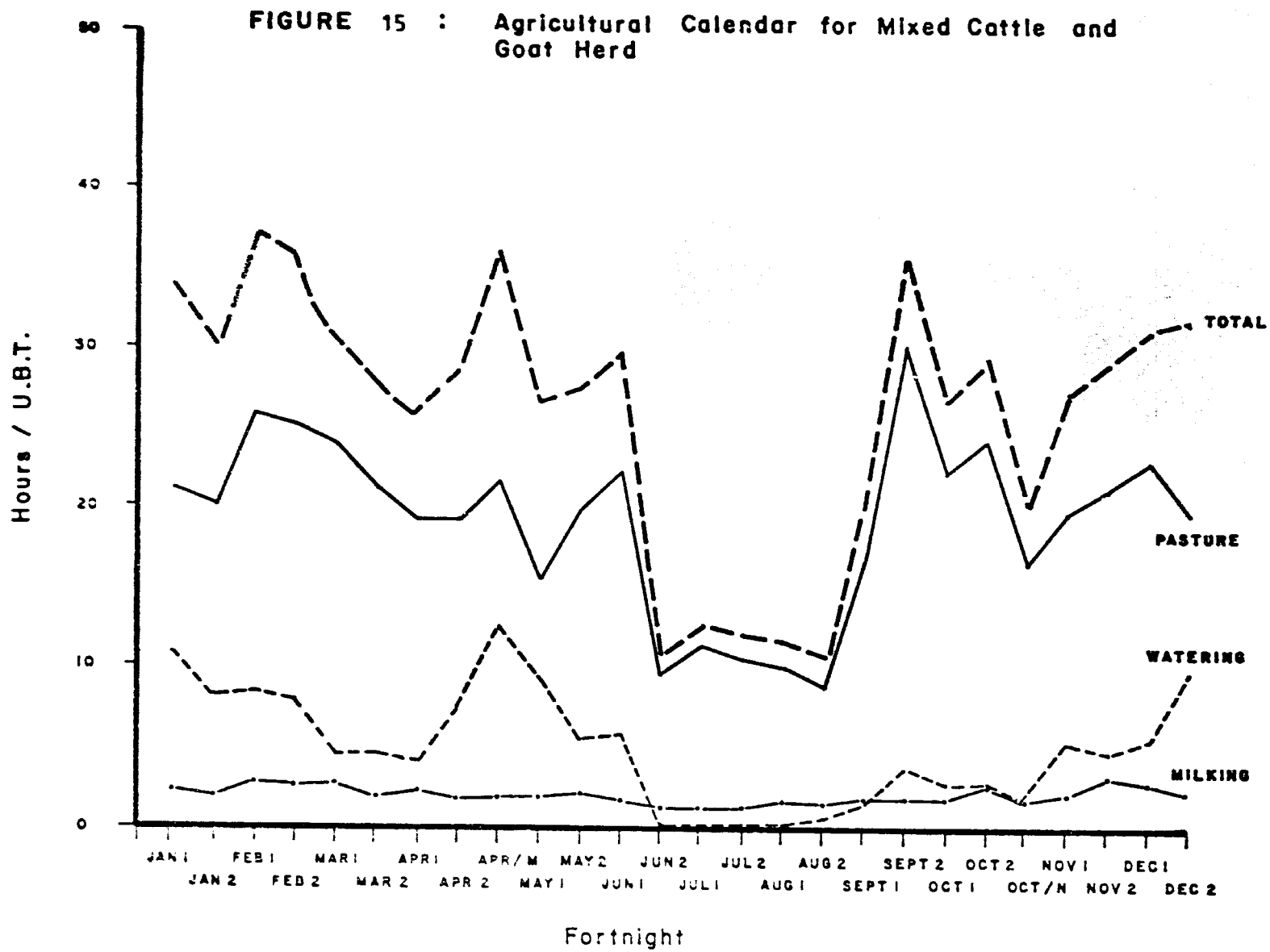
FIGURE 14 : Agricultural Calendar for an Average Goat Herd



Mixed Herd of Cattle and Goats.-- Figure 15 illustrates the amount of labor required per animal unit and per fortnight to maintain a combined herd of twenty to twenty-five goats and three to five head of cattle. The overall pattern is very similar to that of the basic goat herd. In comparing the labor requirements per animal unit of the two types of herds, it does not appear that it is possible to realize any substantial economies of scale by expanding the basic goat herd to include cattle. Average labor requirements for both types of herds were similar in all but the June to August slack period.

The labor calendar for the mixed herd is marked by the same drop in labor requirements as that of the goat herd during the June to August period. However, average labor requirements per animal unit never dropped as low as those for the goat herd during this slack period. This probably was due to the fact that unattended cattle may do more damage to a grain field in a short period than goats. Therefore, cattle had to be watched more carefully than goats, even during the rainy season when water and pasture were more plentiful. Thus, the rainy season labor requirements for the mixed herd did not appear to be as flexible as those for the goat herd.

This relative inflexibility of labor requirements applied equally well to the month of September, the time at the beginning of the grain harvest when labor requirements for the mixed herd rose to one of three annual peaks. During this time, the cattle had to be watched closely, since they in particular were attracted to the ripening heads of grain at a time when the grass cover which they relied on for feed was beginning to be depleted. The goats could still browse from trees and shrubs at this time, but the cattle did not have this option and were thus more attracted to the ripening grain. The following section examines the extent to which these differences in labor requirements interfere with the expansion of cattle production.



Analysis of Bush Tuareg Agricultural Production

In this section, the information presented thus far is incorporated into a linear programming model of a Bush Tuareg mixed farm whose production possibilities are millet, sorghum, goats and cattle. The model is exploited to simulate the effects of three policy options intended to promote specialization in cattle production: (1) government distribution programs which grant or loan animals to livestock producers; (2) grain market interventions which would alter the price and quantity supplied of grain to the local market; and (3) the introduction of new technologies which would increase the milk yields of cows and goats. A critique of the results obtained and alternative policy recommendations follow in the final section of the paper. Briefly, the factors which appear to restrict Bush Tuareg cattle production and limit the efficacy of the above policies are: (1) seasonal labor bottlenecks at the beginning and end of the growing season; (2) the desire on the part of Bush Tuareg mixed farmers to be self-sufficient in grain; and (3) the importance of the goat as a relatively risk-free source of milk, meat, and cash income.

The Model.-- The basic model is a conventional farm management model which allows for selection among millet, sorghum, goat and cattle production activities subject to labor, land and subsistence constraints. The primal problem could be described as follows: with a given unit of value of each of the outputs ( $c_i$ ) and a given upper limit for the availability of the labor input in each fortnight ( $b_j$ ) and of the total land input to sorghum enterprises ( $l_s$ ) what is the size of each activity ( $X_i$ ), as measured in units of land and livestock, which would maximize the net value of the total output? The model can be expressed algebraically as:

$$Y = \text{MAX} \sum_{i=1}^6 c_i X_i$$

subject to:

$$\sum_{i=1}^6 a_{ij} X_i \leq b_j \quad (j = 1, \dots, 26)$$

$$\sum_{i=2}^4 X_i \leq l_s$$

where:  $Y$  = maximum value of output, net of seed, salt, and other purchased inputs

$X_1$  = millet activity (measured in hectares)

$X_2$  = low-yielding sorghum activity (in hectares)

$X_3$  = medium-yielding sorghum activity (in hectares)

$X_4$  = high-yielding sorghum activity (in hectares)

$X_5$  = goat activity (in U.B.T.)

$X_6$  = mixed cattle and goat activity (in U.B.T.)

$i, j$  = subscripts indicating activity and time (fortnight), respectively

$c_i$  = net value of output from one unit of the  $i^{\text{th}}$  activity

$a_{ij}$  = hours of labor required per unit of the  $i^{\text{th}}$  activity in the  $j^{\text{th}}$  fortnight in order to attain the yields implicit in the  $c_i$ .

$b_j$  = total hours of labor available for agricultural activities in the  $j^{\text{th}}$  fortnight

$l_s$  = total hectares of land suitable for sorghum production (lowlands) which the household may expect to obtain.

The model offers as options six activities (enterprises), four of which are related to grain production and two to livestock. The four grain enterprises are measured in terms of the land input in hectares. Three of the grain enterprises involve sorghum production with three different per-hectare yields. The fourth is a millet enterprise based on the Hausa millet technology, as described in the previous section. It is assumed that millet and sorghum enterprises are distinct in that millet cultivation is confined to upland, predominantly sandy soils, and sorghum cultivation is likewise restricted to lowland alluvial soils. This was true for all households in the Bush Tuareg subsample.

The livestock enterprises consist either of goats alone or goats combined with cattle. Each of the livestock enterprises is measured in terms of U.B.T. equivalents (1 U.B.T. = 5 goats = 1.2 head of cattle). Cattle production is not an independent enterprise in the model, since, as previously indicated, all sample households which produced cattle also produced goats, and the labor inputs to the production of one animal type were inseparable from inputs to the production of the other. Therefore, combined goat and cattle production is considered to be one enterprise.



For the purposes of the combined livestock enterprise, it is assumed that there are equal numbers of U.B.T. equivalents of each animal type in the herd. Thus, each unit of the model goat/cattle enterprise contains the equivalent of 2.5 head of goats and 0.6 head of cattle. Each unit of the goat enterprise contains five head of goats. This conforms with the herd compositions assumed above in the calculation of the returns to and the average labor requirements for the respective enterprises.

In incorporating several sorghum technologies and two livestock enterprises, the model does allow for some flexibility in input (labor/land) ratios and herd composition. One potential problem with this formulation, however, is that it assumes that goats will always be combined with cattle in a proportion of at least four head of goats to one head of cattle (2.5 to 0.6). It is doubtful that this poses any great difficulty, since sample members actually did combine goats with cattle in at least that proportion. Furthermore, in the following analysis, whenever the combined livestock enterprise entered the optimal solution, additional units of the goat enterprise usually were selected along with the optimal number of units of the combined goat/cattle enterprise, indicating that the optimal enterprise combination usually involved combining goats with cattle in a ratio greater than 4-to-1. It should be borne in mind, however, that the model does not allow for a combination of goats and cattle in less than a 4-to-1 ratio.

Fixed labor requirements per hectare and per animal unit for each enterprise in each fortnight are derived from the material presented in the previous section. Labor requirements are specified for each enterprise in each fortnight in order to identify as precisely as possible the seasonal labor bottlenecks which constrain agricultural output. Since labor requirements are based on the average observed values within each group of households, the present model is limited to an approximation of the "average" Bush Tuareg household. The behavior of households which deviate in various respects from this overall "average" is simulated by adjusting the labor constraints to reflect the characteristics of larger households, as described below.

Value coefficients for the grain enterprises are the actual average net returns per hectare for the relevant group of households, as described in the previous section. These coefficients and the physical yields and prices on which they are based are listed in Table 7. Physical yields are net

of seed requirements for the following year.

TABLE 7  
GRAIN PRODUCTION STATISTICS AND VALUE COEFFICIENTS  
FOR MODEL GRAIN TECHNOLOGIES

<u>Statistic:</u>	<u>Millet</u>	<u>Sorghum</u>		
		<u>Low-Yield</u>	<u>Medium-Yield</u>	<u>High-Yield</u>
Hours/Ha	305.	530.	1,070.	2,157.
Kg /Ha	46.	300.	850.	1,160.
Kg /Hour	.15	.57	.79	.54
<u>Value:</u>				
Price (CFA/Kg )	68.	61.	61.	61.
CFA/Ha	3,128.	18,300.	51,850.	70,760.
CFA/Hour	10.20	34.77	48.19	32.94

The prices are the means of the weekly price observations recorded during the commodity price surveys conducted by the research team. The mean of the weekly observations, rather than an expected value based on grain sales patterns, was selected as the most representative price at which to evaluate grain output, since on the average, less than one-fourth of total grain production was marketed by Bush Tuareg households during the survey year. A sensitivity analysis of grain prices in the model is included in the following discussion.

The value coefficients for the two livestock enterprises are the measures of livestock output which were derived in the subsection covering that topic. Thus, the coefficients express the value of milk production, the appreciation in value of animals held in the herd (discounted for risk), and the value of surviving animals born into the herd. These coefficients are designed to estimate the return to one year's labor input which can be expected from one animal unit (one U.B.T.).

The returns to labor and livestock implicit in these coefficients are summarized in Table 8. The following analysis includes a sensitivity analysis of these coefficients, based on assumed increases in milk yields beyond the levels observed during the survey year. Since the value of milk

output accounted for more than half of the total estimated returns to livestock enterprises, the sensitivity analysis concentrates on that portion of the value of livestock production.

TABLE 8  
ANNUAL RETURNS TO LABOR AND LIVESTOCK FROM  
MODEL LIVESTOCK ACTIVITIES

<u>Statistic</u>	<u>Activity</u>	
	<u>Goats</u>	<u>Goats and Cattle</u>
Hours/U.B.T.	734.	682.
CFA/U.B.T.	12,324.	16,405.
CFA/Hour	16.79	24.05

Labor constraints are formulated under the assumption that household members would prefer not to spend less time on commerce and domestic activities than that amount of time actually allocated to those activities during the survey year. Furthermore, it is assumed that each household member requires a minimum of three hours of rest during the twelve daylight hours of each day, including the amount of time spent at meals. Thus, the minimum rest requirement for each individual present in the household and the amount of time actually spent on commerce and domestic activities in each fortnight are deducted from the total amount of labor available, to arrive at an estimate of the maximum amount of labor available for agricultural enterprises in each fortnight for each household. These figures are then averaged over a given set of households to derive the labor constraints.

Two sets of households and the resulting two sets of labor constraints are considered in the following analysis. The first set consists of Bush Tuareg goat-producing households which were of average size relative to the entire set of households in the Bush Tuareg subsample. These will be referred to subsequently as the average Bush Tuareg households. Since cattle production was confined to households of above average size, the second set of households for which labor constraints are formulated consists of the larger Bush Tuareg households which produced both large and small ruminants. In the following discussion, these households will be referred to as the large Bush Tuareg households.

A land constraint is included to ensure that optimal solutions do not involve unrealistic land use plans. The land constraint affects only sorghum enterprises, since land suitable for millet production did not appear to be a scarce factor in the survey area. Thus, the constraint applies to those lowland, alluvial, primarily clay soils which were planted predominantly to sorghum.

The land constraint to sorghum enterprises was set at 5.00 hectares. This is the quantity of land suitable for sorghum production which Bush Tuareg households could reasonably expect to obtain. The constraint was never binding in any of the situations considered, suggesting that the availability of labor rather than the availability of land is what limits agricultural production on mixed farms in the southern pastoral zone.

In qualitative interviews, Bush Tuareg households indicated that given the choice between grain and livestock enterprises, they would prefer to assure subsistence needs in grain before engaging in livestock enterprises. To reflect this, a subsistence constraint was incorporated in the model, and solutions to the primal problem were examined with and without this constraint. To formulate the constraint, the minimum grain requirement per working household member was assumed to be the mean observed annual consumption of grain by households in the Bush Tuareg subsample. Thus, the subsistence constraint implies that the physical output of grain from the four grain activities must be greater than or equal to the observed consumption of grain for a set of households of a given size.

With the subsistence constraint introduced into the model, a parametric analysis of labor availability was conducted for households of various initial sizes. The results indicated that household size and labor availability are important determinants of enterprise combination. Specifically, the results suggested that, given the preferences and value-maximizing behavior outlined above, the ability to engage in cattle production while ensuring subsistence food needs is restricted to households of above average size. This would explain why only 30 percent of the sample households, all of which were of above average size, were engaged in the production of large ruminants at some point during the survey year.

Furthermore, it appeared that subsistence constraints were binding only for those households of average or below average size. The minimum grain production requirement imposed by the subsistence constraint did not

alter the optimal solution to the value maximization problem for the relatively large households. However, subsistence constraints were binding for smaller households and did effectively eliminate the possibility of cattle production by such households. Unless otherwise indicated, the subsistence constraint is not incorporated in the model for the purpose of the following analyses. However, separate consideration is given to the extent to which the solutions thus derived will fulfill grain consumption requirements.

The following analysis applies directly to a cross-section of Bush Tuareg households in a year in which, in addition to the other parameters in the model, the amount and distribution of rainfall was as observed during the survey year. This latter consideration is particularly important, since varying amounts and spatial and temporal patterns of rainfall would alter the labor requirements and possibly the relative profitability of agricultural enterprises. Thus, the results of the analysis, with the parameters as given, are useful for cross-sectional comparisons, but given the extensive variability of rainfall patterns in the southern pastoral zone, these results could not be used reliably to predict or explain behavior over time or between regions.

Simulated Effect of Increasing Herd Size. -- To simulate the effect of development programs whose aim is to distribute additional animals to livestock producers, a parametric analysis of herd size is conducted by setting the levels of one or both of the livestock enterprises to zero and then forcing increases in herd size by one animal unit at a time. The effect of the increases in herd size on the optimal levels of the other enterprises and on the total value of output is then examined. The analysis discloses that producers are currently maintaining herds which are of optimal or near-optimal size and that grants of additional animals, without complementary interventions to relieve currently binding constraints, would actually force a reduction in the total value of output.

The underlying rationale for animal distribution programs is that producers are not currently managing more animals simply because they cannot afford to acquire them. The logical extension of this is that the provision of credit or outright grants of animals would enable producers to expand their herds to their optimal size. However, since the following analysis discloses that producers are currently maintaining herds of optimal

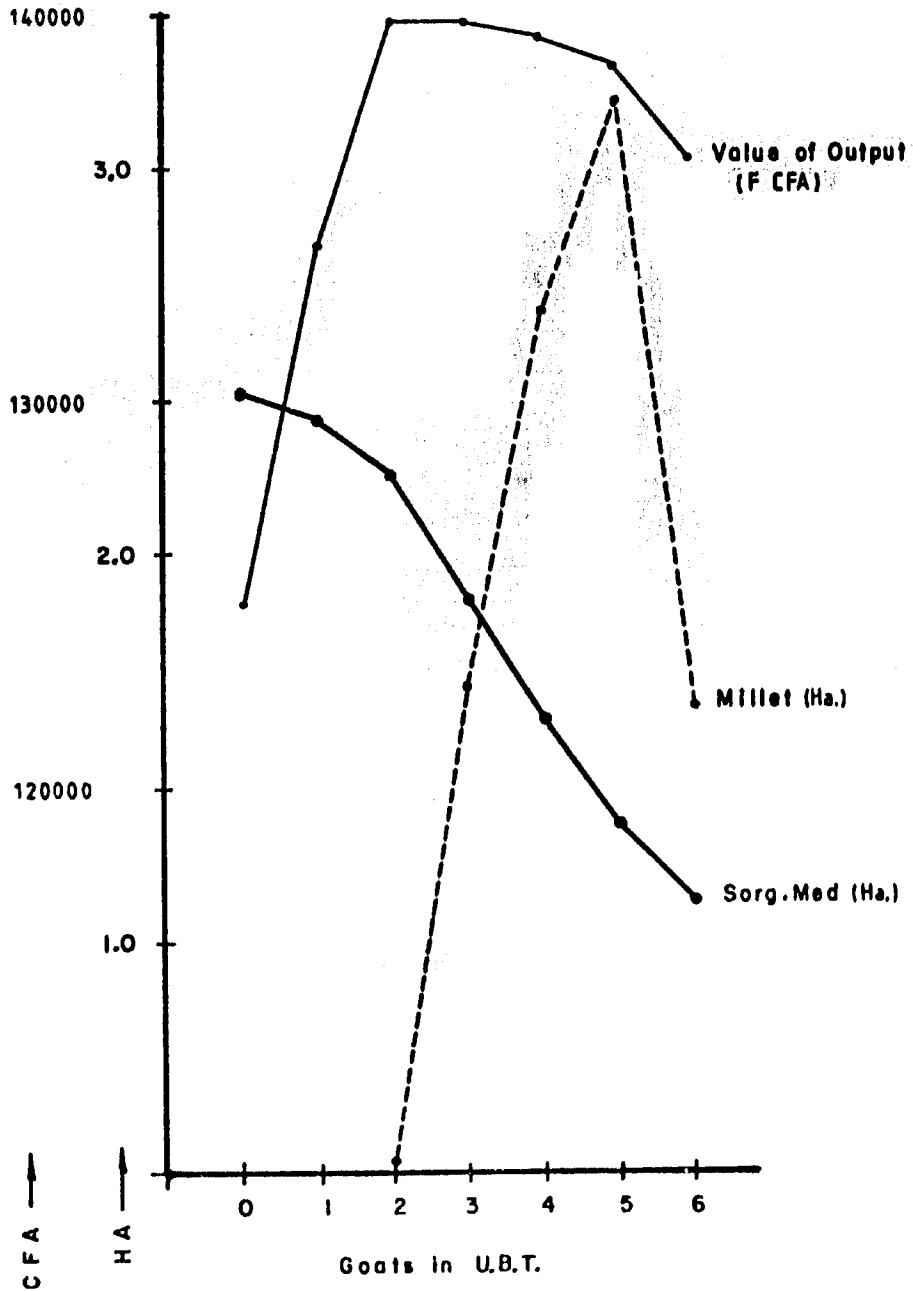
size, it then becomes relevant to ask what constraints limit the expansion of those herds and what complementary policy initiatives would relax such constraints. These are the subjects covered in the remainder of this paper.

The first portion of this section is concerned with the ability of the average Bush Tuareg household to expand goat production beyond current levels. The households in question currently maintain herds of approximately twenty goats, but no cattle. Since Tuareg households indicated that they were reluctant to engage in cattle production unless they could simultaneously maintain a subsistence herd of a least twenty goats, the following examines the effect of increasing the average household's goat herd beyond twenty head, or 4 U.B.T. Since the average Bush Tuareg household did not engage in cattle production, the combined cattle and goat production activity is excluded from the model when such households are the subject of the analysis. The specific issue investigated below is whether households of average size are operating their goat enterprises at optimal levels and, if so, what restricts the goat enterprise to a level at which such households are reluctant to take on the risk of incorporating cattle in their herds.

The results of the parametric analysis of goat herd size for average Bush Tuareg households are summarized in Figure 16. Given the model as stated above, maximum value of output for these households is attained at a goat herd size equivalent to 2 U.B.T., or 10 goats. Up to this point, the net value of output rises rapidly as goats are forced into the solution. Between this point and the point that coincides with current production levels (4 U.B.T., or 20 goats), the value of output declines gradually as goats are added. Beyond 4 U.B.T., the value of the objective function declines more rapidly. When a herd of 35 goats, or 7 U.B.T., is forced in, the solution becomes infeasible, given the labor constraints applicable to this set of households during the survey year. The solution given by the model with the goat herd size set at 20 head (4 U.B.T.) is quite close to the average enterprise size and combination observed among the relevant set of households.

As goats are added initially, the level of sorghum production in the optimal plan decreases, and millet production is substituted for some of the sorghum. Combining millet and sorghum production can be seen as a means of minimizing risk since the success of one or the other crop could not be known in advance due to uncertainty concerning rainfall. The millet

FIGURE 16 : Substitution Relationship Between Grain and Livestock Production with Varying Goat Herd Size: Average Bush Tuareg Household



crop is relatively more successful in years of higher rainfall, and the sorghum fields, being in low-lying areas which receive water from the surrounding hills, provide some grain even in years of abnormally low rainfall. Thus, the combination of grain enterprises ensures some millet output in years in which rainfall is abnormally high and the sorghum crop is drowned out, or a steady supply of grain from lowland sorghum fields in years such as the survey year, when rainfall is below average. The desire to produce both millet and sorghum in order to minimize the risk of total crop failure due to uncertain rainfall assists in explaining why Bush Tuareg households of average size were found to engage in goat enterprises at a scale beyond that which would appear to be optimal. Rather than maximizing the value of output by producing fewer goats, more sorghum, and no millet, producers may prefer to sacrifice some sorghum production in years of low rainfall in order to produce both millet and sorghum and more goats.

At a goat herd size of up to ten head and the optimal levels of millet and sorghum production associated with that herd size, output is constrained by labor availability in early July. However, when additional units of goats are forced into the solution, the most critical period of labor scarcity is late October. As explained above, the labor constraint in this period is due to the need to prevent the animals from consuming the ripened grain which is still in the fields and the need to evacuate the newly ripened grain to secure storage facilities.

The above analysis illuminates several important points. The first and probably most important point is that for the average Bush Tuareg household, there exists an optimal (or near-optimal) herd size of between 2 and 4 U.B.T. of goats (ten to twenty head), and that barring changes in technology, relative prices, or labor availability, the total value of output is drastically reduced when attempts are made to increase herd size beyond this optimal range. The second is that the desire to avoid risk by combining millet and sorghum production may force the producer to select a slightly sub-optimal enterprise combination. The third point is that within the range of enterprise combinations actually selected by this set of households during the survey year, the model indicates that the most critical period of labor scarcity is during the harvest period in late October. These results suggest that in the situation witnessed by the research team,



additional grants of animals, in the absence of complementary policy initiatives, would not enable the average-size household to expand livestock production without seriously affecting grain output and the total value of production from agricultural enterprises.

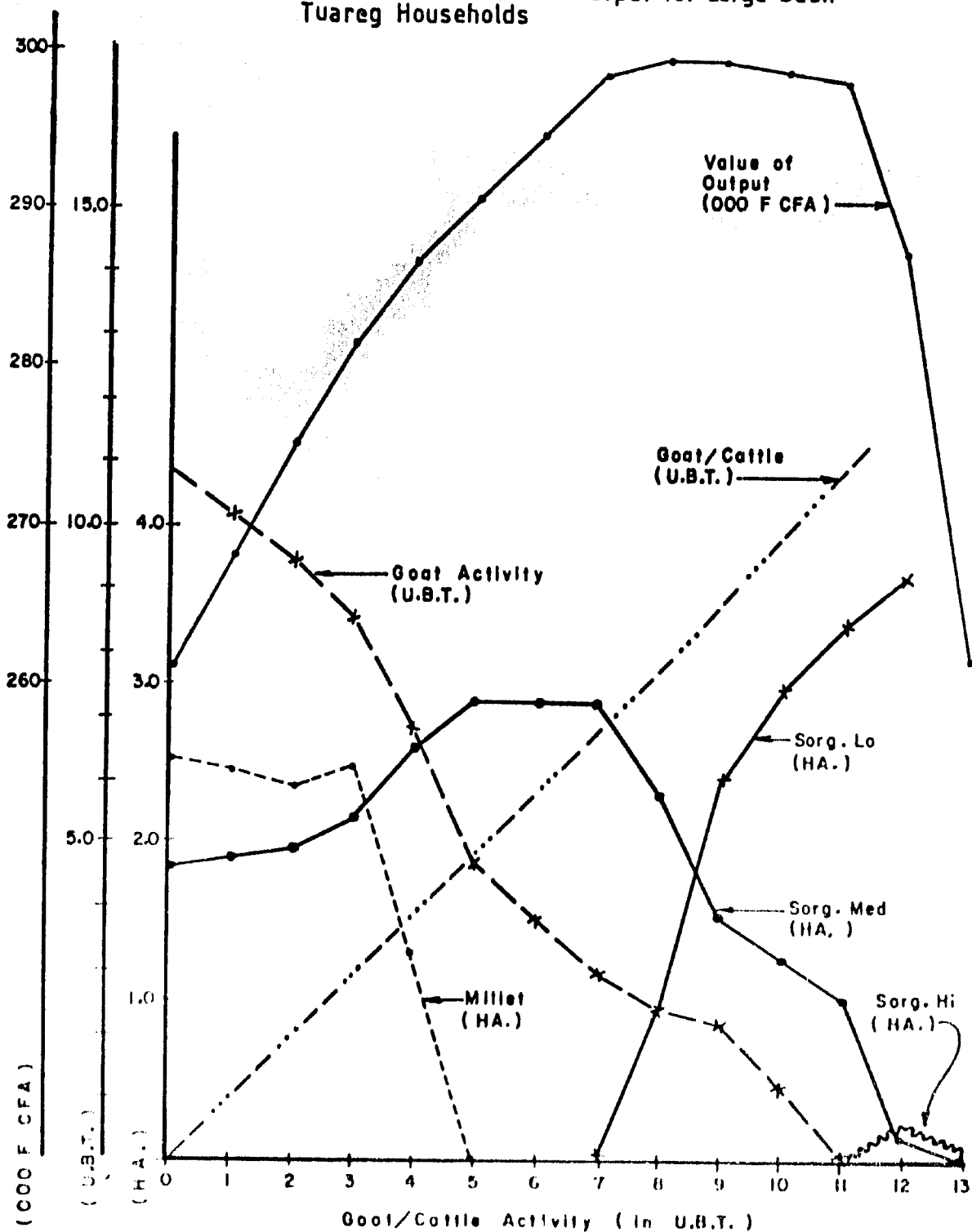
The second portion of this section is concerned with that set of Tuareg households which are large enough to keep both large and small ruminants while producing enough grain to satisfy the household's consumption needs. Cattle production by Tuareg mixed farmers was restricted to households of this size. Since it is found that these larger households also are operating at optimal levels for each enterprise, the analysis of this subsection also attempts to identify the factors which limit the effectiveness of animal distribution programs by restricting the expansion of cattle production.

The analysis centers around a set of parametric programming results which use the labor constraints applicable to large Bush Tuareg households. To obtain these results, the combined cattle and goat production activity was forced into the solution in increments of one animal unit (U.B.T.) up to the point where the introduction of additional goat/cattle units forced a sharp decline in the total value of output. The results of this exercise are illustrated in Figure 17. Each unit of the goat/cattle activity is assumed to contain equal proportions of U.B.T. equivalents of goats and cattle, or 2.5 goats combined with 0.6 head of cattle. Thus, with each increase of one unit of the goat/cattle activity, an additional 0.6 head of cattle are forced into the solution.

The analysis suggests that the value of output is maximized at a level of the goat/cattle activity which is close to 8 U.B.T., or five head of cattle. Furthermore, as other activities are allowed to adjust to optimal levels, the value of output is relatively insensitive to variations in the level of the goat/cattle activity between 7 and 11 U.B.T., which corresponds to four to seven head of cattle. This range and the optimal plans within it coincide with the range of enterprise sizes and combinations actually managed by Tuareg households of comparable size. The value of output declines abruptly when the goat/cattle activity is forced to levels outside of this range.

Based on Figure 17, the effects of the introduction of cattle into the herds of large Bush Tuareg households can be separated into four stages. The first stage is marked by a cattle herd of less than two head and a com-

FIGURE 17: Effect of Expanding Goat/Cattle Herds on Land Use and Total Value of Output for Large Bush Tuareg Households



plementary optimal plan consisting of millet, goats, and medium-yield sorghum. The second stage is associated with a cattle herd of between two and four head, or 3 to 7 U.B.T. of the goat/cattle activity. Within this range, as the cattle herd is increased, the millet activity is forced out of the solution, and the optimal size of the goat herd diminishes.

The third stage is associated with a cattle herd of between four and seven head (7 to 10 U.B.T.). In this range, as indicated above, the maximum value of output is attained, and the maximand is relatively insensitive to changes in herd composition. As the size of the cattle herd is increased within this range, the optimal size of the goat herd remains relatively stable, but labor constraints during the early harvest period force the substitution of the less labor-intensive sorghum technology for the medium-yield technology. This switch to the less labor-intensive grain technology would assist in explaining why some surveys indicate that cattle-producing households achieve lower per-hectare grain yields than similar households not producing cattle. Finally, in the fourth stage, as the size of the cattle herd increases beyond seven head, the total value of output and the size of all grain enterprises declines abruptly.

As cattle are introduced in the first two stages of the above sequence, agricultural output is limited by labor scarcity in late October. However, in the third stage, as the size of the cattle herd is increased beyond five head, the scarcity of labor in late September becomes a more important restriction on the expansion of agricultural output than the late October labor constraint. As explained in the previous section, this is because the larger cattle herds require more care at the beginning of the grain harvest, when they must be kept away from the ripened grain which is still standing in the fields. This suggests that efforts to expand cattle production among large Bush Tuareg households should be accompanied by some means of alleviating the September labor constraint.

This section has concentrated on using the model to derive the optimal enterprise mix associated with each stage of expansion of the livestock herd. The analysis has focused on Bush Tuareg households of either average or above average size. The results suggest that the average Bush Tuareg household is limited to a livestock herd consisting of no more than twenty head of goats. The results also suggest that even the largest Bush Tuareg households are limited to a herd of thirty goats and, at most, seven head of cattle. As

herds are expanded beyond these optimal levels, labor constraints force a sharp reduction in the total value of output and in total grain production. This indicates that animal distribution programs alone are unlikely to be effective in increasing cattle production on Bush Tuareg mixed farms.

The simulation shows that if the opportunity to produce livestock were eliminated, the value-maximizing model household would select an average-yield (850 kg /ha ) sorghum enterprise. As goats and then cattle are forced into the solution, the model household shifts to less productive grain enterprises such as millet (46 kg /ha ) and the less labor-intensive sorghum enterprise (300 kg /ha ). The net value of total output initially rises, and total grain production initially declines. As herds are expanded beyond the levels stated above, however, and the size of grain enterprises is allowed to adjust to optimal levels, both the value of total output and total grain production decrease rapidly.

Since similar sample households are now producing at or near the optimal levels of the livestock enterprises indicated by the parametric analysis, it then becomes relevant to identify the binding labor constraints and suggest means of alleviating those constraints. In the case of the average Bush Tuareg household, labor availability becomes a binding constraint to the expansion of agricultural enterprises in late October at the time of the grain harvest. This constraint also effectively prevents the household of average size from engaging in cattle production, given the following set of preferences: 1) the desire to produce enough grain to fulfill the household's subsistence needs; 2) the desire to diversify grain production to avoid the risk of crop failure in years of abnormal rainfall; and 3) the desire to acquire and maintain a herd of at least twenty goats before engaging in the more risky cattle enterprise.

Although the larger households in the sample were able to meet the above requirements and still engage in cattle production, labor constraints for the large model households still restricted optimal enterprise size and combination to no more than thirty goats and seven head of cattle. At near-optimal herd sizes, the analysis indicated that labor constraints for such households are binding in early July and late September. The former constraint occurs during the peak period of weeding activity in the sorghum fields. The latter comes during the pre-harvest period following the completion of weeding when animals must be kept away from the ripening grain.

Policy initiatives which may assist in alleviating the constraints identified above will be discussed later in the chapter. Prior to that, however, the following section uses the model to examine a different approach to the problem of increasing cattle production among Bush Tuareg mixed farmers.

Simulated Effect of Decreasing Grain Prices. -- This section uses the model to simulate the effects of marketing interventions on optimal enterprise size and combination. The interventions in question are those which would lower grain prices at the local market, thus raising the relative profitability of livestock production. To conduct the simulation, the grain prices used to calculate the value coefficients of millet and sorghum enterprises were lowered by as much as 50 percent of their original levels while holding all other parameters constant.

As in the previous section, the analysis is restricted to Bush Tuareg households of average or above average size. Once again, the primary reason for this choice is that when compared to other sample households, these households appear to have the greatest potential for entering into or increasing cattle production in the near future. More importantly, from among the three production systems surveyed, Bush Tuareg households are probably the most representative of the majority of crop and livestock-producing households in Niger's southern pastoral zone.

To conduct the sensitivity analysis of grain prices, prices were reduced in 5 F/kg increments from the average retail prices for grain used in the previous section (68 F/kg for millet and 61 F/kg for sorghum). Solutions to the value-maximization problem were obtained after each incremental change in the coefficients as a result of the changes in grain prices. The results of such an analysis as applied to the average Bush Tuareg model household are shown in Table 9.

The analysis indicates that solutions to the value-maximization problem are initially quite sensitive to changes in the coefficients. The optimal size of the goat herd increases from eight head (1.66 U.B.T.) to approximately twenty-five head (5.07 U.B.T.) after a decrease in grain prices of only 7 percent (5 F/kg). A decrease in grain prices of 15 F/kg, or approximately one-fourth of the original price, further increases the optimal size of the goat herd to thirty-three head (6.58 U.B.T.).

TABLE 9

EFFECT OF DECREASING GRAIN PRICES ON LAND USE, GOAT HERD SIZE,  
AND THE NET VALUE OF OUTPUT FOR THE AVERAGE BUSH TUAREG HOUSEHOLD

Change in Grain Prices (CFA F/kg )	Crops (in Ha )		Goats <sup>a</sup> (UBT)	Net Value of Output (CFA F)
	Millet	Sorghum (average yield)		
0		2.31	1.66	140,034.
- 5	3.21	1.28	5.07	132,567.
- 10	3.21	1.28	5.07	126,397.
- 15	.58	1.00	6.58	121,510.
- 20	.58	1.00	6.58	117,142.
- 25	.58	1.00	6.58	112,774.
- 30	.58	1.00	6.58	108,406.

<sup>a</sup>The combined goat/cattle enterprise was eliminated from the model for the purposes of this analysis.

Presumably, such a decrease in grain prices would raise the optimal size of the goat herd to the point where the average household could reasonably consider the introduction of the cattle enterprise, knowing that they could rely on their larger goat herd to offset the risks entailed in the new enterprise. In other words, the decrease in grain prices would make it profitable to acquire a goat herd sufficiently large for the household to consider expanding into cattle production. Furthermore, if the drop in prices would induce the household to rely on the local market as a source of subsistence grain, then the subsistence constraint on grain production would no longer be relevant. The final result would be that the average household could engage in cattle production without fear of the risks involved in that enterprise nor of the risk of falling short of subsistence needs in grain as long as the market provided high-quality grain at the reduced prices indicated.

The results of a similar analysis as applied to the larger Bush Tuareg households are listed in Table 10. The results obtained are comparable to those discussed above for the average household. With a 7 percent decrease in grain prices, the optimal herd size and composition changes from thirty-two goats and four or five head of cattle to thirty-four goats and six head of cattle. A further drop in grain prices down to 85 percent of the original level would cause a shift in the herd composition towards cattle so that the optimal herd becomes one of twenty-eight goats and seven head of cattle. This solution remains fairly stable throughout the further reductions in grain prices indicated in Table 10. The stability of the solution in this range may be deceptive, however, since the model does not allow for complete specialization in livestock. Were such an alternative to be included in the model, it is conceivable that the optimal size of the cattle herd would continue to increase as grain prices are reduced by amounts greater than 10 CFA F/kg below original levels.

Despite the shift towards livestock production induced by the fall in grain prices, the above analyses suggest that at least for small changes, more land would be put into grain production as grain prices decline. This is a result of the shift to more land-extensive grain production technologies as the size of livestock enterprises increases. A similar shift was noted in the analysis described in the previous section.

TABLE 10

## EFFECT OF DECREASING GRAIN PRICES ON LAND USE, HERD SIZE, AND THE NET VALUE OF OUTPUT FOR THE LARGE BUSH TUAREG HOUSEHOLD

Change in Grain Prices (CFA F/kg.)	Sorghum <sup>a</sup> (Ha.)			Livestock (UBT)		Net Value of Output (CFA F)
	Low Yield	Average Yield	High Yield	Goat Enterprise	Combined Goat/Cattle	
0		2.82		2.67	7.33	299,696.
- 5	2.61	1.45		2.15	9.14	289,106.
- 10	3.45	1.00			11.16	279,090.
- 15	3.45	1.00			11.16	269,679.
- 20	3.45	1.00			11.16	260,268.
- 25	3.67	.52	.17		11.50	251,226.
- 30	3.69		.25		12.18	243,010.

<sup>a</sup>Millet did not enter into the optimal solution.



Simulated Effect of Increasing Milk Output. -- The following analysis simulates the effect of technological innovations which would increase the milk yield obtained from the two livestock enterprises while all other parameters (including grain prices) in the model are held constant at their original levels. Since the estimates of the value of output from the two livestock enterprises derived above indicate that more than half of the net value of output is obtained from milk production, technological innovations aimed at increasing milk yields should have a greater impact on increasing the relative profitability of livestock enterprises than would marketing interventions aimed at increasing animal prices. For this reason, the present analysis concentrates on the effect of increases in milk yields.

The average milk yields for goat and combined cattle and goat enterprises were 124 liters per U.B.T. for the former and 189 liters per U.B.T. for the latter. In conducting the parametric analysis, it was assumed that since observed milk yields from the combined livestock enterprise were 50 percent greater than yields from the goat herd alone, then the appropriate rate of increase of milk yields for the combined enterprise would also be 50 percent greater than the rate of increase for the goat herd. This is predicated on the assumption that yield-increasing technological innovations would have a greater impact on cattle than on goats.

Accordingly, the parametric analysis was conducted by forcing incremental increases in the value coefficients commensurate with increases in the goat milk yield of ten liters per U.B.T. per year and increases in the combined cattle and goat milk yield of fifteen liters per U.B.T. per year. In either case, the incremental increase corresponds to a rise in milk yields of 8 percent above original levels. Yields were made to increase in this fashion up to the point where the physical yield of milk from each enterprise was 50 percent greater than the initial yield.

In value terms, each incremental increase in yields corresponded to an increase in the value coefficient ( $c_1$ ) of the goat enterprise of 500 F/U.B.T. and that of the combined enterprise of 750 F/U.B.T.<sup>1</sup> Therefore,

---

<sup>1</sup>Market surveys revealed that the prevailing price of milk during the survey year was 50 CFA F/liter.

the initial incremental increase in milk yields produced a 4 percent increase in the value coefficient for the goat enterprise and a 5 percent increase in the coefficient for the combined enterprise. At the maximum level of change associated with this analysis (an increase in yields corresponding to 50 percent of the initial yield), the value coefficients were increased to 24 percent and 27 percent over the initial levels for the goat and the combined cattle and goat enterprises, respectively.

The option of producing cattle was eliminated for the average Bush Tuareg model household, as it was for the previous analysis of grain prices. Therefore, for such households, the analysis was restricted to determining the change which would be required before the optimal size of the goat herd would increase to a level at which cattle could be introduced without undue risk. Once again, it was assumed that, as stated by the sample members themselves, cattle would not be introduced until the household had acquired a herd of at least twenty goats.

The results of such an analysis as applied to the average Bush Tuareg household are shown in Table 11. The results indicate that an increase in the milk yield of goats of twenty liters per U.B.T., or 16 percent, would raise the optimal size of the goat herd from eight to twenty-five head. Presumably, the increase would raise the relative profitability of livestock enterprises to the point where the household could comfortably introduce cattle. The solution remains stable as milk yields are increased further, and the only additional change in the optimal enterprise mix occurs when yields are increased to 1.5 times current levels.

When the same type of analysis was applied to the large Bush Tuareg model household with the goat/cattle enterprise in the objective function, the model generated the results given in Table 12. When compared with Table 11, the table shows that a 24 percent increase in milk yields would have the same effect as a 15 percent decrease in grain prices. Either change by itself would change the optimal size and composition of the herd from thirty-two goats and four to five head of cattle to twenty-eight goats and seven head of cattle. The same problem mentioned in the discussion of the previous analysis would be applicable to increases in milk yields beyond the level mentioned above, i.e., the model does not allow for

TABLE 11

EFFECT OF INCREASING MILK YIELDS ON LAND USE,  
GOAT HERD SIZE, AND THE NET VALUE OF OUTPUT  
FOR THE AVERAGE BUSH TUAREG HOUSEHOLD

Change in Milk Yield (l./UBT)	Crops (Ha )		Goats (UBT)	Net Value of Output (CFA F)
	Millet	Sorghum (average yield)		
0		2.31	1.66	140,034.
+ 10	2.39	1.70	3.60	141,588.
+ 20	3.21	1.28	5.07	143,802.
+ 30	3.21	1.28	5.07	146,336.
+ 40	3.21	1.28	5.07	148,869.
+ 50	3.21	1.28	5.07	151,402.
+ 60	.57	1.00	6.58	154,365.

TABLE 12

EFFECT OF INCREASING MILK YIELDS ON LAND USE, HERD SIZE,  
AND THE NET VALUE OF OUTPUT FOR THE LARGE BUSH TUAREG HOUSEHOLD

Change in Milk Yield (l./UBT)		Crops (Ha )		Livestock (UBT)		Net Value of Output (CFA F)
Goat Enterprise	Combined Goat/Cattle Enterprise	Sorghum (low yield)	Sorghum (average yield)	Goat Enterprise	Combined Goat/Cattle	
0	0		2.82	2.67	7.33	299,696.
+ 10	+ 15	2.61	1.45	2.15	9.14	307,097
+ 20	+ 30	2.61	1.45	2.15	9.14	315,025.
+ 30	+ 45	3.45	1.00		11.16	323,024.
+ 40	+ 60	3.45	1.00		11.16	331,394.
+ 50	+ 75	3.45	1.00		11.16	339,765.
+ 60	+ 90	3.45	1.00		11.16	348,136.

a ratio of goats to cattle in the household herd of less than 4:1.

The initial increases in milk yields bring about the same effect on land use as did the initial decreases in grain prices. For the large Bush Tuareg household, the optimal area planted to grain increases along with the optimal size of the household herd as milk yields are increased by less than 24 percent of the original yields, or as grain prices are decreased by less than 15 percent of the initial prices. Similarly, for the average Bush Tuareg household, the optimal area planted to grain increases along with the optimal size of the goat herd as milk yields are increased by less than 50 percent of the original yields, or as grain prices are decreased by less than 25 percent of the initial prices. This suggests that either of the two policy initiatives could be combined with innovations aimed at alleviating binding labor constraints to avoid forcing a shift to less labor-intensive grain production technologies as livestock enterprises expand.

Basically, the effect of the two policy initiatives on labor constraints is to accentuate the importance of binding labor constraints just prior to and during the grain harvest. For instance, for the large Bush Tuareg household, the shadow price of labor in late September increases from 345 to 387 CFA F per hour as grain prices are cut in half and livestock enterprises are expanded and from 345 to 478 CFA F per hour as milk yields are increased by 50 percent. Late September is consistently the period when the shadow price of labor is highest and is increasing most rapidly as grain prices fall or as milk yields rise, thereby prompting an increase in the optimal size of livestock enterprises.

Similarly, for the average Bush Tuareg household not producing cattle, late October remains the period when the shadow price of labor is highest. As a rise in milk yields of up to 50 percent increases the optimal size of the goat herd, the shadow price of labor in late October increases from 399 to 445 CFA F per hour. As grain prices fall to half of their previous level and the optimal size of the goat herd increases, the shadow price of labor in that period is still the highest, although it decreases from 399 to 196 CFA F per hour. These two sets of results suggest that when combined with either of the policy initiatives examined in this section, complementary initiatives aimed at relieving labor constraints will have the greatest impact on increasing optimal herd size if they are designed to

ease constraints occurring just before or during the grain harvest (i.e., during September and October). Methods of relaxing the constraints occurring during this period will be examined in the remainder of this paper.

#### Summary of Major Results

This section contrasts national development objectives with the objectives of the individual mixed farmer living in the pastoral zone, as reflected in the analysis. While the national objective may be to increase the production of cattle for export, residents of the southern pastoral zone subsist on grain, not cattle, and are reluctant to reallocate resources away from grain production. The social costs associated with continued grain production in the pastoral zone are contrasted in the following discussion with the desirability of grain and goat, but not cattle, production for the individual farmer.

Social Costs Associated with Current Production Patterns in the Pastoral Zone.-- Proponents of the stratification strategy feel that specialization in cattle production by residents of the pastoral zone is in the national interest and that the present allocation of land and labor resources to grain production in that area is inefficient. If this is indeed the case, then there must be some way to reallocate land and labor to cattle production in such a way that the welfare of some individuals can be improved either without adversely affecting anyone else, or by being able fully to compensate damaged parties and still have a net benefit to others. The national planners who advocate specialization believe that the revenues, and in particular the foreign exchange earnings to be gained from the sale of cattle to coastal countries, would provide the additional benefits to be expected from a more efficient resource allocation. The problem, as illustrated below, is that the individual mixed farmer does not perceive the same benefits to be gained from specialization in cattle production as those envisioned by the national planners.

Aside from the alleged opportunity cost associated with inefficient resource allocation in the form of continued grain production in the pastoral zone, there is an additional social cost associated with current production patterns which does not enter into the calculations of the individual producer. The cost in question is the reduction in value of the land resource caused by overexploitation by both crop and livestock

producers. The history of land use in the southern pastoral zone illustrates the causes of the gradual deterioration of the resource base which has occurred during this century and which was accelerated by the period of drought which began in 1968. The first in this sequence of events is the subjugation of the Tuareg warlords by French colonial forces at the beginning of this century and the dissolution of the feudal system of land tenure which they enforced. The period following the pacification of the pastoral zone was one of abnormally high rainfall. The abundant rains, combined with the pacification of the Tuareg and the resultant availability of new land for cultivation, prompted a northward migration of Haussa grain producers during the two decades following the second World War.

Around the same time as the Haussa migration northwards, mechanized deep-bore water pumping stations were opened throughout the pastoral zone. The opening of the pumping stations attracted a larger number of Fulani herds than the area had supported previously. These herds also grew more rapidly as widespread cattle vaccination programs eliminated certain endemic diseases.

The influx of Haussa grain producers and Fulani cattle herders contributed to the devastating effects of the recent drought on the land resources of the pastoral zone. However, the pressure of increased population and the conflicting demands of the various production systems has not been relieved since the drought began. Rather than terminate grain production entirely and leave the area, Haussa grain producers and dispossessed Tuareg herders (Village Tuareg) have congregated in the market towns and have turned increasingly to commerce as the main source of household income. This tendency has been furthered in recent years by the growth in the importance of Kao and similar villages in the southern pastoral zone as the major livestock and commodity markets which service the pastoral zone have shifted north. This northward movement of the major livestock markets provided an alternative source of income for those village-dwellers who could no longer rely on their own grain production as a source of food. However, such households have continued to produce grain, often with the assistance of hired labor, since they have little to lose

by doing so, their subsistence being assured by their income from trade. They can hire laborers to plant large areas of land, but avoid further costs merely by abandoning the field if the crop does not come up well. The system of land tenure may encourage such practices, as will be explained below.

Prior to subjugation of the Tuareg by colonial forces, the pastoral zone was, as its name belies, a region specialized in livestock production. Its success in this role was dependent on a system for controlling access to rangeland which was enforced by the Tuareg warlords. Most importantly, prior to this century, the southern portion of the pastoral zone -- including the area covered by the survey -- was set aside as a dry season grazing reserve. Animals were evacuated from the area during the rainy season, when they could take advantage of northern pastures. This system of seasonal migration allowed the pastures of the southern pastoral zone to develop during the rainy season so that livestock producers could rely on them as a source of forage once the rains stopped and pastures in the north had been exhausted.

However, with the expansion of grain cultivation and the influx of Fulani herds from the south, this system of seasonal migration, which allowed the pastures of the southern pastoral zone to develop during the rainy season, was abandoned. Obviously, few would benefit from a reinstatement of the Tuareg feudal system of land management. But in order to prevent further deterioration of the land resource and allow the pastoral zone to develop its potential as a breeding zone for livestock, some system of land management which encourages the protection of dry season grazing reserves must be introduced.

The challenge, therefore, is to find a system of land management which is enforceable and which limits, but does not preclude, grain cultivation, an activity which residents of the southern pastoral zone seem hesitant to abandon. Banning grain cultivation outright is not the solution. The 1961 law which defines the pastoral zone and which prohibits grain cultivation within it has never been effectively enforced. Part of the reason why it has not been effective is simply because it is contrary to the self-interest of the individual producer, as explained in the following section.



The Individual Farmer's Reluctance to Abandon Grain Cultivation and Specialize in Cattle Production.-- Despite the apparent national interest in promoting specialization in cattle production within the pastoral zone, the individual mixed farmers who inhabit the southern portion of that zone continue to allocate labor and land resources to grain and goat production rather than cattle. There are several reasons underlying this choice of activities. In the first place, over half of the mixed farm household's food needs, in terms of energy intake, are derived from grain consumption, whereas the consumption of livestock products contributes no more than percent of energy requirements. The only alternative to household production as a source of grain is the market, but residents of the pastoral zone have had unfortunate experiences with this means of obtaining grain. In particular, the fluctuations in the price and supply of grain on the market during the recent drought accentuated the hazards of relying on the market to provide such an important component of the household diet. Furthermore, increases in the price of fuel have raised transportation costs, which are passed on to the consumer in the form of higher prices for grain shipped to the pastoral zone from the agricultural zone to the south. Also, much of the grain which is offered for sale in the markets of the pastoral zone is of lower quality than that produced locally and stored in local granaries.

The linear programming analysis indicated that for Bush Tuareg households, increases in herd size beyond current levels would force a decrease in grain output. If the objective of development policy is to promote livestock production while confining the area planted to grain and conserving the quality of the land resource, confidence in the grain market must be developed. Policy recommendations along these lines are discussed in the following section.

Another reason why individual mixed farmers are hesitant to specialize in cattle production is the comparative advantage of the goat as a less risky source of food and cash income. There are several reasons why sample households -- and Tuareg sample households in particular -- preferred goats over other animal types. Goats are more resistant to the severe climate and particularly to drought conditions. They can browse trees and exploit

sources of feed otherwise unacceptable to cattle, and their water requirements per standard animal unit are lower than the water requirements of cattle. They also offer several advantages for the herd manager in that they have less of a tendency to stray and require less attention than cattle. A young boy can handle a goat herd, but older males are more often required to manage cattle. The goat herd also is more manageable in that individual units within it are smaller and of lower value. Less initial investment is required than in the case of the cattle herd, and less risk is associated with the individual animal. Furthermore, goats can be sold to meet immediate cash needs, whereas the sale of cattle requires a larger disinvestment and more advance planning. For these reasons, it was found that mixed farmers were hesitant to diversify their livestock holdings by acquiring cattle until they had built up a herd of at least twenty goats.

Finally, the linear programming analysis indicated that Tuareg mixed farms desiring to expand their cattle herds faced labor constraints at the beginning and end of the growing season. In the simulation, as cattle herds increased in response to policy initiatives which raised the profitability of livestock enterprises relative to grain, the labor constraint just prior to the harvest in late September increased in importance. This is of particular significance, since rainfall during this period was less atypical during the survey year than in either of the other two periods (early July and late October) when labor availability restricted agricultural output.

The unusual rainfall patterns in early July and late October suggest that constraints which occurred at those times might not be as critical in years in which the rainfall distribution is closer to the average. In 1976, a thirty-day drought struck the survey area from late June to late July, in the midst of the growing season. The need to replant fields at the end of this period may have imposed a labor requirement which might not be present in years in which such a drought did not occur. Also, in 1976, rainfall in October was well above average, and as a result, the sorghum harvest was prolonged.

The unusually heavy rainfall at the end of the growing season may have distorted the labor requirements normally associated with harvesting.

However, there is no indication that activities were abnormally affected by rainfall in September 1976. The constraint which arose at that time came from the need to guard cattle to keep them away from the ripening grain while simultaneously guarding the grain fields to keep others' animals away from them. This suggests that the September labor constraint is not only the most important in terms of the increasing opportunity cost of labor as cattle herds expand, but also that it is the most likely to persist under different rainfall conditions. The need to guard the animals as well as the grain fields just prior to the harvest will always be a problem. The following section presents some attempts to resolve that problem as well as others raised by the results of the formal analysis.

#### Policy Recommendations

The previous section has illustrated the extent of the disparity between national and individual objectives. The present section discusses a set of policy recommendations which might reconcile the two viewpoints. These policy recommendations are aimed at increasing cattle production by mixed farmers in the pastoral zone while restricting the area planted to grain and preserving the quality of the land resource. The analysis thus far has indicated that policies aimed at increasing the relative profitability of cattle production will not of themselves be sufficient to divert land and labor resources away from grain and into cattle production. Such policies must be accompanied by complementary initiatives. Structural changes are required in addition to simple marginal changes in technologies and prices. One such initiative proposed below is the attribution of seasonal property rights to livestock producers, which could relieve the September labor constraint, preserve the quality of the land resource, and to some extent internalize the social costs associated with the overexploitation of land. Associated land tenure reforms which would discourage those who have alternative sources of income from continuing the expansion of grain production would be another complementary initiative.

The introduction of labor-augmenting changes in grain production technology would enable labor resources to be reallocated from grain to cattle production without decreasing grain output or increasing the area planted to grain. However, this approach does not respond to the problem of protecting the land resource. A more appropriate strategy, which would respond more directly to the concerns of the individual producer, would be the development of the market as an alternative to household grain production. Along the same lines, development projects aimed at goat production might enable the relatively impoverished producer to expand into cattle production more rapidly. Specifically, increases in the milk yields of goats might decrease the size of the subsistence herd required to assure a steady milk supply prior to diversification into cattle. These alternatives are explored in the following discussion.

Increasing the Relative Profitability of Cattle Production.-- The linear programming analysis has indicated that the production of grain is currently a rational choice of activities for the profit-maximizing producer. The actual choice of grain and livestock production activities by Tuareg mixed farmers is now close to optimal levels indicated by the model. One approach to altering this choice of activities and bringing it more in line with the national objectives outlined above would be to increase the relative profitability of cattle production.

Three policy options which would embody this approach were examined in the formal analysis. The first consisted of grants of animals to mixed farmers. Such programs have been underway for the past several years, but their outreach has been limited to Fulani herders currently specializing in cattle production. Using the techniques of parametric programming, the analysis indicated that if such programs were to include mixed farmers, they would have relatively little impact on cattle production unless accompanied by programs aimed at relieving the

labor and subsistence constraints embodied in the model. Without such complementary programs, increasing the size of herds held by Tuareg mixed farmers beyond current levels would force a shift to more land-extensive grain production technologies and a commensurate decline in the net value of agricultural output. Such a shift would hardly be desirable. Also, as the analysis indicated, the shift to more land-extensive technologies would involve allocating more land to grain production in order to fulfill the household's subsistence needs.

Two policy alternatives which might shift the economic advantage to livestock production were selected for analysis. The first was to lower the relative price of grain, and the second was to increase milk yields. The two initiatives suffered similar fates in the simulation. The expansion of the herds as a result of the increase in the relative profitability of livestock production was accompanied by an increase in the area planted to grain caused by a shift to less productive grain technologies. The shift to less productive grain technologies as the cattle herd expanded was made necessary by the increase in the importance of the September labor constraint. The following policy approaches are designed to address this problem.

The Extension of Seasonal Enforcement of Property Rights to Livestock Producers.-- Currently, the only legally-enforceable private interest in land recognized in the survey area is the right of the grain producer to cultivate his fields without interference from trespassing herds. If trespass by animals results in actual damage to the crop, no matter how slight, a cause of action arises, and the grain producer may bring his claim before a local tribunal headed by the local Haussa village chief. Judgements are enforced by armed nomad guards. The decisions of the tribunal rarely favor the trespassing herder.

On the other hand, no comparable protection is offered to those who wish to develop the land for purposes of livestock production by improving the pasture or cultivating forage crops. The ultimate effect of this policy is to provide an incentive for the grain producer to expand the area he has planted to grain, since this is the only effective way to gain a private interest in the land. No similar incentive exists for the livestock

producer. There is no means by which the livestock producer can set aside a plot of land as a dry season grazing reserve and enforce his rights when this plot is encroached upon.

If the legal protection currently extended to grain crops during the rainy season were to be extended to producers of forage crops or other inputs to livestock production, the sometimes conflicting demands of grain and livestock production might be resolved. Furthermore, the expansion of the private property rights of livestock producers might stimulate livestock producers to make improvements in the land which would preserve its quality and prevent further desertification. This does not necessarily imply a shift away from the priority goal of supplying sufficient grain for the population if grain production technologies which yield higher returns to land can be implemented.

The following is an example of how such a system might function. An individual livestock-producing household, or a cooperative, would agree to make certain improvements on the land, such as the production of forage. A land management bureau established at the regional level of the Livestock Service could maintain agents at the village level who would distribute grass seeds, provide extension services, and settle disputes over damage done to the forage crop. Such a program would not only preserve, but improve the quality of the land. The extension of private property rights to such individuals or cooperatives would also be consistent with the tenets of Islamic law, as long as some improvements on the land are made.

The household could mark its allotted land by a thorn-brush fence, and the right to an action for damages would arise whenever this fence is breached and the encroaching animals consume the forage which is developing on the plot. In addition to the agreement to make improvements, the only condition which would need to be imposed upon the individual claiming the property interest would be that he not allow his own animals to consume the developing grasses until the latter part of the rainy season. This would ensure that the grasses be allowed to develop and avoid the problems involved in allocating the damages between the owner's animals and those which committed the trespass. Furthermore, the suit for damages could only be brought if the trespassory act occurred during the rainy season when the grasses were developing, up to the time when the owner decided to let his own animals graze on the plot.

Outside of the rainy season, no individual property interest would be recognized and, just as in the case of the grain fields, the land would revert to public rangeland.

This scheme, if effective, might provide an incentive for protecting grasses during the rainy season. The point in protecting the grass cover during the rainy season is to allow it to develop. The rainy season is the time when such protection is most needed, since this is the time when plant growth takes place and when a healthy grass cover can prevent soil erosion. Also, if the grasses are not consumed as they grow, a larger crop of grass seeds would result, and the quality of the range in the following year would be improved.

Such legal protection combined with an appropriate extension program might result in benefits for the producers as well, if it encourages Tuareg mixed farmers to produce forage or to set aside reserves during the rainy season. The linear programming analysis indicated that, as the cattle herd expands, most of the available September labor must be devoted to guarding the animals to prevent them from encroaching on the grain fields and consuming the ripening grain. If the attribution of property rights to livestock producers does stimulate the setting aside of pasture reserves, the labor requirements of livestock enterprises during the critical September period might be reduced by confining the animals to the plot which had been set aside during the rainy season. This would alleviate the September labor constraint, if little additional work is required to confine the animals to the plot.

Another desirable aspect of this alternative is that it provides a system of land management based on existing institutions. There would be no reduction in the rights of grain producers to bring an action to recover damages caused by trespassing herds, although a strong argument can be made for revising the procedure by which such rights are enforced. This approach involves only the extension to livestock producers of rights to bring a similar action. Possibly, the involvement of a Livestock Service agent in the dispute settlement procedure might promote more equitable solutions. In any case, it is apparent that some procedural reform is required at the village level for the approach to be effective.

Several problems must be overcome, in addition to procedural reform, before such an approach can accomplish the goals of resolving property dis-

putes or protecting the environment. The primary problem is that currently there is no system for recording interests in real property. Since the forage plot requires less in the way of obvious improvements than a plot planted to grain, disputes may frequently arise concerning ownership of the interest in a given forage plot. This problem can be resolved partially by stipulating that the interest can only be claimed upon the erection of obvious improvements, such as a thorn-brush fence and the performance of acts indicating an intent to exclude all animals from the plot. Furthermore, the term of the interest should be for only one rainy season, renewable in subsequent years by the maintenance of the fence, improvement of the grass cover and acts indicating the intent to exclude animals.

The second problem is that transit corridors must be maintained for herds moving through the area to northern pastures. This could be accomplished by limiting the areas in which forage plots could be claimed. Again, the lack of a system for recording property interests poses a problem. It may be necessary to have a tribunal at the regional level to apportion lands to each group and to settle disputes over conflicting claims. This would add an unrealistically heavy judicial and administrative burden. A more realistic alternative would be to limit either the allowable compensation for damages or the amount of land which could be claimed for forage crops. This would discourage producers from claiming too large a plot and thus cutting into the land which would otherwise be available for transit corridors. The latter alternative would lend itself more readily to self-administration.

The intention of the scheme is to provide a means of protecting the grass cover during the rainy season and of resolving the conflicting demands of grain and livestock production. The recognition of a limited property interest akin to the interest of the grain cultivator in his land during the rainy season might accomplish these objectives. However, additional information on technical coefficients is required before the feasibility of forage production can be confirmed.

Associated Land Tenure Reforms. -- A problem related to the above is that current property laws in Niger, as they were explained to this author by a local government official, recognize a more permanent interest in land than that mentioned above once a household has planted a given plot



to grain for three consecutive years. The ability to acquire more permanent rights to the land merely by continuing to plant grain is an additional incentive to village-dwellers to continue grain cultivation, even though they have an alternative source of income from trade which makes the cultivation of grain for subsistence unnecessary. These rights must be renewed each growing season by planting, but there is no requirement that the owner continue to cultivate the entire field through to harvest in order to maintain his rights to the entire parcel. Furthermore, the planting requirement may be fulfilled by hiring laborers to plant and weed for the first few months of the season, thus avoiding the need to allocate household labor to these tasks. Then, once the plants have sprouted, the farmer can abandon the field altogether while maintaining his permanent interest in it and his right to sue for damages if trespassing herds encroach upon it.

Alternatively, once a more permanent interest is acquired, the farmer can lease his land to households which are unable otherwise to obtain land, and have his tenants plant and cultivate his parcel. The farmer may demand additional services from the tenant's household, such as assistance with domestic chores or labor on other fields owned by the lessor. The produce from the plot thus loaned is normally the property of the tenant, but the system allows the landlord to maintain his more permanent interest in the property while obtaining additional labor services as a form of rent.

It is obvious from the above description that such practices are in need of reform. The incentive to put land into grain production, even without the intention of bringing the crop to fruition, must be eliminated. While the ability to acquire a permanent interest in land through continued cultivation may provide a necessary and useful incentive for grain producers in the agricultural zone to the south, it is clearly a detrimental policy in the pastoral zone.

Labor-Augmenting Change in Grain Production Technology. -- An alternative approach to relieving the September labor constraint and avoiding the necessity of shifting to less productive grain technologies as cattle herds expand would be to introduce changes in grain production technologies which would increase labor productivity. A simple example of such

technological change would be the introduction of grain varieties which mature more rapidly. This would shorten the waiting period between the August weeding and the October harvests, when fields must be guarded to prevent animals from destroying the crop. The decrease in the labor requirement would enable mixed farmers to complete the harvest earlier, thereby leaving them more time to devote to livestock production. Possibly, the reduction in labor requirements during the harvest season would also prevent having to shift to more land-extensive technologies once the cattle herd expands.

The result of such an effort, however, would be at best to hold constant the area planted to grain by eliminating the need to increase the area planted in order to meet the household's subsistence needs as cattle herds are expanded. On the other hand, such technological changes may even result in an increase in the area planted to grain due to the increase in the relative profitability of grain enterprises. Given the development objectives of encouraging cattle production while restricting grain production, the development of substitutes for household grain production may be a preferable approach.

Developing the Market as an Alternative to Household Grain Production.--

The linear programming analysis indicated that Tuareg mixed farmers are constrained from expanding their cattle herds by the desire to produce enough grain to meet subsistence requirements. Although in some cases, profit-maximizing behavior alone would dictate an increase in the cattle herd and the use of the increased income from the larger herd to purchase grain for the household, Tuareg households refrained from doing so due to a lack of confidence in the market, particularly as a source of supply for such an important component of the household diet. It is therefore necessary to build confidence in the market as a source of grain before the development objectives listed above can be attained.

An assured supply of cheaper, high-quality grain to the local market could create greater confidence in the market as a source of grain and thereby increase the relative attractiveness of livestock enterprises. To achieve such confidence, the grain appearing on the market would have to be of comparable quality to the grain produced by the households

themselves and would have to be slightly cheaper and more consistently available than was the case during the survey year. This effectively precludes any effort on the part of the government grain marketing board (OPVN), unless that agency adopts a more realistic storage policy by allowing agents to get rid of rotting and infested grain rather than allowing it to contaminate new grain shipments in the warehouse. It is possible that the paved road which is scheduled to link the Azawak region with the two regional capitals at Agadez and Tahoua will help to assure more regular and less expensive grain supplies from the south.

The Development of Goat Production. -- The goat, rather than the cow, is the basic component of the Bush Tuareg livestock enterprise. The smallest and least wealthy households are likely to own one or two goats, and even the largest Bush Tuareg household strives to maintain a herd of twenty to thirty goats in addition to its cattle holdings. The fact that goats are more common to households in the northern Sahel raises the question of whether development programs for that area should not concentrate on, or at least pay some attention to, the development of goat production. Certainly, if the intention of a development program is to have some immediate impact on the well-being of the least wealthy households, a cattle production project is not in order. Rather, one would anticipate that a project aimed at increasing and prolonging the milk yields of traditionally-managed goat herds would have a greater immediate benefit for a larger number of households, including the least wealthy.

Furthermore, the desire to build up a subsistence herd of at least twenty goats before diversifying into cattle production currently limits the ability of the average household to produce cattle. The subsistence herd of goats is required to assure a supply of milk for the household, since the output of milk from small cattle herds is less certain. An increase in the milk yields of goats might reduce the number of goats required for the subsistence herd, and enable households of average size to acquire and manage the small cattle herd which the linear programs-using model indicates as optimal once the goat herd constraint is eliminated.

## Conclusions

The above policy recommendations suggest ways in which the reality of the individual farmer's needs and motivations might possibly be reconciled with development objectives that are in the national interest. The recommendations stem from the basic disparity noted in the previous section of this paper. Although cattle exports are an important source of foreign exchange earnings, although social welfare in the pastoral zone may be maximized by specialization in cattle production, and although continued grain production and uncontrolled land use in that area is resulting in a steady deterioration of the quality of the land resource, extensive grain production is still in the private interest, and individual farmers continue to devote their efforts to grain crops. Few mixed farmers in the pastoral zone find themselves able or willing to specialize in cattle production, or even to increase cattle production at the expense of their grain crops. National objectives may simply be incompatible with those of the indigenous population, most of whom are only peripherally involved in cattle production.

Programs aimed at increasing the attractiveness of cattle production to mixed farmers might have some impact on increasing the number of cattle held by them in the southern pastoral zone. However, it is unlikely that marginal changes in technologies and prices alone will be effective in reducing the area planted to grain and preserving the quality of the land resource. To accomplish such objectives would require structural reforms such as reforms in property law and the development of confidence in the grain market as an alternative to household production. In addition, complementary programs to develop the productivity of goats would enable less wealthy households to reach the position where they can assume the risks associated with cattle production.

## CHAPTER 5

### THE LIVESTOCK AND MEAT MARKETING SYSTEM IN UPPER VOLTA; AN EVALUATION OF ECONOMIC EFFICIENCY

by Larry Herman

#### TABLE OF CONTENTS

	<u>Page</u>
<u>INTRODUCTION</u> . . . . .	329
<u>LIVESTOCK PRODUCTION IN UPPER VOLTA</u> . . . . .	332
Growth Rates and the Effects of the Drought . . . . .	335
Pastoralists and Extensive Stockraising . . . . .	337
Nontraditional Stockraising . . . . .	341
<u>THE LIVESTOCK AND MEAT MARKETING NETWORK</u> . . . . .	342
Evolution of Commercial Livestock Flows . . . . .	342
Regional Production and Consumption Patterns . . . . .	344
Livestock Imports and Transits . . . . .	347
Cattle Exports . . . . .	352
Livestock Market Activity . . . . .	357
Butchering and Meat Marketing . . . . .	363
Meat Exports . . . . .	366
<u>SALES BY HERDERS</u> . . . . .	370
The Sample . . . . .	370
The Composition of Marketed Livestock . . . . .	371
Seasonal Variations in Sales . . . . .	375
The Condition of Livestock . . . . .	377
Risk and Salvage Sales . . . . .	380
Herders' Cash Needs . . . . .	380
Proximity to Markets . . . . .	381
Seasonal Variations in Demand . . . . .	381
Market Conditions Faced by Herdsmen . . . . .	382
Marketing Alternatives . . . . .	385
Access to Market Information . . . . .	389
Independence of Transactions . . . . .	390
The Opening of Market Transactions . . . . .	392
<u>PRICE MODEL FOR FIRST-BUYER CATTLE SALES</u> . . . . .	393
The Model . . . . .	393
Estimated Results . . . . .	396
Age . . . . .	396
Castrated Males . . . . .	399

	<u>Page</u>
Regional Price Variation . . . . .	399
Type of Seller . . . . .	399
Seasonal Price Variation . . . . .	401
Seller Access to Information . . . . .	401
Type of Buyer . . . . .	401
Type of Market . . . . .	401
 <u>THE TRANSPORTATION SYSTEM FOR CATTLE</u> . . . . .	 402
Transportation Methods and Infrastructure . . . . .	402
Transportation Costs . . . . .	404
Domestic Trekking . . . . .	404
Trekking to Export Markets . . . . .	408
Rail Transportation . . . . .	411
 <u>LIVESTOCK MARKET STRUCTURE, CONDUCT AND PERFORMANCE</u> . . . . .	 415
Market Concentration Among Professions . . . . .	416
Information Flows . . . . .	419
The Role of Intermediaries . . . . .	420
Vertical Integration . . . . .	421
Collusive Behavior by Market Professionals . . . . .	422
Market Performance . . . . .	423
 <u>CONCLUSIONS AND POLICY RECOMMENDATIONS</u> . . . . .	 426
A Summary: The Marketing System in a Changing Environment . . . . .	 426
Policy Recommendations . . . . .	430
Livestock Market Infrastructure . . . . .	430
Reorganization of Trade . . . . .	431
Transportation . . . . .	431
Trek Routes . . . . .	431
Truck Transportation . . . . .	432
Rail Transport . . . . .	432
Meat Marketing and Abattoir Construction . . . . .	432

CHAPTER 5

LIST OF TABLES

<u>Table</u>		<u>Page</u>
1	Livestock Distribution by ORD (1969) . . . . .	334
2	Evolution of Voltaic Cattle Herds . . . . .	336
3	Effect of the Drought on Voltaic Cattle . . . . .	336
4	Distribution of Domestically Produced Meat Supply, Consumption and Surplus by ORD, 1969 (estimated). . . .	346
5	Recorded Cattle Imports into Upper Volta, 1969-1976 . . . . .	348
6	Evolution of Recorded Transit Cattle Through Upper Volta, 1953-1976 . . . . .	350
7	Evolution of Cattle Exports from Upper Volta, 1931, 1948-1958, 1960-1977. . . . .	353
8	Number of Cattle Offered for Sale Annually in Selected Voltaic Markets . . . . .	361
9	Evolution of Beef and Meat Official Slaughters, 1954-1976 . . . . .	365
10	Chilled Meat Exports: Upper Volta to Ivory Coast 1954-1976 . . . . .	367
11	Sex and Age Structure of Cattle Sold by Sample Members . . . . .	372
12	Composition of Livestock Sales by Djibo Sample Members . . . . .	374
13	Sale Conditions for Herder Sample . . . . .	386
14	Access to Price Information and Effect on Cattle Prices . . . . .	391
15	Estimated Parameters of Price Model for First Buyer Cattle Sales by Djibo, Kaya, and Pouytenga Herdsmen, 1976-1977 . . . . .	397
16	Rates of Change in Prices of Cattle for Selected Ages from Third-order Polynomial Regression . . . . .	398

<u>Table</u>	<u>Page</u>
17	Costs of Trekking Cattle Within Upper Volta . . . . . 406
18	Costs of Trekking Cattle to Foreign Markets . . . . . 409
19	Costs of Exporting Cattle by Rail, Ouagadougou - Abidjan . . . . . 412
20	Number of Active Buyers in Voltaic Cattle Markets, 1976-1977. . . . . 417
21	Concentration Ratios for Cattle Slaughterers and Exporters . . . . . 418
22	Vertical Integration and Diversification Among Market Participants . . . . . 422
23	Composition of Wholesale Prices for Cattle and Beef Delivered, Ouagadougou and Abidjan . . . . . 425

LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
1	Age Composition of Males and Females in the Herds . . . . . 340
2	Evolution and Destination of Cattle Exports from Upper Volta, 1948-1977 . . . . . 354
3	Chilled Meat Exports: Upper Volta to Ivory Coast, 1954-1976 . . . . . 368
4	Seasonal Variations: Animal Sales and Revenues Per Herder, Djibo Herder Sample, 1976-1977 . . . . . 376
5	Seasonal Variations: Market Entries and Slaughters, 1970-76 . . . . . 378
6	Theoretical Patterns of Livestock Sales . . . . . 379
7	Monthly Average Cattle Prices: Djibo Cattle Market, May 1976 - April 1977 . . . . . 383
8	Price-Age Relation for First Buyer Cattle Sales by Djibo, Kaya, and Pouytenga Herdmen, 1967-1977 . . . . 400



LIST OF MAPS

<u>Map</u>		<u>Page</u>
1	Cattle Flows in Upper Volta . . . . .	343
2	Production and Consumption of Meat, Surplus and Deficit by ORDs, 1969 . . . . .	345
3	Major Cattle Markets in Upper Volta . . . . .	360

LIST OF DIAGRAMS

<u>Diagram</u>		<u>Page</u>
1	Organization of Cattle Marketing in Upper Volta . . . . .	358

## CHAPTER 5

### THE LIVESTOCK AND MEAT MARKETING SYSTEM IN UPPER VOLTA: AN EVALUATION OF ECONOMIC EFFICIENCY

by Larry Herman

The major objective of this study is to describe and evaluate the organization, conduct, and performance of the cattle and meat marketing network in Upper Volta and to identify the major constraints to efficient market operation and expansion. The theoretical justification for undertaking the research is that efficient marketing benefits both consumers and producers and enables prices to serve their economic function of efficiently allocating resources. A competitive market model is used as a standard of evaluation because the Voltaic system currently operates as an unencumbered free market; and where competitive market conditions exist, economic efficiency is most likely to result.

The principal results of the research show that the cattle and meat marketing system is very complex and traditionally based, yet generally performs well its function of distributing livestock and meat products at reasonably low cost. There is evidence of a high degree of competition at most stages of the marketing circuit, as shown by low concentration ratios and the absence of overt collusion. Cattle flows appear responsive to changes in relative prices among alternative markets. Market information seems to be readily available to producers and marketing agents, even over long distances. The marketing circuit was not found to support an abundance of non-productive individuals, as is commonly alleged; the much maligned "intermediary" was found to provide useful services to both producers and merchants. Spatial price differentials and traders' margins are reasonably consistent with transportation and transaction costs. Major constraints to expanding or improving marketing are of a technical nature, involving mainly transportation infrastructure rather than market structure or conduct.

Producers were found to have access to market information, which they use in deciding when and where to sell their cattle. They seem to be responsive to short-term price fluctuations, taking advantage of seasonal variations in the physical condition of the animals and market conditions. Long-run herder commercial strategies are most likely to be affected by policies which reduce risk caused by drought and disease. However, evaluation of long-run behavior is complicated by the effects of the recent drought on herd size and composition and by the fact that the study was limited to evaluation of livestock marketing and not production.

## INTRODUCTION

A stated goal of livestock policy in Upper Volta and throughout the Sahel is to increase the exploitation of existing animal resources and improve the marketing efficiency of traditional livestock marketing circuits.<sup>1</sup> Simply put, the government hopes to be able to increase offtake, improve the quality of marketed livestock, decrease marketing costs, and expand the capacity of the marketing network. Comprehension of the workings of the current marketing system is critical if planners are to propose useful interventions that improve upon existing marketing structure rather than conflict with it. Failure to do so poses the risk of destroying the basic marketing structure instead of correcting its weaknesses (McLeroy, 1974, p. 1). Interventions must be based upon a clear understanding of the commercial behavior of livestock owners, merchants, intermediaries, butchers, and other participants in the marketing circuit, and of the conditions under which they operate.

The motivations and mechanisms which result in livestock being sold, transported to a final market, slaughtered, and ultimately sold to consumers in the form of meat are often far different in West Africa from those applicable to more modern livestock sectors; they subsequently call for interventions that go beyond the typical price and market control policies employed elsewhere. However, many of the characteristics of the Voltaic livestock marketing system will be of interest to policy makers in other Sahelian countries with important livestock sectors, and to planners in coastal countries which depend on Sahelian sources for large portions of their meat requirements.

Most livestock policy in livestock-producing countries of the Sahel has, until recently, been directed toward production; marketing has been the secondary focus. However, an increasing awareness of the importance and potential of marketing and related interventions to stimulate the sector has led to the creation of the Office National de l'Exploitation des Ressources Animales (ONERA) by the Voltaic government. Similar agencies in other countries have been created to carry out government

<sup>1</sup> See, for example, Sous-Commission de la Production Animale, Programme de Production Animale Pour le 3e Plan, 1977-81, Ministère du Développement Rural, République de Haute-Volta.

policy in this area.<sup>1</sup> It is hoped that programs instituted by ONERA to improve market and transportation infrastructure, augment domestic meat processing capacity, and organize and facilitate trade will stimulate production and sale of livestock, reduce marketing costs, and increase the capacity of the network. The implicit assumption is that the traditional marketing system constrains the growth of livestock trade and that a more modern and rational sector will yield a larger quantity and better quality of livestock marketed at lower cost.

The role of marketing in developing countries is widely discussed in the literature,<sup>2</sup> and the objectives which economists and government officials attach to marketing systems and marketing policy are many. However, the principal and commonly accepted criteria for judging a marketing system are:

1. low cost distribution;
2. responsiveness to supply and demand patterns;
3. promotion of an efficient allocation of resources to and from the sector.

To the extent that the marketing system fails to meet these goals, interventions are called for to alleviate the constraints to efficient marketing. Examples of perceived deficiencies in the Voltaic livestock marketing system include:<sup>3</sup>

1. Problems of market organization: It is often contended that the marketing chain is too long, involving excessive numbers of traders, middlemen, and transactions that serve no economic function.

---

<sup>1</sup>Previously, livestock marketing was supervised by the veterinary and customs services.

<sup>2</sup>A broader discussion of the literature is found in the full report of this study (Herman, 1979, Chapter 3).

<sup>3</sup>The objective here is not to set up the proverbial straw man. The list of market failings include only charges found throughout the literature on West African livestock marketing (SEDES, 1969; Bishop, 1972; Bary, 1971; and USAID, 1975, to cite four examples) and often voiced by government officials and local experts. The system has also been credited for performing effectively and at low cost, considering its numerous "handicaps" (SEDES, 1969, p. 333). The questions of interest here are to what degree are these "handicaps" inherent in the marketing system, and how can one best deal with them to achieve some precise standard of efficiency.

2. **Abuses in market conduct:** Traders are accused of engaging in exploitive practices at the expense of livestock producers who are at a bargaining disadvantage due to lack of market information, monopsonistic power held by traders, or collusion by the middlemen.
3. **Institutional imperfections:** Poor transmission of market information and credit market failures are two commonly cited examples.
4. **Shortcomings of market infrastructure:** It is often alleged that market efficiency is hampered by a lack of modern equipment in livestock markets and slaughterhouses and poor transportation infrastructure.

Thus, it is the goal of this study to provide an analytical economic evaluation of the Voltaic livestock marketing system in order to examine the alleged imperfections, assess its efficiency under current conditions, and comment on some of the proposed remedies. Such an evaluation will provide the basic information needed by policy makers if they are to make those choices which will improve the system rather than make it conform to an inappropriate model.

The analysis is based on fieldwork carried out by the author in Upper Volta between January 1976 and March 1977. With the assistance of a Voltaic collaborator and enumerators, four types of surveys were designed and implemented to generate primary marketing data not available from other sources. These were: herder livestock marketing surveys, cattle market surveys, a meat price study, and an export survey. In addition, throughout the fourteen months of field research, market participants were interviewed for market information and personal histories. Information sources also included data from governmental and regional authorities, where available. Finally, the author had the opportunity to actively participate in several marketing activities, which stimulated interesting insights for evaluating the data.

The primary conclusions of the study are presented in seven sections. The first gives a broad outline of livestock production in Upper Volta. The second section describes the livestock and meat marketing system and summarizes recent developments in the livestock trade. The third section

examines the marketing behavior of livestock owners. The livestock and meat transportation system is described and evaluated in the fourth part. The following section examines the market structure of the wholesale livestock and meat trade. The sixth section looks at market conduct; finally, the seventh section evaluates market performance in terms of cattle flows, prices, traders' margins, employment, and social costs.

### LIVESTOCK PRODUCTION IN UPPER VOLTA

The importance of the Voltaic livestock sector in the national economy is evidenced by the fact that it traditionally accounts for about 10 percent of GDP, one-fourth of total agricultural production, and almost half of the country's export earnings (IMF, 1970; IBRD, 1974; SCET, 1972). Livestock is the leading source of rural money income, and stockraising is the principal economic activity for a large share of the population, especially in the Sahel and in the east. The sector contributes approximately 7 percent of domestic revenues to the national budget through export taxes, head taxes, and the licensing of marketing agents. Even so, direct government returns to the sector have been small, usually less than 2 percent of government expenditures (Robinet, 1973, p. ii). The sector annually produces about 54,000 metric tons of meat (excluding offals) and 70 million liters of milk for human consumption (SCET, 1972, pp. 56-60). Since fish and game are of relatively little importance in the Voltaic diet, the livestock sector provides almost all of the animal protein consumed by the population.

Upper Volta's cattle population is estimated at 2.5 million, with goats numbering 2.4 million and sheep 1.6 million (SCET, pp. 34, 52). The cattle are divided between the zebu (Bos indicus) breed found predominantly

in the north and central parts of the country, and the smaller taurin (Bos taurus) and crossed zebu-taurin breeds which are resistant to trypanosomiasis and are found in the more humid south. The zebu make up about two-thirds of the cattle population. The average annual cattle production rate<sup>1</sup> is estimated at 14 percent with offtake at 12 percent and capitalization at 2 percent (SCET, p. 12). Fertility rates are generally low (estimated at between 35 percent by SCET and 50 percent for Sahelian cattle by Peretti), while calf mortality is relatively high (estimated at over 30 percent, with less than half of the calves reaching maturity (IBRD, 1974)). The cattle mature slowly under natural pasture grazing, a steer taking between four and eight years to reach a marketable liveweight of 300-350 kilograms.

Table 1 presents the geographic distribution of population and livestock. It shows that the predominantly pastoral north accounts for only one-quarter of the nation's cattle and small ruminants. The carrying capacity of the northern rangeland is estimated at 13 hectares per UBT.<sup>2</sup> This is already thought to be exceeded (IBRD, 1974, p. 6). In the south, carrying capacity is about seven to eight hectares per UBT, with current density between ten and fourteen per UBT. Improved management, including the planting of forage grasses, is thought to be able to raise carrying capacity in the south to nearly four hectares per UBT (ibid.). It is the feeling of the Voltaic government and various donor agencies that prospects for increased animal production are best in the traditionally agricultural south rather than the already overstocked north.

---

<sup>1</sup>Surviving calves divided by total herd size.

<sup>2</sup>Tropical Livestock Unit (Unité Bétail Tropical), computed by the pasture requirement of different livestock classes. Typically 1 UBT = 1 lactating cow = 2/3 draft ox = 1.1 adult steer = 4 six-month-old calves = 5 sheep = 6.6 lambs = 5.8 goats (SEDES, 1974). For calculating carrying capacity, the hectare per UBT is intuitively appealing. For comparing densities, however, the number of head (or UBT equivalent) is the more commonly used figure. There is, of course, a direct inverse relationship between the two. Given the hectare per animal unit, one inverts and multiplies by 100 to find density.

TABLE 1  
LIVESTOCK DISTRIBUTION BY ORD (1969)

ORD	Area <sup>a</sup>	Population <sup>b</sup>	Cattle <sup>c</sup>	Density <sup>d</sup>	Cattle per Capita	Small Ruminants <sup>c</sup>	Density <sup>d</sup>	Hectares per UBT <sup>e</sup>
Sahel	36,869	258	560	15.2	2.2	900	24.4	6.3
Quahigouya	12,293	540	152	12.4	0.3	300	24.4	7.4
Kaya	21,578	604	287	13.3	0.5	650	30.1	6.6
Ouagadougou	24,179	859	232	9.6	0.3	300	12.4	10.5
Fada N'Gourma	49,992	275	283	5.7	1.0	350	17.0	17.9
Koupéla	9,039	279	105	11.6	0.4	100	11.1	9.1
Koudougou	26,324	751	180	6.8	0.2	250	9.5	14.5
Dédougou	37,356	604	320	8.6	0.5	400	10.7	11.8
Bobo-Dioulasso	20,529	330	159	7.7	0.5	350	17.0	11.4
Gaoua-Diébouyou	17,448	380	127	7.3	0.3	200	11.5	13.3
Banfara	18,393	218	95	5.2	0.4	200	10.9	17.4
Total								
Upper Volta	274,000	4,978	2,500	9.1	0.5	4,000	14.6	10.5

Source: SCET International, Ediafric

<sup>a</sup> Square kilometers

<sup>b</sup> In thousands

<sup>c</sup> Thousands of head

<sup>d</sup> Number of head per square kilometer

<sup>e</sup> Computed on basis: cattle=.8 UBT per head; Small ruminants=.15 UBT per head.



Livestock-raising systems vary throughout the country. In the north and parts of the east and northwest, traditional Fulani extensive livestock systems prevail, where the livestock manager usually owns most of the herd. Farther south, however, one finds enclaves of somewhat less mobile livestock raisers among the sedentary farmers of the region. These herders are more likely to manage herds made up of animals which they tend for absentee owners, usually local farmers, merchants, or government civil servants from the region, as well as their own cattle. Even in the predominantly pastoral Sahelian zone, the three major livestock-raising groups (Fulani, Bellah, and Tuareg) make up only slightly over one-half the population. In most other regions, Fulani account for less than 10 percent of the population. Their minority "foreign" status often results in significant pasture and water rights problems.

#### Growth Rates and the Effects of the Drought<sup>1</sup>

Lack of good herd census information makes it difficult to accurately assess herd growth rates or losses from the drought years. It is believed that the national herd grew at a rate of between 3 and 4 percent annually prior to the drought. The combination of good rains and improved government livestock services in the fifties and the sixties served to stimulate herd growth (see Table 2). The initial response to the drought in the early seventies was to increase offtake in order to salvage some value for animals least likely to survive. The increased short-run supply had the effect of decreasing prices drastically. The anticipated long-run response is a reduction in offtake until herds are reconstituted to their stable structure.

In his study of the economy of the Voltaic Sahel, Peretti concludes that because of the drought and its reduction of the population of young females, herd size in the Sahel is not likely to increase significantly during the next twenty years without significant improvements in fertility and calf mortality rates (Peretti, 1976, pp. 69-86). The situation in the

---

<sup>1</sup>"The drought" is used here and throughout the chapter to refer to the period of exceptionally low rainfall throughout the Sahel between 1968 and 1974.

TABLE 2  
EVOLUTION OF VOLTAIC CATTLE HERD, (1952-1975)

<u>Year</u>	<u>Zebus and Crossbreeds<sup>a</sup></u>	<u>Taurins</u>	<u>Total Cattle</u>	<u>Year Growth</u>
1952	n.a.	n.a.	1,300,000	
1960	n.a.	n.a.	1,800,00	3.99%
1967	1,570,000	825,000	2,395,00	4.16%
1968	1,600,000	848,000	2,448,000	2.21%
1969	1,630,000	870,000	2,500,000	2.12%
1975 <sup>b</sup>	n.a.	n.a.	2,540,000	0.26%

SOURCE: SCET International and SEDES, 1975

n.a.: not available

<sup>a</sup> zebu-taurin crossbreeds

<sup>b</sup> from SEDES, 1975

south was much different. The cattle population actually increased during the drought, in part due to the migration of some northern pastoralists seeking relief from drought conditions, but largely due to the purchases of animals at favorable prices during the drought by southern farmers, traders, and civil servants. Tyč (SEDES, 1975) calculates that Voltaic herds as a whole may have increased by 1.6 percent during the drought years (Table 3).

TABLE 3  
EFFECT OF THE DROUGHT ON VOLTAIC CATTLE  
(in numbers of head)

<u>Year</u>	<u>Region</u>			<u>Total</u>
	<u>Sahel</u>	<u>Center</u>	<u>South</u>	
1969	600,000	1,270,000	630,000	2,500,000
1975	408,000	1,402,000	730,000	2,540,000
% change	-36%	+10.4%	+15.9%	+1.6%

SOURCE: SEDES, 1975.

There are reasons to suspect that these calculations are conservative and that the net change in national herd size was an even greater increase (Herman, 1979, Chapter I). What is clear is that there has been a geographical redistribution of cattle from the north to the south since the drought.

#### Pastoralists and Extensive Stockraising

Traditional pastoralism in Upper Volta is characterized by communally held pasture land, the absence of any permanent physical structures such as corrals or stock buildings, the lack of significant forage cultivation, and few explicit costs of production. Animals are fed almost exclusively on natural pasture and stubble from fields planted to staple food crops, with only lactating cows receiving any feed supplement during the dry season. Water is generally scarce and is one of the prime factors in transhumance patterns. These seasonal movements range between twenty and one hundred kilometers. Herd size varies widely in terms of ownership, but cattle management units are usually kept between thirty and eighty head. Larger herds incorporate too great a risk from disease and herd control. Cattle herds are more valued for their milk production than for their meat, though exchange value plays an important role in providing for that part of pastoralists' grain needs which they cannot meet from their own agricultural efforts.<sup>1</sup>

Historic, climatic, biological, and economic factors have combined to motivate traditional pastoralists (Fulani, Bellah, and Tuareg) in Upper Volta to become less mobile and increasingly dependent upon agriculture.

Most Voltaic pastoralists follow nomadic lifestyles; however, most do move their livestock in regular seasonal patterns. These transhumance movements significantly affect commercial behavior because of the accessibility of the herds to livestock markets. Transhumance is

<sup>1</sup>The above description borrows liberally from one found in SCET International report (SCET, 1972, p. 11).

motivated by six factors;

1. Search for pasture: In the north, herders move their cattle to "remote" pasture lands to take advantage of wet season grasses and surface water. These lands are usually unable to maintain many livestock during the dry season.
2. Search for water: Herders take advantage of temporary water holes that appear during and remain for a short period of time following the rainy season. Often following water courses, the herders return to permanent water sources (lakes or, more often, wells) for the dry season.
3. Protecting crops: Throughout the country, herders move cattle away from their fields during most of the growing season to reduce the risk of crop damage from cattle.
4. Labor supply: During those months of peak labor requirements for agricultural tasks, almost all family members must be available. Herds are tended by the fewest, youngest family members possible.
5. Market opportunities: This is a significant factor only for those pastoralists frequenting the most remote regions of the Sahel. Before harvest, when grain supplies are lowest, herders are required to move toward markets where they are able to sell animals or milk for the required millet.
6. Search for salt: Some northern pastoralists traditionally take their cattle to salt licks in Mali and to some areas of the Sahel in Upper Volta. Presently, most herders purchase salt for their cattle rather than following such migrations.

In general, northern herders move north to short-term pasture land during the rainy season (July-September), return south during the "cold" season (October-February) according to the availability of pasture and surface water, and remain near permanent water sources during the dry season (March-June), grazing on field stubble and available grasses. Pastoral migration patterns in the south vary considerably. In general, herders maintain rainy season camps near their fields and move their herds according to a variety of strategies depending upon water availability,

social relations with the dominant population, and labor availability. The range of the transhumance is generally of smaller magnitude for southern pastoralists than for those in the north, and thus has less effect on marketing behavior.

Pastoralists' herd management practices are largely based on historical, climatic, and economic factors, though they may appear to be culturally ingrained. The greatest risks to the herder are those which arise from herd loss due to drought and disease. As a result, pastoralists, especially in the Sahel where the environment is particularly harsh, tend to structure their herds in a manner that minimizes risk. This is done by keeping large herds with many older animals which are particularly resistant to both drought and disease. This can be seen by examining Figure 1, which compares the age structure of northern and southern herds. It is evident from the figure that the predominantly pastoral herds of the north contain a significantly higher proportion of cattle over nine years of age than do southern herds, which are not exposed to such harsh conditions.

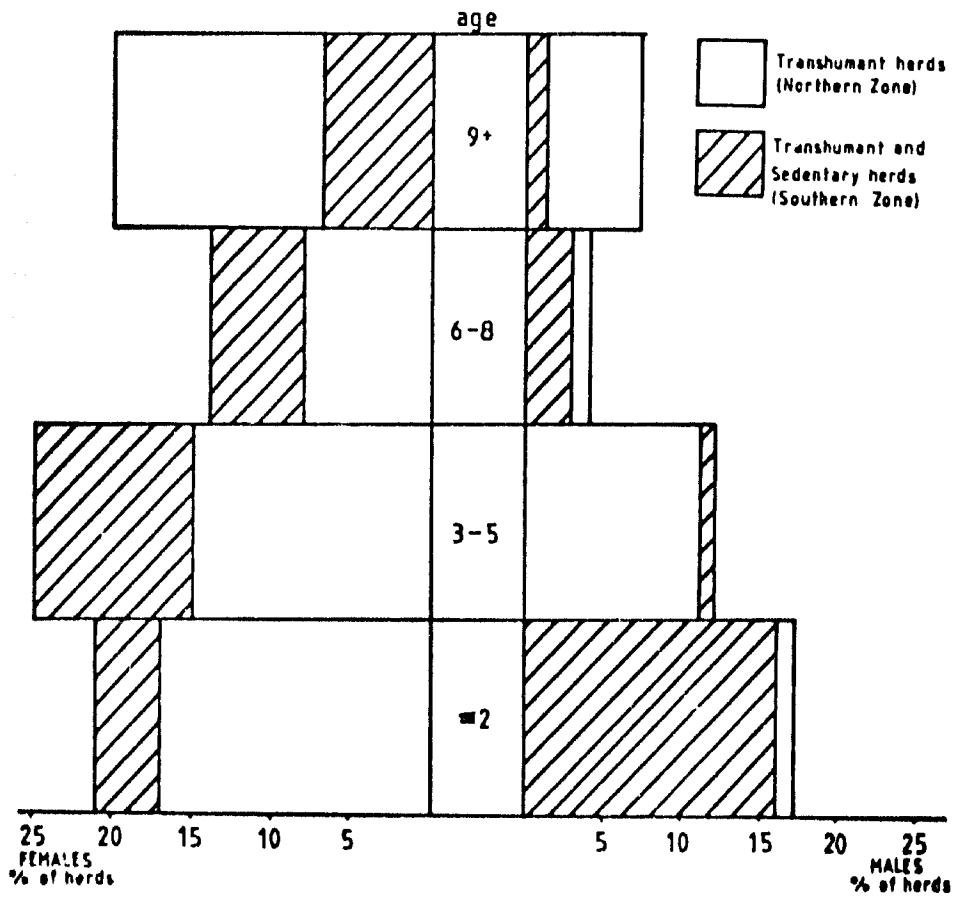
In general, traditional herders' long-run management and marketing strategies are constrained by several factors, the most important being:

1. Herders independently assume all of the risks of loss through catastrophe such as drought, and thus tend toward a strategy of herd expansion whenever possible.
2. To the extent they are not self-sufficient, pastoralists must rely on livestock sales to satisfy basic cash and commodity needs, most importantly grain requirements; thus livestock sales may depend largely on factors outside the livestock sector, notably the herders' agricultural output and grain prices.
3. Herders choose to hold assets only in the form of livestock which may lead to a "target" income approach to cattle sales.

---

<sup>1</sup>Delgado analyzed the differences in herd structure between cattle owned by Fulani and those owned by the sedentary population and civil servants in the Tenkodogo region. This more exact comparison (though based on a relatively small sample) shows striking differences in age composition, with Fulani herds having a far greater proportion of older males and females than did these nontraditional cattle owners (Delgado, 1979, Chapter VI).

FIGURE 1 Age Composition of Males & Females in the Herds:  
Zebus and Cross Breeds, 1970



SOURCE: SCET International

### Nontraditional Stockraising

As noted earlier, the Fulani in Upper Volta own about 70 percent of the nation's cattle resources. The remainder are owned by farmers, merchants, and civil servants. It is important to note, however, that a large portion of this latter group of animals are entrusted to the Fulani for raising. In the south, this results in separation of ownership and management, to some degree.<sup>1</sup> In most cases, however, the absentee owner retains control over major decisions such as marketing.

Such relationships are perhaps not what is envisioned by policy makers who advocate the increased integration of agriculture and stock-raising. Many see such integration as being the most likely strategy for Upper Volta to follow to achieve improvements in livestock production, because of the theoretical potentials for growth in the agricultural south and the unlikelihood of the Sahel to exhibit much advancement in livestock production in the near future, as noted earlier (SEDES, 1975; SCET, 1972; and IBRD, 1974). This attitude is the basis for the Voltaic long-run strategy of "stratification." The objectives of this plan (Upper Volta, Ministère du Développement Rural, 1976) are to divide the country into two zones of production. The northern, or Sahelian zone would be devoted to breeding -- supplying young male cattle out of traditional extensive stock-raising systems. These yearlings would be moved south through the livestock marketing circuit to farmers and businesses for growing out, fattening, and finishing. They would also be used in animal traction programs and ultimately finished before slaughter. This is to be carried out by encouraging the organization of feedlots, animal traction, short and long-term fattening by peasants, village livestock projects, better management of existing pasture land, forage farming, and the increased use of agro-industrial by-products as livestock feed.

In the grand sense envisioned, stratification bears little resemblance to the state of livestock production in Upper Volta today. Even the limited part of production not in the hands of traditional pastoralists is

---

<sup>1</sup>Delgado found that 60 percent of cattle in the Fulani-controlled herds he surveyed in the southern region of Tenkodogo actually belonged to non-household members. Each herd was made up of cattle belonging to 3-9 different non-Fulani owners (Delgado, 1979, pp. 67-68).

far from the ideal hoped for by planners. While mixed farming has several important benefits for those who adopt it, it also has many disadvantages -- one of the most important of which is the increased labor required to care for the livestock, often a major constraint when dealing with large stock. Thus, the level of true mixed farming by nontraditional herders is presently low.

### THE LIVESTOCK AND MEAT MARKETING NETWORK

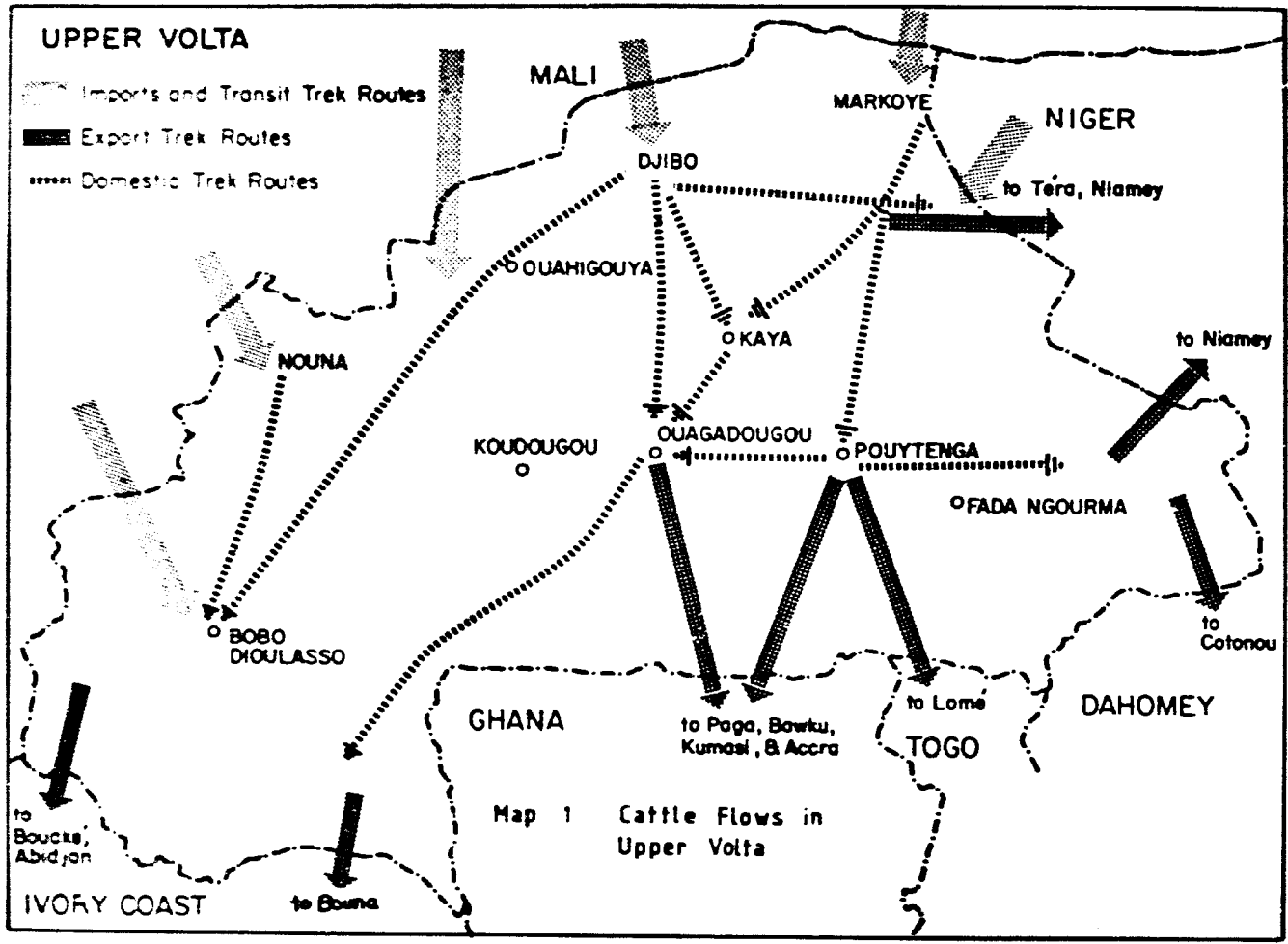
Livestock and meat marketing in Upper Volta is carried out under a complex traditional system with, until recently, few government interventions, little market infrastructure, and a labor-intensive organization. One of Upper Volta's major assets as a livestock supplier is its location. As a corridor for livestock movements between the northern cattle surplus regions and the coastal deficit countries, traders from eastern Mali and western Niger have traditionally passed through Upper Volta on their way to markets in the south, often interacting with Voltaic cattle merchants in the markets along their trade routes. The marketing system draws cattle both from Sahelian and southern producing zones and channels them toward terminal markets in Upper Volta, Ivory Coast, Ghana, Togo, Benin, and even Nigeria. Upper Volta has an advantage over its northern neighbors and fellow cattle surplus states because of its close proximity to four meat-deficit states and also because of the railroad line originating in Ouagadougou and terminating in Abidjan, historically one of West Africa's largest markets for Sahelian beef.

#### Evolution of Commercial Livestock Flows

Map 1 shows the major flows of livestock in Upper Volta. The wide dotted arrows represent imports and transit cattle from Mali and Niger which traditionally entered Upper Volta at many points along the northern border,<sup>1</sup> continue through the Voltaic marketing circuit or transportation

<sup>1</sup>Imports and transits were legally shut off in 1976 by the government. In fact, cattle continue to cross the frontier clandestinely.



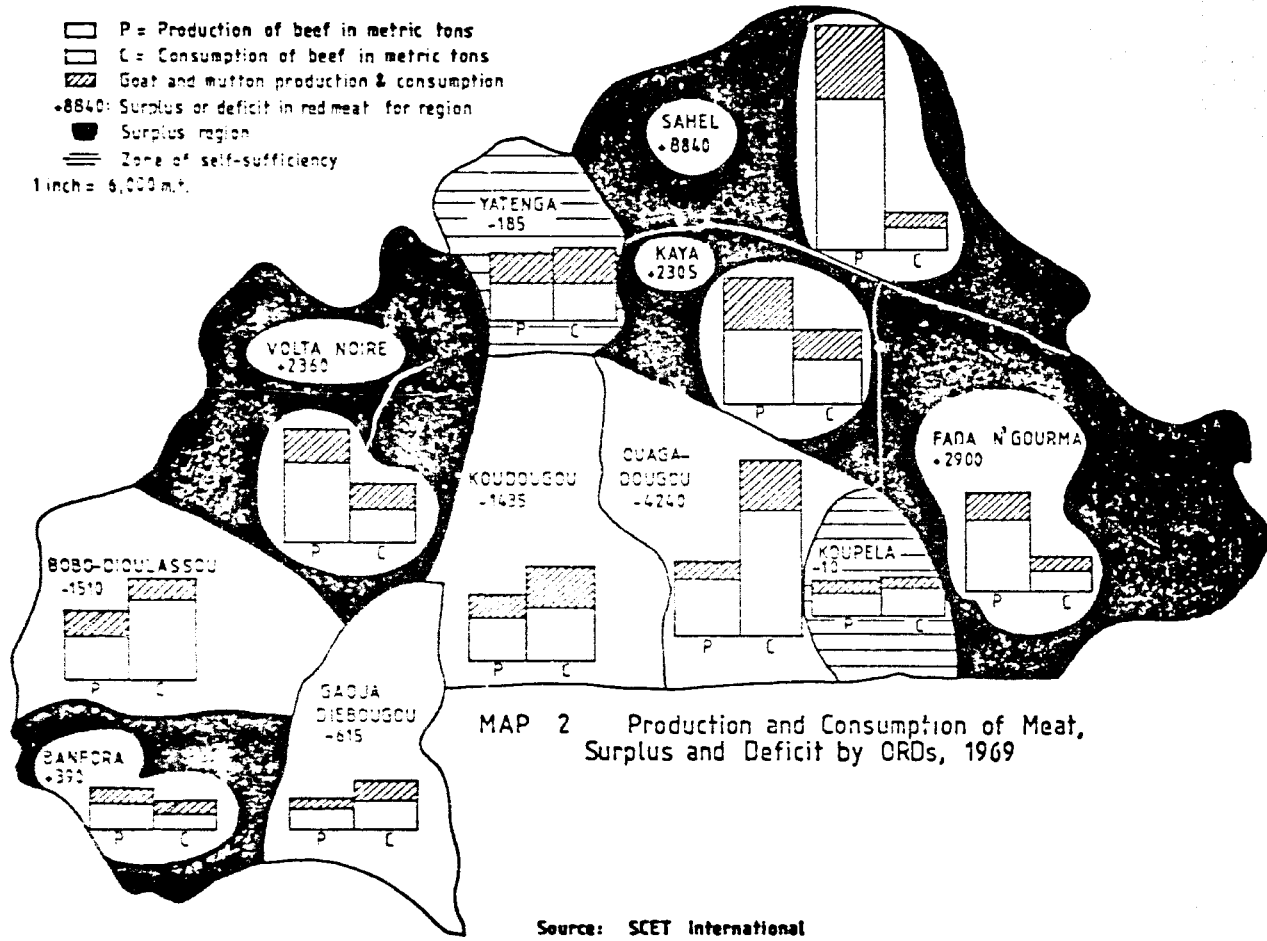


network, and move toward Voltaic or coastal terminal markets. The darker narrower dotted arrows show the major exit points for trekked export cattle. The striped arrows found only within the Upper Volta borders represent important domestic trade routes and cattle trails. It is along these domestic routes that cattle are moved from points of entry and from northern collection markets, to regroupment, domestic terminal, and foreign markets. Finally, the solid line indicates the railroad line of the Regie des Chemis de Fer Abidjan-Niger, over which almost two-thirds of Upper Volta's cattle exports pass.

Pattern of imports, exports, and domestic movements are constantly changing as traders adjust to the conditions of the market. In general, the dominant flow of cattle is from the northeast toward the southwest. These movements can be seen in the Markoye-Kaya-Ouagadougou-Ivory Coast and the Djiho-Ouahigouya-Bobo-Dioulasso-Ivory Coast vectors. It is also true, however, that traditionally many Malian cattle found their way to Ghana through Upper Volta, moving in a southeasterly direction. Most recently, cattle have been shipped east and even northeast as traders responded to high prices in western Niger for both young and slaughtered cattle. The rest of this section examines commercial livestock movements in terms of regional production and consumption patterns, additions to national surplus through imports and transits, and exports.

Regional Production and Consumption Patterns.-- The traditional dominance of the Sahelian region in providing Upper Volta's meat surplus in the form of live animals is demonstrated in Table 4 and Map 2. Each shows the geographic distribution of meat (cattle and small ruminants) production (offtake), consumption, and the resulting surplus or deficit for the pre-drought era. The figures show that the Sahel supplied the entirety of surplus meat, while the rest of the country was only self-sufficient in meat production during that period. It can also be seen that the country is broadly divided between a surplus meat zone in the north and east, and a deficit zone in the south and west. Besides the Sahel, the other surplus regions are the O.R.D.'s of the Black Volta

□ P = Production of beef in metric tons  
 □ C = Consumption of beef in metric tons  
 ▨ Goat and mutton production & consumption  
 +8840: Surplus or deficit in red meat for region  
 ■ Surplus region  
 ▨ Zone of self-sufficiency  
 1 inch = 5,000 m.f.



MAP 2 Production and Consumption of Meat, Surplus and Deficit by ORDs, 1969

Source: SCET International

TABLE 4  
DISTRIBUTION OF DOMESTICALLY PRODUCED MEAT SUPPLY, CONSUMPTION, AND SURPLUS<sup>a</sup>  
by O.R.D., 1969 (estimated)

O.R.D.	BEEF			Goat and Mutton			Total surplus
	Production <sup>b</sup>	Consumption <sup>c</sup>	Surplus	Production <sup>d</sup>	Consumption <sup>e</sup>	Surplus	
Sahel	7,000	800	+6,200	3,260	620	+2,640	+8,840
Yatenya	1,750	1,750	0	1,090	1,275	- 185	-185
Kaya	3,300	1,920	+1,380	2,355	1,430	+ 925	+2,305
Ouagadougou	2,550	5,650	-3,100	1,390	2,230	-1,140	-4,240
Fada N'Gourma	3,200	900	+2,300	1,270	670	+ 600	+2,900
Koupéla	1,150	870	+ 280	360	650	- 290	- 10
Koudougou	1,980	2,500	- 520	905	1,820	- 915	-1,435
Volta Noire	3,640	1,580	+2,060	1,450	1,150	+ 300	+2,360
Bobe-Dioulasso	1,830	3,650	-1,820	1,270	960	+ 310	-1,510
Gaoua-Diebougou	720	1,180	- 460	725	880	- 155	- 615
Banfora	880	700	+ 180	725	515	+ 210	+ 390
Total Upper Volta	28,000	21,500	6,500	14,500	12,200	+2,300	+8,800

Source: SCET International, 1972.

<sup>a</sup>In metric tons.

<sup>b</sup>Production based on herd population (Table 1.2) and meat production per head, averaging 11.2 kg (Table 1.9).

<sup>c</sup>Calculated as follows: 3.3 kg per capita in rural areas; 29.5 kg per capita in urban centers.

<sup>d</sup>Production based on herd population (Table 1.2) and 3.625 kg meat production per head.

<sup>e</sup>2.5 kg per capita

(with production concentrated around Nouna and Tougan in the north), Kaya, Fada N'Gourma, and Banfora.<sup>1</sup> The deficit in both Yatenga and Koupéla is so small that in reality these regions should be considered self-sufficient, because regional meat production is within 10 percent of regional consumption.

The disastrous effects of the drought on Sahelian herds has undoubtedly eroded the dominant position of the Sahel in producing the country's exportable surplus. Nevertheless, the general pattern of surplus in the north and east and deficit in the south and west still holds and is responsible for the southwesterly flow of commercialized livestock mentioned above.

Livestock Imports and Transits.-- Adding to domestic meat production and surplus are those livestock which enter Upper Volta from Mali and Niger. Officially, these entries can take two forms: imports and transit herds. Imports include all livestock resold in Upper Volta, whether eventually slaughtered in Upper Volta or moved on to the coast. Transits are those livestock which simply traverse the country en route to coastal destinations. Traditionally, cattle merchants from the interior delta and Gao regions in Mali and from western Niger have used direct routes that pass through Upper Volta to Ghana and Ivory Coast.

The evolution of cattle imports into Upper Volta is presented in Table 5. Total officially recorded imports fell drastically in the years their total prohibition in 1975. Official imports from Mali exceeded those from Niger. It is important to note that unofficial imports, for which there are no good data, were perhaps as important as recorded imports. It is most common for herders from Mali or Niger to bring their own arrivals to one of the northern Voltaic collection markets. In the past, Malian cattle made up the majority of cattle offered for sale in markets like Marhoye, Déou, and Djibo. Farther east, a similar situation

<sup>1</sup>The fact that Banfora is a surplus zone according to these estimates is a function of the sparse population of the region. In absolute terms production is limited. The southwest region (including Bobo-Dioulasso) as a whole is a deficit area.

TABLE 5  
RECORDED<sup>a</sup> CATTLE IMPORTS INTO UPPER VOLTA, 1961-1976<sup>b</sup>

Year	O R I G I N		Total
	Mali	Niger	
1961	2,561	1,488	4,049
1963	14,994	2,229	17,223
1964	1,289	7,450	8,739
1965	n.a.	n.a.	15,882
1966	23,138	--	23,138
1967	13,557	--	13,557
1968	n.a.	n.a.	9,573
1969	n.a.	n.a.	7,319
1970	10,622	--	10,622
1971	13,805	--	13,805
1972	7,949	40	8,005
1973	154	--	154
1974	1,257	--	1,257
1975	--	--	0

<sup>a</sup>Cattle for which Voltaic import taxes are paid.

<sup>b</sup>Imports no longer allowed as of 1976.

n.a. Breakdown according to country unavailable.

Source: Statistiques: Service de l'Élevage, Ouagadougou, Recueil Statistique, SEDES, 1975b, and SCET International, 1972.

existed in the Seytenga market where, until the flow reversed in 1976, Nigerien cattle were predominant.

Official statistics on transit cattle movements are compiled in Table 6. Once again one notes that Malian cattle are more prevalent than Nigerien cattle. And as in the case with imports, transits decreased drastically in the years preceding the official prohibition of such movements.

Four factors were primarily responsible for the fall in recorded and actual number of cattle entering Upper Volta from Mali and Niger:

1. The effects of the drought on cattle herds in eastern Mali and western Niger.
2. A restructuring of import, transit, and export taxes affecting such entries.
3. The border conflict between Upper Volta and Mali in 1974-75.
4. A shift in West African cattle trade away from exports to Ghana and towards markets in Niger which channel cattle toward Nigeria.

The national herds of Mali and Niger were far more seriously affected by the drought years between 1968 and 1974. Total cattle losses are estimated to be on the order of 30-40 percent of the pastoral Sahelian herd in those countries (SEDES, 1975, p. 3). For the regions adjoining the Voltaic Sahelian zone the losses were quite probably similar to those described for the Voltaic Sahel in a previous section of this chapter, around 33 percent. This undoubtedly led to a massive reduction in cattle sales by these herders, both because of the reduced number of cattle upon which to draw and because of the need to reduce offtake in order to reconstitute the herds. This led to the decrease both in the number of Malian and Nigerien herders who brought cattle to northern Voltaic markets for sale, and in the number of cattle merchants could import into or transit through Upper Volta.

The second factor involved the changes in the structure of import, export, and transit taxes which are applicable to traders passing through western Upper Volta on their way to the Ivory Coast from the Delta region of Mali. Whereas traders would at one time profitably ship their herds

TABLE 6  
EVOLUTION OF RECORDED TRANSIT CATTLE<sup>a</sup> THROUGH UPPER VOLTA, 1953-1976<sup>b</sup>

Year	ORIGIN AND DESTINATION						Total Transit Cattle
	From Mali			From Niger			
	To the Ivory Coast	To Ghana, Togo, and Benin	Total from Mali	To the Ivory Coast	To Ghana, Togo, and Benin	Total from Niger	
1953-58 <sup>c</sup>	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	52,667
1960	25,406	11,250	36,656	--	3,844	3,844	40,500
1965	19,621	30,313	49,934	--	6,702	6,702	56,636
1966	63,421	37,047	100,468	--	18,868	18,868	119,336
1967	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	36,220
1968	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	48,272
1969	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	60,974
1970	13,096	35,062	48,158	--	12,787	12,787	60,945
1971	17,857	36,219	54,076	6,453	10,335	16,788	70,864
1972	16,013	24,665	40,678	--	7,492	7,492	48,170
1973	24,580	11,450	36,030	182	15,450	15,632	51,662
1974	5,690	10,685	16,375	--	14,000	14,000	30,375
1975	3,702	--	3,702	100	2,870	2,970	6,672

<sup>a</sup>Cattle for which export taxes paid in country of origin and transit tax paid in Upper Volta.

<sup>b</sup>Transits prohibited as of 1976.

<sup>c</sup>Annual Average for six-year period.

n.a.: Breakdown according to country unavailable.

Source: Statistiques: Service de l'Elevage, Ouagadougou, SEDES, 1975b, and SCET International, 1972.



directly to Bobo-Dioulasso where, they were loaded onto the train to Abidjan, they now choose to route the herds via Koutiala or Sikasso. There they either arrange truck transport for shipment farther south or continue onto Ouangolodougou or Ferkéssédougo where they pick up the train, avoiding payment of Voltaic taxes.

The third factor was the border conflict between Upper Volta and Mali in 1974-75, resulting in the closing of the border to all official trade. The final and possibly most important element was the shift away from the Ghanaian market, largely due to the inconvertibility of the Ghanaian currency. As can be seen from Table 6, at the time this represented a large share of the cattle transited through Upper Volta (over 50 percent of the transit cattle passing through Upper Volta between 1960 and 1974).

Still, Malian cattle have continued to enter Upper Volta and its livestock marketing chain. Individual herders bring cattle into the country for sale at markets close to the border. Cattle merchants bring herds into Upper Volta clandestinely and arrange to get papers indicating that the herd originated in Upper Volta (R.H.V., MDR, *Projet de Développement de l'Élevage Ouest-Volta [PEOV]*, 1978, p. 4). Principal entry points are in the northeast around Déou, Marhoye, and Gorom-Gorom, in the north central near Djibo and Thiou; and in the northwest around Barani, Djibasso, and N'Dorola. Many of the cattle embarking on the train in Bobo-Dioulasso are actually Malian in origin but bear the name of one of these places on their certificates of origin and thus are treated as Voltaic animals, both fiscally and statistically.

The reversal of flows from Niger into Upper Volta occurred for many of the same reasons as the decline in Malian entries. The declining market for Sahelian beef in Ghana, the increased costs of transiting through Upper Volta, and high prices in Nigerian cattle markets combined to stop movements from Niger into Ghana through Upper Volta.

Cattle Exports,-- As noted earlier, livestock products are Upper Volta's largest positive international trade export, accounting for nearly one-half of all official exports by value. Taxes on exports are also one of the largest sources of domestically generated revenues. The bulk of both of these accounts is derived from the shipment of live animals to the coast, with cattle being the most important form of export. Livestock exports have been declining in recent years, however, in terms of volume, revenues, and percent of total exports (SCET, 1972, Part II, pp. 211-213).

Cattle exports from Upper Volta are, for the most part, the largest, healthiest, and best quality animals produced in the country. There are three principal reasons for this. First, cattle must be healthy and strong to travel the thousand or more kilometers they must go before reaching the coastal markets; weak or unhealthy cattle are slaughtered locally in Upper Volta. Second, there is a very limited demand for high quality beef in Upper Volta; such a demand does exist to a greater degree on the coast. And third, for reasons that will be explained in a later section, costs per head of export favor larger cattle over smaller cattle since they are distributed over a larger quantity of meat and thus represent a lower cost per kilogram.

Most exported cattle are males, either adult steers or bulls. Net carcass weights average roughly 150 kilograms. The major importing countries are Ivory Coast, Ghana, Togo, Benin, and Nigeria. In terms of tonnage, live cattle exports represent about 13 percent of offtake annually (IBRD, 1974, Annex 1, p. 4). Cattle are shipped on hoof or by train. There is practically no use of truck transport originating directly out of Upper Volta. During the early seventies, 63 percent of exported cattle were transported by train (exclusively to Ivory Coast), 36 percent on hoof, and only 1 percent by truck. Over two-thirds of the cattle exported to Ivory Coast are shipped by train.

Table 7 and Figure 2 illustrate the evolution of officially recorded cattle exports from Upper Volta. Prior to the opening of the rail connection, between Ouagadougou and the coast (Abidjan) in 1954, cattle were exported at a rate of between 30,000 and 40,000 head annually. Beginning with the establishment of the rail link and through the first

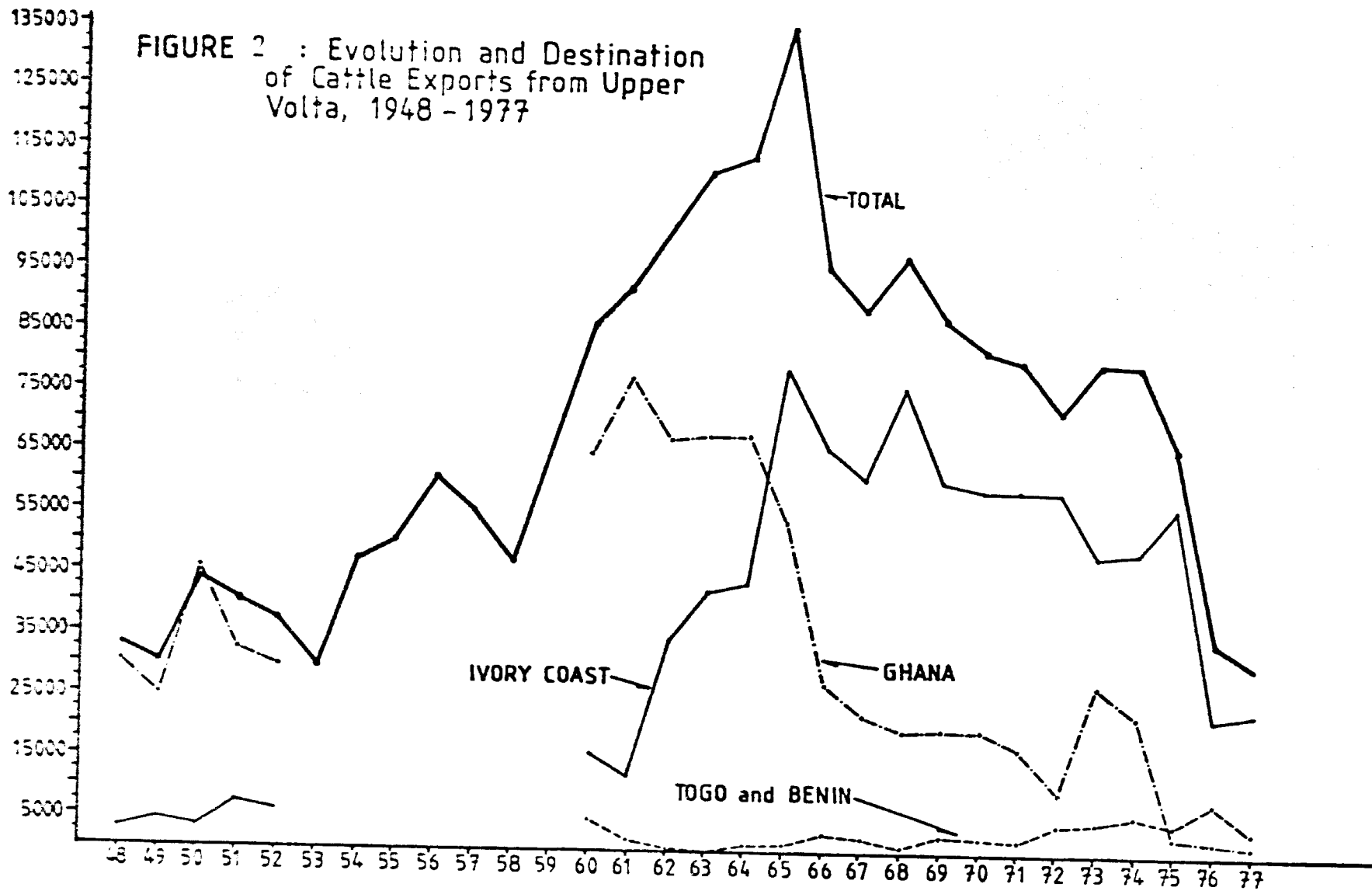
TABLE 7  
EVOLUTION OF CATTLE EXPORTS FROM UPPER VOLTA  
1931, 1948-1958, 1960-1977

	Destination						Total number exported
	IVORY COAST		GHANA		TOGO AND BENIN		
	Number of head	Percent of total	Number of head	Percent of total	Number of head	Percent of total	
1931	11,815	35	21,810	65	-	-	33,625
1948	2,783	8	31,202	92	-	-	33,985
1949	4,980	16	25,518	84	-	-	30,498
1950	3,684	8	40,752	92	-	-	44,436
1951	7,415	18	33,216	82	-	-	40,631
1952	6,375	17	30,165	83	-	-	36,540
1953	a	a	a	a	a	a	30,000
1954	a	a	a	a	a	a	47,000
1955	a	a	a	a	a	a	51,000
1956	a	a	a	a	a	a	61,000
1957	a	a	a	a	a	a	56,000
1958	a	a	a	a	a	a	48,000
1960	16,406	19	64,648	74	3,893	7	86,949
1961	12,280	13	78,427	84	2,128	2	92,835
1962	34,397	33	67,803	66	509	1	102,709
1963	43,852	39	68,382	61	-	-	112,234
1964	44,235	39	68,638	60	1,703	1	114,576
1965	79,486	59	53,763	40	1,940	1	135,189
1966	66,629	68	27,306	28	4,054	4	97,929
1967	62,239	70	23,184	26	3,046	4	88,469
1968	76,824	78	19,396	20	2,083	2	98,303
1969	62,539	72	20,711	24	3,458	4	86,708
1970	59,207	71	20,865	25	3,248	4	83,320
1971	59,589	73	18,482	23	3,045	4	81,116
1972	58,041	80	9,949	14	4,915	7	72,905
1973	48,573	60	27,497	34	5,365	7	81,435
1974	49,490	62	23,481	29	6,957	9	79,927
1975	57,918	87	3,706	6	4,826	7	66,450
1976	23,219	66	3,503	10	8,416	24	35,138 <sup>b</sup>
1977	24,779	78	2,815	9	4,004	13	31,602 <sup>b</sup>
TOTAL (1960-1977)	879,651	57	602,576	79	65,592	4	1,548,146

Source: Statistique de Service de l'Elevage, Ouagadougou, R.H.

<sup>a</sup> Breakdown according to country unavailable.

<sup>b</sup> Includes 324 head exported to Nigeria.



SOURCE: Statistique de Service de l'Élevage, Ouagadougou, R.H.V.

few years of independence (1960-1965), exports increased steadily, peaking at 135,189 head in 1965. This period of growth can be attributed to three major factors:

1. Growth of herd size and offtake throughout the fifties and early sixties due to an extended period of above average rainfall, expansion of veterinary services, and reduction of disease outbreaks (USAID, 1975, Section III, p. D-34).
2. Increased demand for cattle in Ivory Coast as a result of the dynamic economic growth in that country and increased urbanization (especially in Abidjan), including the influx of Europeans.
3. The improved transportation links with the coast, most notably the railroad from Ouagadougou to Abidjan, which effectively lowered transport costs and improved the ability of cattle merchants to respond to coastal market conditions by reducing shipping time from two months to two to three days

In addition to these factors which affected real growth in exports, the figures probably also reflect improved record keeping, especially for export to Ivory Coast, since cattle shipped by train are easier to control than those trekked.

Since 1965, exports have been declining almost continuously, beginning with a drastic decrease of 35 percent between 1965 and 1967, dominated by the drying up of the Ghanaian market. In 1968 exports rose in response to salvage sales by herders as a result of a bad year of rainfall. The level of cattle exports then continued to fall until 1973. The decline in 1972 was most pronounced, probably the result of the 1968 drought which had reduced the calf crop and increased calf mortality and was just beginning to show up in significant decreases in offtake. Two more years of serious rain deficiency in 1972-1974 again caused an increase in salvage sales by herders and shows up as a peak in cattle exports during those years. In 1975, the overall pattern of decline evident in the previous decade resumed, as exports fell by 17 percent. This was followed by an even larger decrease in 1976 when exports fell by almost half to their lowest level in almost a quarter decade. The decline in cattle exports

continued in 1977, though by a much smaller margin. The principal cause of the shrinkage of the export trade during the seventies was the reduced offtake by herders following the drought years. However, it was exacerbated by an increase in domestic demand and a decrease in foreign demand, especially in Ivory Coast; Sahelian exports lost much of their market share to non-African suppliers, most notably Argentina. Once again the figures are to some degree misleading, since exports to alternative markets in Niger and Nigeria during this period were largely unrecorded.

The breakdown of exports according to destination (also shown in Table 7 and Figure 2) presents an interesting pattern of change. Ghana's position as the principal foreign market for Voltaic cattle was traditionally established in pre-colonial times (Osseindowski, 1928, p. 277) and continued through the early sixties. In absolute volume, cattle exports to Ghana remained stable through 1964, averaging just under 70,000 head in the early years of the Voltaic independence. The Ghanaian market for Voltaic cattle fell off sharply in 1965 and 1966, corresponding to the years of Ghanaian political and economic instability. The most serious factor was the establishment in 1965 of an independent Ghanaian monetary unit, the cedi. The unwillingness of Voltaic cattle merchants to accept cedis in payment for cattle and the high cost of foreign exchange to Ghanaian buyers resulted in a decline in exports to Ghana through 1972. The Cattle Development Board (CDB) was established by the Ghanaian government in 1972 with the responsibility of taking over the importations of livestock. After a difficult time in 1972, when trade declined to under 10,000 head of cattle, the CDB began buying directly in the Ouagadougou cattle market, increasing the cattle trade between the two countries three-fold in their second year of operation. However, the CDB was only able to sustain purchases into 1974. The closing of the quarantine stations at the border due to an outbreak of disease and the subsequent backlog of cattle and delays in payment by the Bank of Ghana led to a drying up of sales to Ghana in late 1974. Since then, only a small number of cattle have been exported by private Voltaic merchants, leaving Ghana behind even Togo and Benin in share of Voltaic cattle exports.

In sharp contrast to the Ghanaian market, exports to Ivory Coast were relatively small prior to and during the early years of independence. However, the Ivorian market share grew rapidly during the late fifties and sixties, both in absolute and relative volume. As noted above, this was in response to increased demand due to the rapid growth of Ivory Coast's population, and was facilitated by the rail link between the two countries. During the last decade, Ivory Coast maintained its market share at over two-thirds of total Voltaic cattle exports. In 1968 exports to Ivory Coast rose as a result of increased sales by herders, noted above. The decline in 1973 and 1974 is attributed to the redirection of exports toward Ghana because of the CDB purchases in Ouagadougou. However, in 1976 a precipitous fall in exports to Ivory Coast had disastrous effects on total Voltaic cattle exports. In late 1975, unhappy with the fall in Sahelian exports and hoping to find a stable source of cheap beef, the Ivorian government began importing large quantities of frozen beef from Europe and South America. By the following year, these frozen imports had displaced a large part of the fresh meat market. The frozen meat was priced below fresh meat prices, thus eroding further the position of Sahelian cattle exports to Ivory Coast.

Exports to Togo and Benin traditionally made up a small but stable of total Voltaic exports. Their share increased steadily from 1971 until 1976, when it accounted for over 8,000 head, or one-fourth of total cattle exports. Exports to Nigeria have been of increasing importance since 1976, when Niger cut off exports as part of a herd rebuilding program. At first, Nigerian traders bought cattle in Upper Volta for shipment to northwestern Nigeria. More recently, Voltaic merchants have established the necessary contacts in Nigeria to enable them to deal there. Still, few of these exports are officially recorded.

#### Livestock Market Activity

Diagram 1 is a schematic drawing of the Voltaic livestock marketing network. It broadly describes the origin and type of cattle most likely to be sold in different types of markets. Markets are divided into three

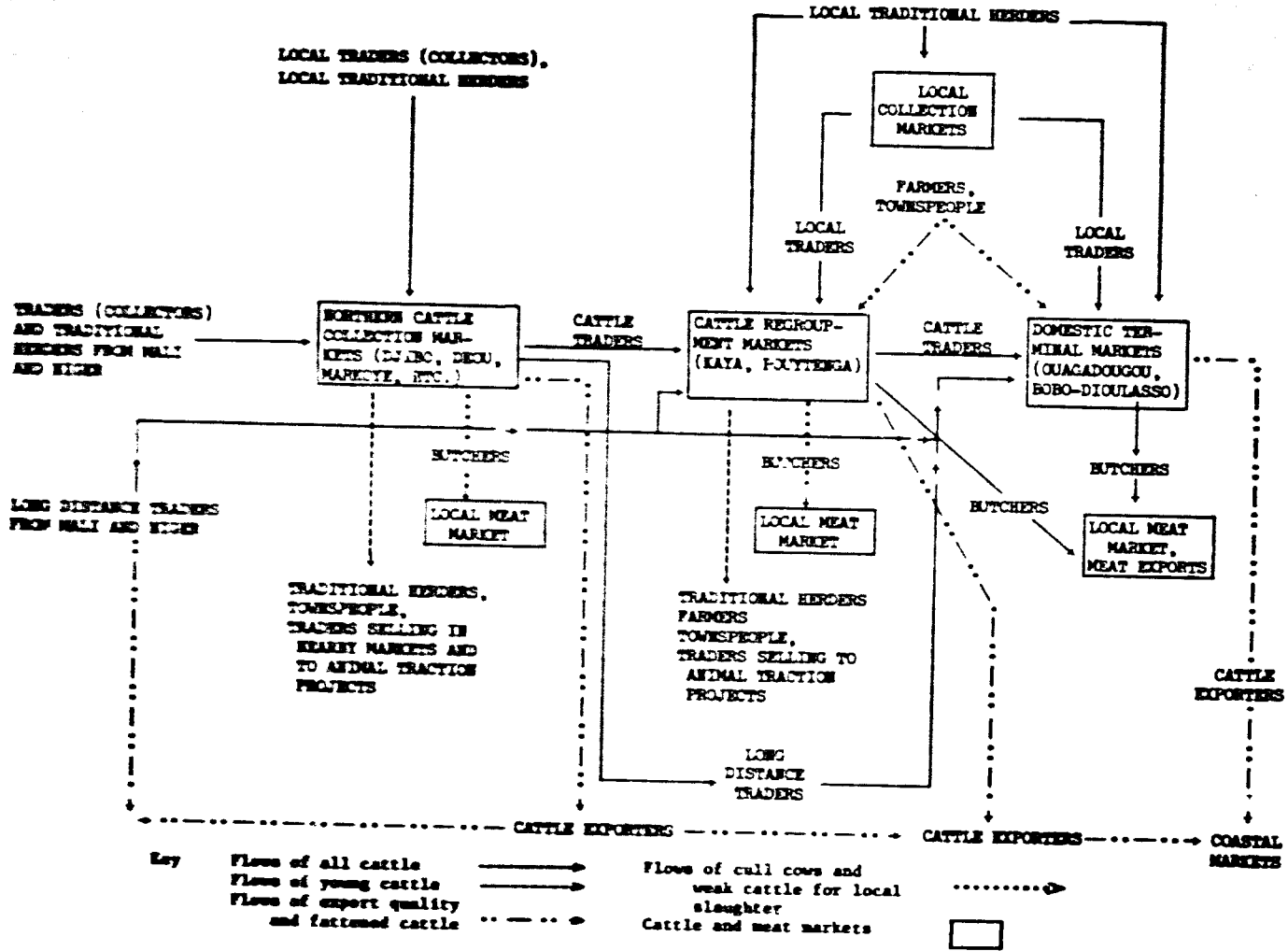


Diagram 1: ORGANIZATION OF CATTLE MARKETING IN UPPER VOLTA



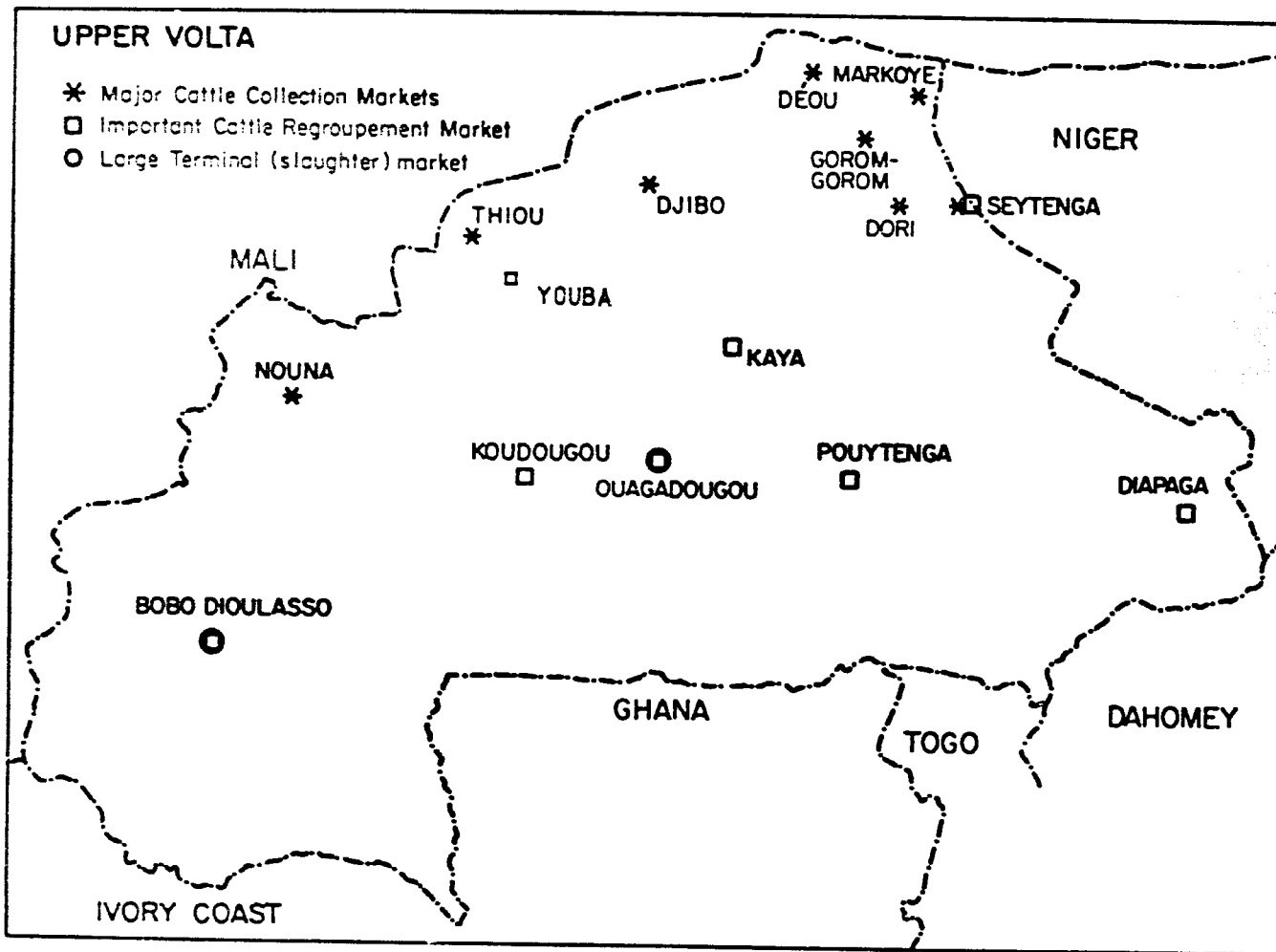
major categories: 1) collection of primary markets; 2) regroupment or redistribution markets; 3) terminal or slaughter markets. Map 3 identifies the most important of these markets in Upper Volta.

The collection market is characterized as a northern market in the cattle producing, or surplus zone, where animals usually first enter the market chain. There is also a set of smaller southern collection markets. What distinguishes primary from other types of cattle markets is the predominance of herders as sellers, and herders and traders as buyers, with local butchers playing a minor purchasing role. Cattle are "collected" by traders who form commercial herds for shipment south, either to regroupment or terminal markets, where the animals are resold to butchers or other traders. Herders often buy young animals in these markets, to replace the older stock they have sold off.

The redistribution market is distinguished from the collection market not so much by its location in the south -- for, as explained earlier, there are many small collection markets throughout that region of Upper Volta -- but by the dominating presence of traders as sellers. These merchants, having bought their cattle in other markets or in the bush directly from the herder, sell their herds to other merchants who move the cattle onward toward terminal markets. Regroupment markets generally attract greater numbers of butchers, both local and from nearby urban areas, than do primary markets.

Upper Volta really has no true terminal markets, where practically every sale is to a butcher and no cattle move on to other markets. In both the Ouagadougou and Bobo-Dioulasso cattle markets, approximately one-half the sales are to exporters. Thus, one would not be wrong in defining these markets as redistribution points. Bearing this in mind, both of these markets will be referred to as terminal markets in this report, for two reasons: first, because butchers' purchases of cattle are of so much greater importance in these two cities than in other regroupment centers; and second, because practically all of the remaining sales are to exporters, making these two cities major embarkment points for exports.

Table 8 represents the official statistics for cattle offered for sale in selected markets of each type. The data indicate an overall



Map 3: MAJOR CATTLE MARKETS IN UPPER VOLTA

TABLE 8

## NUMBER OF CATTLE OFFERED FOR SALE ANNUALLY IN SELECTED VOLTAIC MARKETS

Market	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
<u>PRIMARY MARKETS</u>											
Djibo	na	na	4,000	13,328	13,197	15,210	9,787	6,949	9,403	6,700 <sup>b</sup>	20,096
Dori	9,838	6,314	7,150	2,225	7,595	4,629	3,658	3,762	4,086	3,298	3,352
Markoye	47,241	28,664	22,770	21,467	24,354	23,935	18,579	13,359	6,387	5,262	7,152
<u>REDISTRIBUTION MARKETS</u>											
Diapaga	6,085	6,350	4,374	688	2,888	2,570	6,193	29	110	583	1,071
Kaya	27,199	32,111	24,482	31,922	33,794	39,102	33,973	21,181	14,950	16,832	21,123
Pouytenga	22,013	26,420	18,508	27,042	28,327	25,779	27,589	22,440	24,175	47,508	21,144
Youba	3,725	6,427	4,557	8,347	5,530	4,232	4,383	6,065	2,808	6,030	11,897
<u>SLAUGHTER MARKETS</u>											
Bobo-Dioulasso <sup>a</sup>	11,567	18,716	15,000	28,614	26,867	21,372	6,177	9,782	n.a.	n.a.	n.a.
Ouagadougou	30,480	32,160	26,207	28,026	31,078	43,537	40,364	35,490	25,278	n.a.	n.a.
<u>TOTAL OFFICIALLY RECORDED ENTRIES</u>											
			201,053	285,703	290,666	271,809	181,072	159,971	215,236	180,620	

<sup>a</sup>The figures for Bobo-Dioulasso are curious since market entries are considerably exceeded by recorded slaughters in the Bobo-Dioulasso Abattoir and most butchers purchase cattle at the city's cattle market. There are, however, two separate cattle markets in Bobo-Dioulasso and the numbers recorded may reflect only one of these markets.

<sup>b</sup>The figure appearing in the official statistics was 47,508. This was assumed to be an error since the author's own market survey in Djibo counted only 4,467 head offered for sale from May through December. The figure appearing is the author's estimate for 1976.

SOURCE: Statistiques: Direction des Services de l'Elevage, Ouagadougou, Haute Volta.

pattern of decline in market activity. Much of the decline can be attributed to a fall in offtake as a result of the drought, after an initial period of increased offtake during the drought years. Another factor is the disappearance of imported and transit cattle<sup>1</sup> from Niger and Mali. The most severe declines in market activity occurred in Sahelian primary markets, especially in the Oudalan (northeast). Also declining in importance was the cattle market in Diapaga, though this market is now making a resurgence as a redistribution market for exports to Nigeria.

Two other changes in marketing patterns not evident in Table 8 are worth noting. First, during 1976 and 1977, the border market in Seytenga emerged as a major redistribution market for cattle exports to Niger and Nigeria. This phenomenon was temporary, as the point of exchange later moved east, to Téra and Gothéye in Niger. Second, there has been an increase in unrecorded market activity in small primary markets in the south such as those which surround major redistribution markets like Kaya and Pouytenga. These markets attract traders, butchers, and intermediaries from the larger markets and offer the growing cattle-owning populations in the south alternatives to selling in redistribution markets. These examples give some indication of the changing nature of markets and the flexibility of the marketing system in responding to changing supply and demand conditions.

In all but the smallest cattle markets, the mechanics of transacting business are similar. Intermediaries or brokers negotiate the sale for the seller, though the seller retains the right to approve the price. Markets usually meet on an open field. Some meet in enclosures newly constructed by the government.

Animals are purchased singly or in groups, but scales are never employed, even where they exist, so price is always determined per

---

<sup>1</sup>Technically, transit cattle could not be sold in Voltaic markets.

head and never by weight (at least not explicitly). Prices are bargained openly, so information is quite available within the market.

#### Butchering and Meat Marketing

Like most other livestock production and marketing operations, butchering and meat marketing is largely carried out in the traditional sector with little reliance on modern technology. Except in the largest cities, there are neither mechanized slaughter nor cold room facilities, and there is little differentiation between cuts of meat. In most places, the traditional butcher buys live animals, slaughters them himself, cuts the meat, and resells it in retail markets -- a fully integrated butchering system.

For the most part, poor sanitary conditions exist both in places of slaughter and in meat markets. In most villages, slaughtering is usually done on the ground in the market itself; in small towns, it is done on a stone or cement slab floor which receives only superficial rinsing with cold water. Even in Ouagadougou, which has a new modern abattoir in which sanitation during slaughter is as good as anywhere in West Africa, wholesale meat sales take place on the ground just outside the abattoir's delivery dock. The area is rarely, if ever, cleaned, and vultures congregate on the roof and dock, picking at the displayed carcasses whenever they can. Throughout the country, retail meat sales take place in open markets from wooden tables which are infrequently washed down with hot water. The meat is sold almost immediately because of its perishability and the lack of refrigeration equipment, noted above. Even in Ouagadougou and Bobo-Dioulasso, where both public and private cold rooms are available, the use of such equipment is limited to a small number of European-style retailers who use their own facilities, and some meat wholesalers and exporters who use the chill rooms of the abattoirs.

Most retail meat sales take place in open-air markets from small stalls or by vendors who circulate through the markets with trays of meat in piles. Meat is most often sold in the form of a tas<sup>1</sup> consisting of an assortment of meat, fat, bone, and stomach and intestinal parts. Most organ and other edible fifth-quarter parts are sold separately by retail specialists. Prices are usually set by the size of the tas. In most cases, not even identifiable cuts of meat are sold explicitly by weight. Official prices are set by the government, but they are not enforced and have little relation to actual meat prices in retail markets.

Table 9 shows the evolution of official slaughters of all butchery animals from 1954-76. The recorded number of head of cattle slaughtered increased dramatically between the mid-fifties and mid-sixties. This might have, in fact, been due to an increase in beef consumption resulting from increased urbanization, but it is more likely accountable to better recording of these slaughters. Similar increases take place in other categories and are attributable to the same phenomenon. During the late sixties and through 1976, official cattle slaughters have remained relatively stable, increasing or decreasing by roughly 10,000 head (about 15 percent) but showing no significant long-run trend. Official tonnage jumped substantially from 1975 to 1976, largely a result of adjustments in the mean carcass weights applied to the recorded slaughter figure after weighings at the Ouagadougou slaughterhouse showed the prior estimates for cattle carcass weights to be significantly in error.

With the exception of a downward aberration in 1969, recorded slaughters of small ruminants show a fairly steady increase throughout the period covered. As with cattle, much of the increase is due to the efforts of the government to locate all commercial slaughters in slaughterhouses and other controlled areas. The fact that the number of head increased sharply in 1976 while tonnage fell is again due to adjustments in the mean carcass weights applied to the slaughter figures to calculate tonnage. The data on pork can be interpreted similarly, though without question pork is increasing rapidly as an acceptable beef substitute.

---

<sup>1</sup>The French word tas will be used throughout this report to identify meat sold in piles.

TABLE 9

EVOLUTION OF BEEF AND MEAT OFFICIAL SLAUGHTERS,<sup>a</sup> 1954 - 1976

YEAR	CATTLE			SMALL RUMINANTS			PORK			HORSES, DONKEYS, CAMELS			TOTAL MEAT TONNAGE (mt)
	# of Head	Tonnage <sup>b</sup> (mt)	% of Total Meat	# of Head	Tonnage <sup>b</sup> (mt)	% of Total Meat	# of Head	Tonnage <sup>b</sup> (mt)	% of Total Meat	# of Head	Tonnage <sup>b</sup> (mt)	% of Total Meat	
1954	27,180	3,533	83	48,467	630	15	2,397	96	2	-	-	-	4,259
1955	9,670	1,257	59	58,833	765	36	2,624	105	5	-	-	-	2,127
1956	33,955	4,414	89	57,791	751	14	2,739	110	2	-	-	-	5,275
1957	36,004	4,681	83	63,687	828	15	3,068	123	2	-	-	-	5,632
1958	38,532	5,009	83	63,584	827	14	4,374	175	3	-	-	-	6,011
1959	37,034	4,814	82	70,409	915	16	3,426	137	2	142	18	-	5,884
1960	42,995	5,589	82	79,496	1,032	15	4,541	182	3	264	34	-	6,837
1961	50,820	6,607	81	92,997	1,209	15	6,629	265	3	624	81	1	8,162
1962	53,348	6,935	81	99,816	1,298	15	6,220	249	3	739	96	1	8,578
1963	62,866	8,173	81	121,937	1,585	16	5,716	229	2	1,200	156	2	10,143
1964	75,239	9,781	82	130,921	1,702	14	6,903	276	2	1,419	185	2	11,944
1965	73,979	9,617	81	131,637	1,711	14	7,452	298	3	1,492	194	2	11,820
1966	72,096	9,372	80	141,435	1,839	16	7,709	308	3	1,802	234	2	11,753
1967	81,160	10,551	79	170,161	2,082	16	10,911	436	3	1,126	263	2	13,332
1968	82,995	10,784	80	157,874	2,052	15	9,777	391	3	1,320	270	2	13,497
1969	65,627	8,485	82	97,762	1,271	12	8,525	341	3	1,721	205	2	10,302
1970	75,730	9,845	80	142,627	1,854	15	10,122	405	3	1,726	210	2	12,314
1971	83,481	9,865	77	175,010	2,275	18	10,110	401	3	2,402	283	2	12,824
1972	74,032	9,624	74	206,583	2,716	21	10,983	439	3	2,495	155	1	12,934
1973	81,816	7,775	71	229,278	2,607	24	12,404	496	5	1,755	136	1	11,014
1974	72,682	6,905	67	236,061	2,714	26	12,982	519	5	2,655	233	2	10,371
1975	61,532	5,846	62	258,735	2,947	31	13,378	535	6	1,501	167	2	9,495
1976	72,116	8,669	72	330,501	2,546	19	16,703	869	7	1,285	296	2	13,335

SOURCE: 1954-1966, SCET International, 1972.  
1967-1976, Direction de la Statistique, Service de l'Elevage, Ouagadougou.

<sup>a</sup>Weights in metric tons.

<sup>b</sup>Tonnage calculated from following estimated mean carcass weights:

Animal	1954-72	1973-75	1976
Cattle	130 kg	95 kg	*
Small ruminants	13 kg	-	-
Sheep	-	13 kg	8.5 kg
Goat	-	11 kg	7.5 kg
Pork	40 kg <sup>oo</sup>	40 kg	52 kg
Horses	150 kg	125 kg	145 kg
Donkeys	80 kg	52 kg	81 kg
Camels	250 kg <sup>oo</sup>	155 kg	198 kg

\* For 1976, mean weights of cattle were broken down into following categories: Bulls - 125 kg ; steers - 137 kg ; cows - 104 kg ; young males - 85 kg ; calves - 73 kg.

<sup>oo</sup> For horses, donkeys and camels breakdown by type unavailable for 1954-1966. 130 kg used as estimate of mean overall carcass weights -- consistent with overall mean for 1967-72.

Meat Exports.-- One of the major goals of Voltaic livestock marketing policy is to increase the levels of meat exports so that Voltaic butchers and merchants can capture a greater measure of the value added in the livestock marketing chain. Consistent with this is the opening of the modern abattoir in Ouagadougou, plans for renovation of the Bobo-Dioulasso slaughterhouse, and the formation of a publicly supported agency, in cooperation with Ivory Coast, to operate refrigerated transportation in the two countries.

Currently, meat exports are carried out by private butchers from Ouagadougou and Bobo-Dioulasso. Beef exports normally constitute over four-fifths of all meat exports, with Ouagadougou supplying about two-thirds and Bobo-Dioulasso the remainder of the quantity exported during the last decade (see Table 10 and Figure 3). Almost all of the chilled meat exports are directed to Ivory Coast. Meat exports are transported principally by rail in refrigerated cars provided by CODEPAG (a private company) and operated by the RAN (the railroad running from Ouagadougou to Abidjan which is jointly owned by the Voltaic and Ivorian governments). One of the major problems for meat exported in this way is the unreliability of the refrigeration equipment on the rail cars. Breakdowns occur frequently, resulting in substantial meat spoilage. At times these losses can be devastating for the exporter. One of Ouagadougou's largest butchers ceased operation as a meat exporter several years ago because of the tremendous losses he incurred when refrigerated cars twice malfunctioned and completely ruined two large shipments of beef. He has since turned to live cattle exports.

When breakdowns do occur, losses are not necessarily total. When the meat arrives in Abidjan, it is inspected by the Ivorian veterinary service. Exporters may sell meat that is unacceptable to the quality butcher shops for which it usually intended, to other butchers who resell the meat in traditional urban markets. The prices offered by these

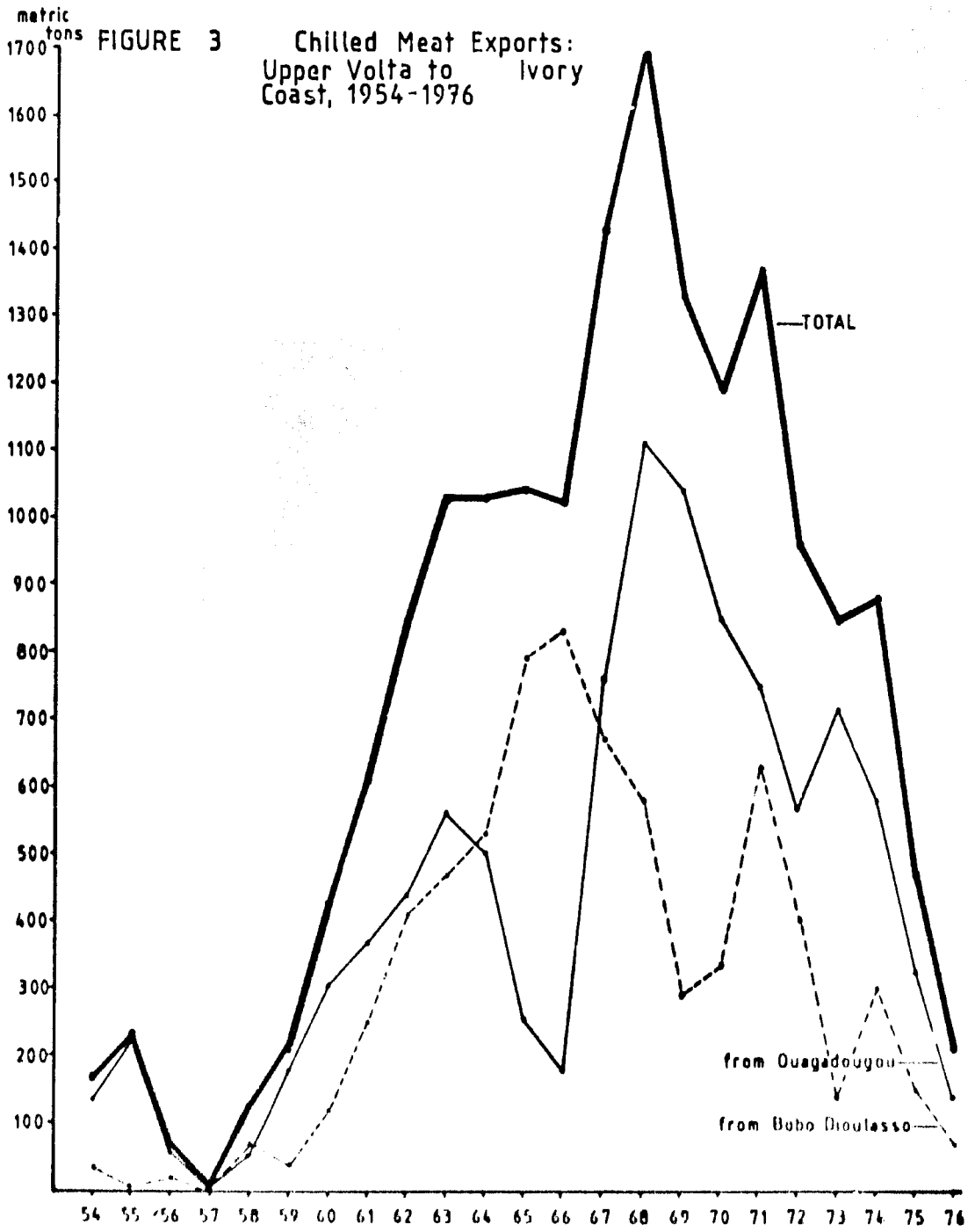
<sup>1</sup>In 1968, 74 tons of meat were exported by truck to Ghana, most of this to a meat packing plant in Bolgatanga. The following year an additional 55 tons were exported. The plant has since ceased operation and as a result, no have meat exports to Ghana.



TABLE 10  
 CHILLED MEAT EXPORTS: UPPER VOLTA TO IVORY COAST,  
 1954-1976 (in metric tons)

Year	FROM OUAGADOUGOU		FROM BOBO-DIOULASSO		TOTAL MEAT EXPORTS
	Meat Exports	% of Total Meat Exports	Meat Exports	% of Total Meat Exports	
1954	138	80	35	20	173
1955	219	94	14	6	233
1956	56	75	19	25	75
1957	7	100	-	0	7
1958	54	44	68	56	122
1959	176	81	40	19	216
1960	306	72	119	28	425
1961	366	60	248	40	614
1962	437	52	409	48	846
1963	561	54	471	46	1,032
1964	506	49	528	51	1,034
1965	255	24	791	76	1,046
1966	177	18	829	82	1,006
1967	760	53	670	47	1,430
1968	1,112	66	580	34	1,692
1969	1,040	78	287	22	1,327
1970	850	71	339	29	1,189
1971	749	55	625	45	1,374
1972	565	59	399	41	964
1973	715	84	139	16	854
1974	582	66	296	34	878
1975	326	69	147	31	473
1976	138	65	74	35	212
TOTAL (23 yrs.)	10,095	59	7,127	41	17,222

Source: Statistique Services de l'Elevage, Ouagadougou.



SOURCE: Statistique, Services de l'Élevage, Ouagadougou

traditional market retailers are considerably lower than those paid by quality butcher shops. As is shown in a later section, meat exports are profitable only if they can be sold to European-style butcher shops.

Referring back to Table 10 and Figure 3, one can see that chilled meat exports peaked during the late sixties and early seventies. For the most part, exports from Ouagadougou have dominated, as those from Bobo-Dioulasso declined as a result of a lack of capacity at the local slaughterhouse. Exports from Ouagadougou increased sharply at this point but soon began to fall as mechanical problems plaguing the refrigerated railroad cars started resulting in major losses for some exporters. Chilled meat exports have since continued to decline to the point where despite the hopes of the Voltaic government, they are now lower than at any time since 1958.

The first two sections of this chapter presented an overview of the current situation of the Voltaic livestock sector. It should be clear that in terms of both production and marketing, the sector is undergoing major transformations. At the same time, the government has demonstrated a new found interest in directing more policy toward livestock and meat marketing issues than it had been doing. It is thus against this background of changing supply, demand, and marketing interventions that this study attempts to evaluate the efficiency of the traditional livestock and meat marketing system. The next section of this chapter continues with a discussion of the conditions under which livestock producers sell their livestock.

### SALES BY HERDERS

One of the major criticisms of agricultural marketing systems in poor countries has been that producers consistently sell their products under disadvantageous conditions. Suggested causes of this situation include: the seasonal characteristics of production and marketing; the inability of producers to make informed choices over several marketing alternatives; monopsony power in the hands of market middlemen; and institutional (both social and physical) deficiencies in the marketing system (Bauer and Yamey, 1954; Jones, 1972; Abbott, 1967).

There is general agreement that producers' bargaining position is strengthened to the degree that alternative marketing outlets exist (competition among middlemen); they are known to the producers (unhindered, low-cost information flows); and that producers are willing and able to seek out these options.

The broader issues of competition among traders and other facets of market structure and conduct for the entire livestock marketing chain are covered in subsequent sections of the chapter. This section outlines the results of the research on marketing behavior and sales patterns by Voltaic herdsmen. It uses the data to ascertain whether herdsmen do in fact have marketing alternatives which they can take advantage of and whether those options they select suggest an effort to maximize returns from their sales. The section begins with a note on the sample of herdsmen surveyed for the research. It then examines the composition of livestock sales by region. The question of the seasonality of livestock sales and prices is discussed next. This is followed by a description of the market conditions faced by the herdsmen. The final sections suggest a model of cattle price formation which takes into account characteristics specific to both animal and transaction.

#### The Sample

In the first section of this chapter it was noted that about three-fourths of Upper Volta's cattle are owned by Fulani herdsmen. It was also

noted that many of these herdsmen reside outside the Sahel. The selection of a sample of herders was made to reflect this distribution of ownership as closely as possible, given the practical constraints to carrying out the research. Three regions were selected which met the criterion of incorporating a cross section of livestock-raising patterns; these were Djibo, Kaya, and Pouytenga.

The Djibo region is a predominantly pastoral zone in the Sahelian region of Upper Volta. All 134 sample members were Fulani. Kaya, located in the heart of the Mossi Plateau, is a predominantly sedentary region featuring both permanent Fulani villages and livestock-owning Mossi populations. This was reflected in a 73 percent Fulani, 27 percent Mossi distribution among the seventy-four sample members in the Kaya region. The initial choice of Pouytenga as the third sample area was due more to important cattle market than to any especially interesting livestock raising system found there. It turned out that the region displayed the interesting characteristic of relying heavily on the livestock entrustment system for cattle raising (see Delgado, 1979). The sample in the Pouytenga region included twenty-six Fulani households (31 percent) and fifty-six Mossi households (67 percent). Among the latter were included several minor cattle merchants.

#### The Composition of Marketed Livestock

The question of the composition of sales by herdsmen is especially important in light of the government's intention to implement the Stratification Policy. That entails the formation of a "breeding zone" in the Sahel, in which pastoralists would be encouraged to sell off their stocks of male cattle at a young age so they could be grown out and fattened in the south under more intensive production systems. Table II, however, shows that such a flow of young male cattle seems already to be the case. Three-quarters of all cattle sales by the Djibo area herdsmen were male. Of these, almost two-thirds were sold in their first two years and over four-fifths were sold by four years of age. Given that zebu cattle raised

TABLE 11

SEX AND AGE STRUCTURE OF CATTLE SOLD BY SAMPLE MEMBERS  
(Percent of animals sold in each region)

<u>Age</u>	<u>Djibo</u> <sup>a</sup>		<u>Kaya</u> <sup>b</sup>		<u>Pouytenga</u> <sup>c</sup>	
	<u>Males</u>	<u>Females</u>	<u>Males</u>	<u>Females</u>	<u>Males</u>	<u>Females</u>
< 2	46.3%	6.7%	7.7%	2.7%	0.1%	---
3-4	14.9%	0.6%	11.7%	3.7%	1.2%	0.1%
5-6	8.9%	---	26.7%	2.7%	26.5%	5.5%
7-8	3.5%	0.3%	29.0%	2.7%	36.1%	17.5%
9+	<u>1.0%</u>	<u>17.8%</u>	<u>7.0%</u>	<u>6.3%</u>	<u>2.5%</u>	<u>10.4%</u>
<b>TOTAL</b>	<b>74.6%</b>	<b>25.4%</b>	<b>82.0%</b>	<b>18.0%</b>	<b>66.5%</b>	<b>33.5%</b>

SOURCE: Field research, May 1976 - February 1977

- a. Total of 315 cattle sold over 9 months.
- b. Total of 300 cattle sold over 7 months.
- c. Total of 805 cattle sold over 8 months.

under a system of extensive stockraising don't reach maturity until six years, in general, this would indicate a tendency for the northern pastoralists to sell off young males with significant potential for fattening. This pattern is quite consistent with the traditional Fulani emphasis on milk and animal reproduction as opposed to meat production.

The data collected for cattle sales by southern livestock owners shows a significantly higher age distribution. In contrast to the predominantly young male cattle sold by Djibo area herdsmen, less than 2 percent of the Kaya sample's sales were of male cattle two years or younger. The Pouytenga sample sold virtually no cattle in that age bracket. In both southern samples, the vast majority of male cattle were sold between five and eight years of age. While this evidence does not in itself prove that the young cattle sold by northern herdsmen are bought, grown out or fattened, and then sold by southern stockraisers, it does seem to indicate that an indigenous "stratification" system is already in effect.

Table 11 also indicates a difference in the sales patterns of females in the three regions. Djibo area herdsmen only sold females at extremely young or old ages. The surprisingly large number of heifers sold can be attributed to the demand and subsequent high prices generated by a herd reconstitution program in Niger. Once cows approach reproducing age in good health, northern Fulani herdsmen are reluctant to sell them. The Fulani herdsmen also tend to cull their cows at old ages. Both Djibo and Kaya area Fulani sold substantial numbers of cows from thirteen to sixteen years old, for an average culling age of 12.05 years. The predominantly Mossi cattle owners in the Pouytenga region appear to cull their cows at much earlier ages; eleven was the oldest reported age at which cows were sold in that region.

Another interesting comparison may be made between sales of cattle and small ruminants (goats and sheep). Table 12 presents the data for the Djibo sample, comparing number of sales and revenues from cattle and small ruminants. It shows that although cattle account for less than one-half of the total number of sales, they make up more than 86 percent of total revenues from animal sales. In spite of the fact that almost twice as many goats as sheep were sold by the sample, lower average prices for goats resulted in their contributing only slightly more revenue than did sheep.

TABLE 12

## COMPOSITION OF LIVESTOCK SALES BY DJIBO SAMPLE MEMBERS

CATTLE						
	No. of Sales <sup>a</sup>	% of Total livestock sales	% of Total cattle sales	Revenues <sup>b</sup>	% of live- stock revenues	% of Cattle revenues
Young males (< 4)	192	29	62	3,015,580	43	51
Mature males (> 5)	<u>40</u>	<u>6</u>	<u>13</u>	<u>1,498,522</u>	<u>22</u>	<u>25</u>
Total Males	232	36	75	4,514,522	65	76
Heifers	22	3	7	552,405	8	9
Cows	<u>57</u>	<u>9</u>	<u>18</u>	<u>897,120</u>	<u>13</u>	<u>15</u>
Total females	<u>79</u>	<u>12</u>	<u>25</u>	<u>1,449,525</u>	<u>21</u>	<u>24</u>
Total Cattle	311	48	100	5,963,627	86	100
SMALL RUMINANTS						
	No. of Sales <sup>a</sup>	% of Total livestock sales	% of Total S.R. sales	Revenues <sup>b</sup>	% of live- stock revenues	% of S.R. revenues
Goats	221	34	65	541,892	8	55
Sheep	<u>121</u>	<u>19</u>	<u>35</u>	<u>444,433</u>	<u>6</u>	<u>45</u>
Total S.R.'s	<u>342</u>	<u>53</u>	<u>100</u>	<u>986,325</u>	<u>14</u>	<u>100</u>
Total livestock sales	653	Total livestock revenues		6,949,952		

SOURCE: Herder Survey

<sup>a</sup>Number of head<sup>b</sup>CFA Francs



### Seasonal Variations in Sales

The question of seasonality of agricultural production and the timing of sales and purchases of agricultural commodities by farmers is widely covered in the literature. Most attention is focused on food crops and the economic pressures on farmers in poor countries which cause them to sell off production immediately following harvest when prices are low, and often require them to buy the very same commodities during the pre-harvest period at significantly higher prices (Jones, 1972, p. 16; Abbott, 1976, p. 367). The supply and demand conditions which give rise to this situation are explained by the gestation period and storability of the crop and the seasonality of peasants' cash needs. It might seem that the characteristics of livestock production would not make temporal marketing patterns of livestock as crucial as in the case of staple food crops; however, suggestions that herdsmen are vulnerable to adverse seasonal market conditions have been advanced (Dupire, 1968, p. 357; Rupp, 1975, pp. 72, 120).<sup>1</sup>

The factors which work on the seasonality of livestock sales are: the variations in the condition of the animals and the risk of holding livestock over different seasons (analogous to gestation and storability in the food crop case); the cash needs of the producer and his proximity to markets; and the seasonality of demand. The assertion that herdsmen do not sell their livestock at a seasonally opportune time is based on the view that herders' cash needs outweigh all other considerations and result in sales of livestock during periods of low prices. This section examines the seasonal patterns of livestock sales by Voltaic herdsmen.

Figure 4 shows the seasonal variations in livestock sales and revenues for the Djibo herder sample between April 1976 and February 1977. Cattle

---

<sup>1</sup>Such suggestions also appear implicitly throughout much of the anthropology literature. It is often claimed that the primary motivation for Fulani livestock sales is cash need (Johnson, 1977, pp. 12-13, Barral, 1967, p. 29). An accompanying disinclination to hold assets in forms other than livestock thus make it difficult for the herdsman to take advantage of seasonal price variations when they don't coincide favorably with his own cash needs pattern.

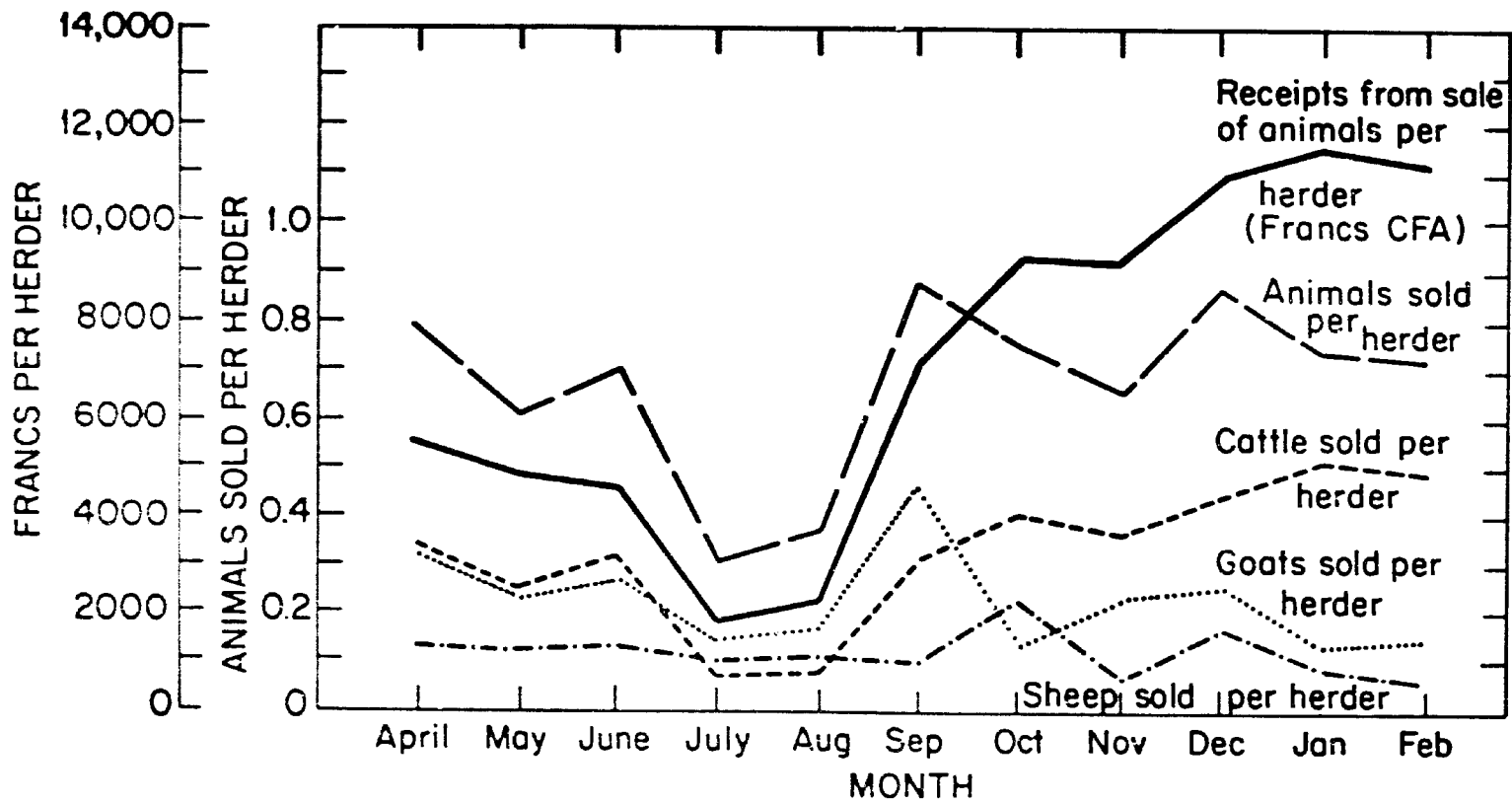


FIGURE 4. SEASONAL VARIATIONS: ANIMAL SALES AND REVENUES PER HERDER: DJIBO HERDER SAMPLE, 1976-77

sales exhibit a very smooth pattern which can be characterized by three seasons. Sales are falling during the end of the dry season and into the early rainy season (April-July) with a small upturn in sales in June. The period of heaviest rain (July and August) results in a severe decrease in sales. Cattle sales then increase almost continuously during the end of the rainy season and through the end of the year, tapering off from January to February.

Figure 5, which presents the seasonal variation in several Voltaic cattle markets for the period 1970-1976, shows that the pattern found for the Djibo herder sample is indeed reflected in market entries over a long period of time and in other regions. In all four markets shown (Djibo, Kaya, Ouagadougou, and Pouytenga) sales are lowest during the early rainy season (May-July) and then increase rapidly to a peak near the end of the year. There are inconsistent patterns during the dry season (January-May), though in most cases there appears to be a modest peak between March and May.

Returning to Figure 4, one notes less of a definite seasonal pattern in the case of small ruminant sales. The level of goat sales is depressed during the rainy season months of July and August and increases in September. It falls precipitously, however, in October, increases in November when cattle sales are falling off, and falls again in January when cattle sales are rising. Sheep sales are remarkably stable throughout the year, with modest peaks in October and December. The rainy season has no depressing effect on sheep sales.

These patterns can indeed be explained by the factors mentioned above. Figure 6 shows the assumed effects of various factors upon livestock sales. Those above the month bar are positive effects on supply or demand expected to increase the level of sales. Conversely, those below the time line have depressing effects on quantity sold.

1. The Condition of Livestock: Livestock put on weight and are in best physical condition following the rainy season and throughout the harvest season. To best take advantage of this one would suppose that herders would sell more livestock during this period. As the livestock's condition worsens throughout the dry season, herders would attempt to hold

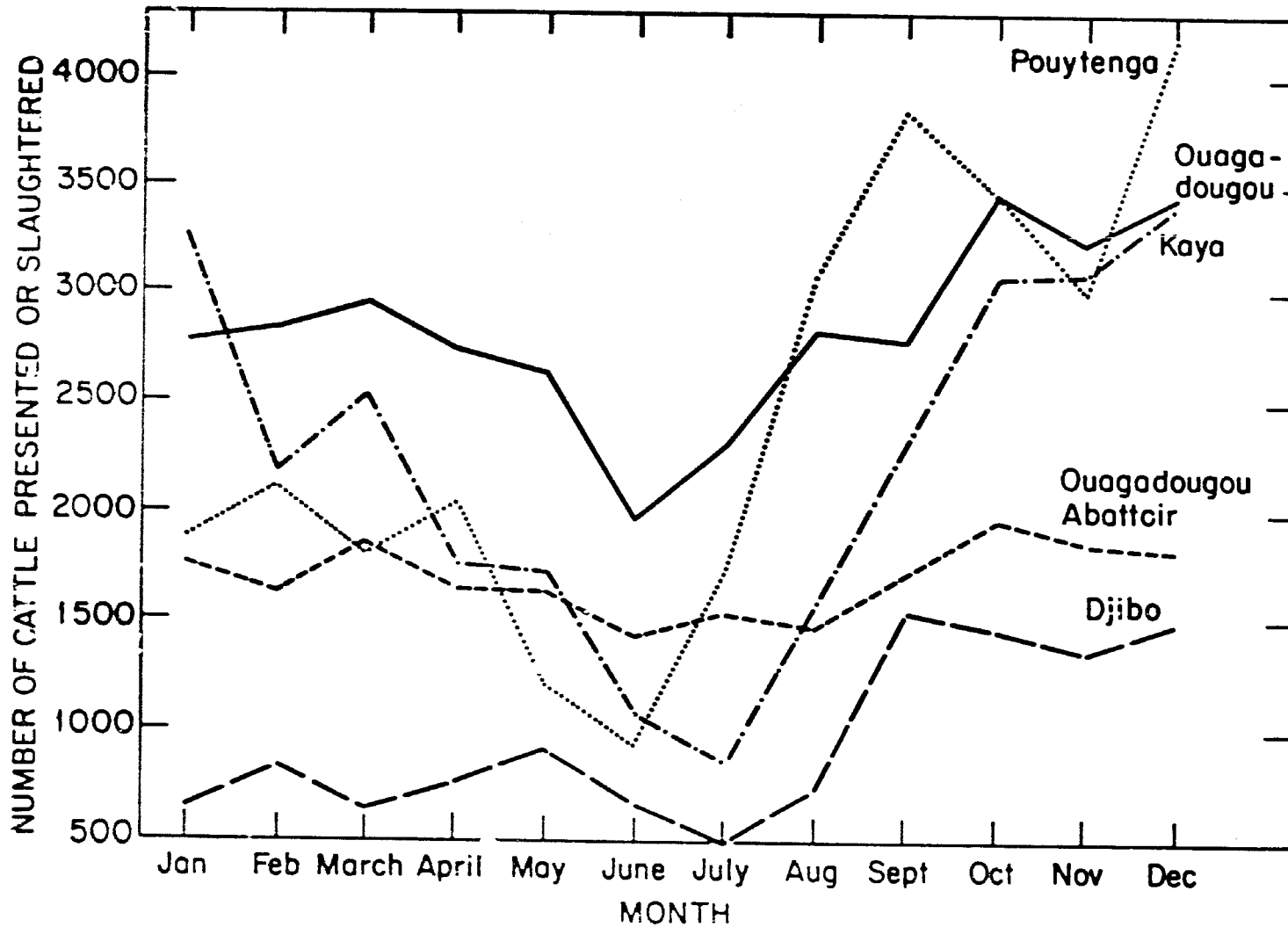
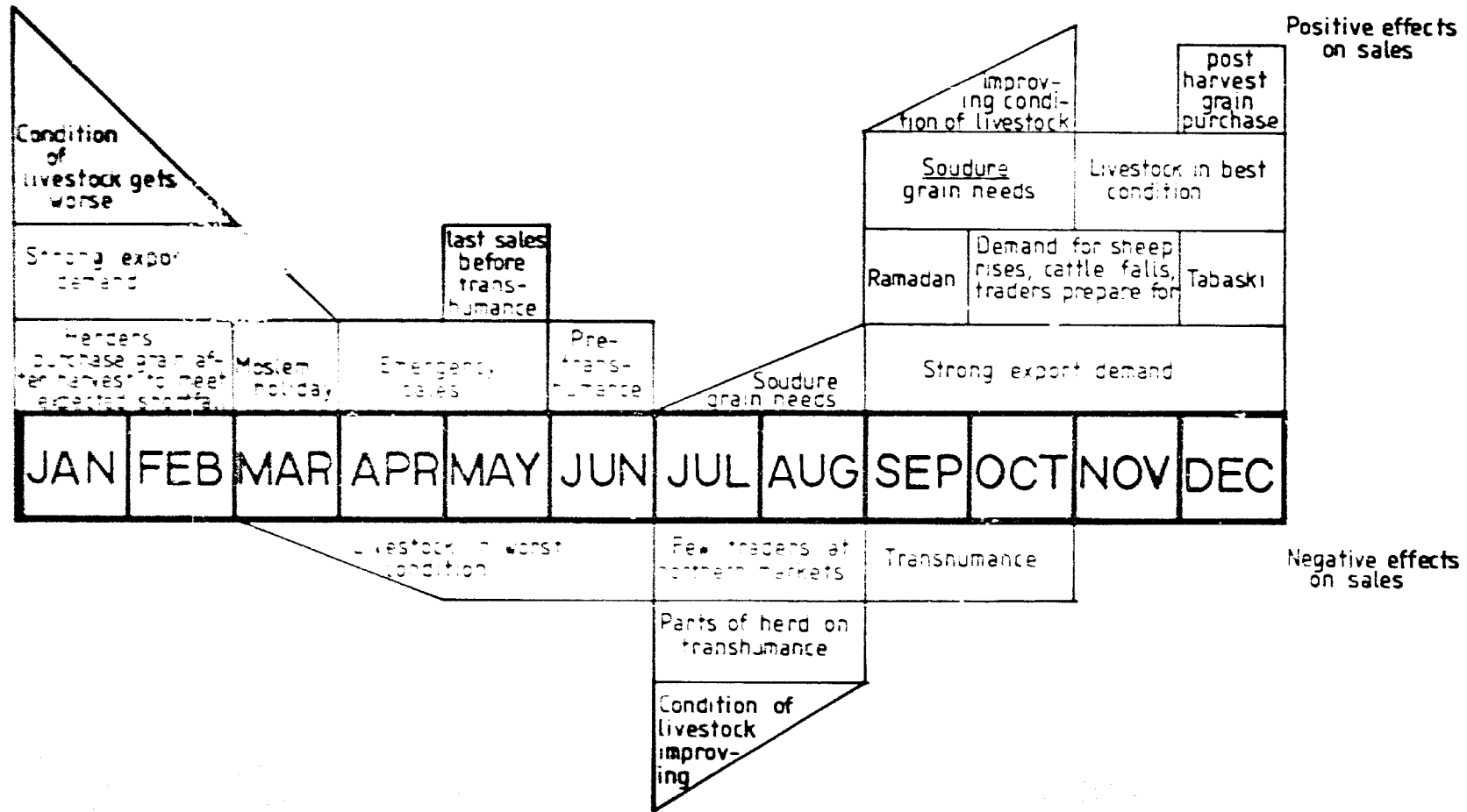


FIGURE 5. SEASONAL VARIATIONS: MARKET ENTRIES AND SLAUGHTERS, 1970-76

FIGURE 6 Theoretical Pattern of Livestock Sales



off sales of their "skinny" cattle, waiting for the rains, when these animals will start gaining weight again.

2. Risk and Salvage Sales: There are instances when herdsmen will sell off animals in poor condition. This occurs when an animal is viewed as too much of a risk to carry through the dry season. Ideally, these animals would be culled when in best condition, say October through January. Still, herdsmen find themselves selling some cattle during the period of greatest risk because of misjudgements they may have made. Thus the positive sale effect, "Emergency Sales," in April and May on Figure 6.

3. Herders' Cash Needs: This is the motivation for sale most often discussed in the literature. In the case of the Djibo herdsmen (and applicable to herdsmen throughout the country) the most important needs are for cereals, taxes, household goods, and ceremonial or holiday obligations.<sup>1</sup> Cereals transactions are strongest during two periods: after the harvest (November through January) many herdsmen attempt to purchase millet at what they perceive as low post-harvest prices to make up the anticipated shortfall in their own production for personal consumption. The other major period of grain purchases occurs during the so-called period of soudure, between planting and harvest, when households which run short of grain must purchase supplies to carry them through their own harvest. It should be noted that both of these periods coincide with the time when animals are in good condition.

Payment of taxes is usually required in the late fall, though in some villages it is put off until January or February. Once again this period coincides with the time when livestock are in good condition.

---

<sup>1</sup>For the 657 sales recorded in the Djibo sample, responses to the question: "Why did you sell the animal?" broke down as follows:

To buy millet	69%
To buy cloth goods or jewelry	12%
To pay taxes	9%
To repay debts	1%
Medical expenses	2%
To arrange ceremonies	2%
To buy "cola"	3%
Other	2%

In general, purchases of household goods may be viewed as discretionary expenditures which may be timed so as to maximize the terms of trade between the source of income (livestock) and the object of purchase. There is no a priori reason to suppose that these needs would occur so as to subject the herdsmen to unfavorable terms of trade. There does seem to be an obligation to make many of these purchases, especially cloth and European-manufactured cooking ware, during holidays. This leads to an increase in livestock sales around the period of the major Moslem holidays, Ramadan, Tabaski, and the Prophet's Birthday. Because the Moslem calendar follows an uncorrected lunar cycle which shifts approximately eleven days each year relative to the solar calendar, Moslem holidays have no fixed season and will fall at different times of the year over a thirty-three-year period. During the survey period, Ramadan was in September, Tabaski in early December, and the Prophet's Birthday in March.

4. Proximity to Markets. During the rainy season and into the fall, large parts of the cattle herds are taken away from the villages on their transhumance to northern pastures. One expects this to have a positive effect on sales prior to the movement (May and June) and a negative effect when the herds are removed from market opportunities (July through October).

5. Seasonal Variations in Demand: The seasonal variation in demand is evidenced in three ways. First, northern primary markets like Djibo are almost inaccessible to southern traders during the rainy season. Second, the peak export season runs from September through March. Third, before the Tabaski season, many cattle traders move to sheep trade, thus depressing the cattle demand temporarily and boosting sheep sales. All of these fit the pattern found in Figure 4.

Comparing the theoretical patterns resulting from these five factors (Figure 6) with the actual pattern of sales of Djibo area herdsmen (Figure 4) and the seven years' straight averages for four major markets (Figure 5), one finds almost perfect correlation. The next step is to look at prices to determine whether there is any definite pattern, especially one that would indicate a disadvantageous selling pattern.

Figure 7 presents the average monthly prices of six categories of cattle for the period of May 1976 to April 1977 in the Djibo cattle market. While there is no dominant pattern which would indicate clear-cut seasonal movements in price, several observations can be made from the graph. The prices for mature bulls and heifers indicates increasing trends over the survey period. The price of young males is remarkably stable over the entire year. The prices of mature steers, cows, and male calves show the strongest variation over season. Generally, prices are lowest sometime during the rainy season, rise during the period from August through October, fall again around November, and rise again at the end of the year. The price of steers fell dramatically from January to February. A similar decline is observed for cows between February and April. It is somewhat surprising to see the prices of mature males rise over the same period. If there is any pattern to be discerned from the data, it is one of peaks near September and January with troughs during the rainy season and around November.

While the data on herder's livestock sales and cattle prices don't appear to warrant any strong conclusions, they certainly seem to favor the view that herdsmen are rational in timing of sales over the view that they sell during periods that are unfavorable to them in terms of price. The modest price peaks (October and January) correspond very well to periods of increasing cattle sales. Periods of lowest price (July to August and November) occur when sales are slumping. The pattern of herders' sales seems best explained by the factors presented earlier in this section, all of which indicate temporal sales strategy which would be difficult to improve upon.

### Market Conditions Faced by Herdsmen

Bauer and Yamey theorize that exploitation of producers by middlemen is made difficult if one of two conditions hold: 1) if there is competition among traders seeking to purchase agricultural commodities at the farm level, or 2) if viable marketing alternatives are available to the producer and he is informed of these options (Bauer and Yamey, 1954).



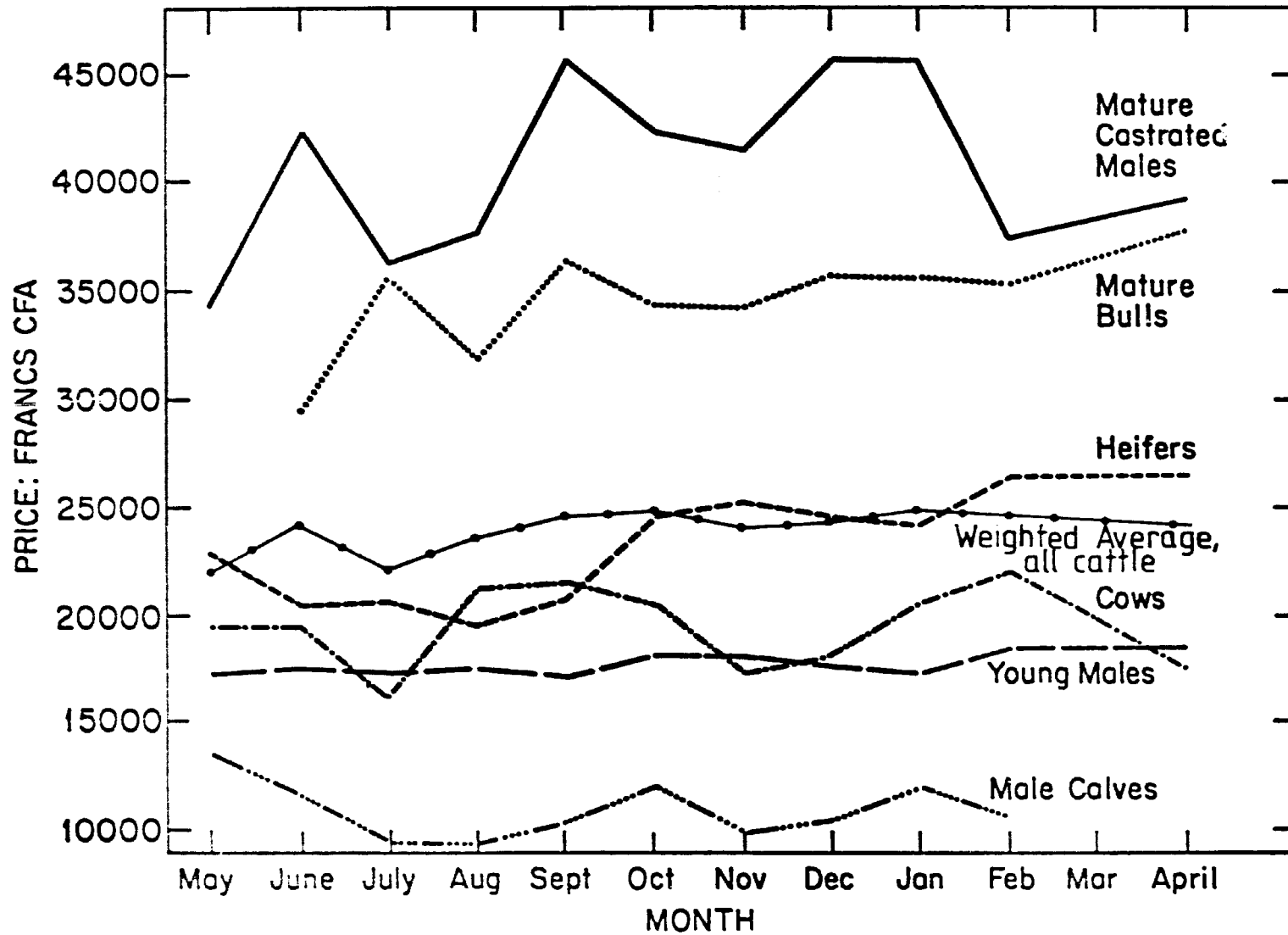


FIGURE 7. MONTHLY AVERAGE CATTLE PRICES: DJIBO CATTLE MARKET, MAY 1976-APRIL 1977

This subsection looks at the conditions under which Voltaic herdsmen sell their cattle, the applicability of the Bauer and Yamey model, and the effects of various factors on herders' bargaining position.

The belief that herders' interests are protected by competition in the marketing circuit is based on the view that traders will compete with one another in the purchase of agricultural commodities at the farm level, thus assuring producers of a fair price, i.e., one that is consistent with commodity prices in consumption markets and the costs of marketing, transport, and processing.<sup>1</sup> Such conditions may not always exist. Production may be so dispersed that certain localities may not be able to support trading operations by more than one or a few traders. Or, traders may otherwise be able to effect varying degrees of monopsony power, through collusion, institutional arrangements, or with tie-in selling obligations.<sup>2</sup>

Whatever the cause of the noncompetitive market conditions faced by the producer, the second set of conditions could still ensure him of a reasonable price for his product. If he knows of viable marketing alternatives, say to sell in a market further away, then he should be willing to bypass the first middleman if the price differential is not consistent with the producer's valuation of the service. In order to maintain his position, the middleman is forced to offer a price which includes a margin no greater than the value the seller places on his service.<sup>3</sup> Any

---

<sup>1</sup>In fact, the argument here is largely incomplete, since producer prices are linked to consumer prices by several markets, transactions, and product transformations. For farm level prices to reflect accurately the level of consumer demand less the minimum marketing margin requires efficiency at each stage of the marketing circuit. That issue is discussed later in this chapter. The point here is to examine the ability of those middlemen who directly link livestock producers with the marketing circuit to exert monopsony power in their dealings with the herdsmen.

<sup>2</sup>Examples include herder indebtedness to or dependence on certain traders for purchase of other commodities.

<sup>3</sup>The problem with this alternative is that its ultimate solution would be discriminatory pricing by middlemen which in itself would be sufficient grounds for declaring the system inefficient. For unless every seller valued the services at a price equal to the costs (including normal profits) of those services, middlemen could gain the so-called consumer surplus from their clients. The lesson here is that while producers' awareness of market alternatives does limit the degree of monopsony power any middlemen can wield, it does not necessarily negate it entirely.

price lower than that would encourage the producer to sell elsewhere.

In looking at the marketing behavior of Voltaic herdsmen, four questions were emphasized:

- 1) What are the marketing alternatives which face the herdsmen?
- 2) Does the herder have access to market information information which enables him to make an informed decision?
- 3) What social or economic relations restrict sellers from exercising free choice among marketing alternatives?
- 4) To what degree are marketing arrangements open and prices explicitly agreed upon?

In answering the first question, the study examined the places in which animals were sold, other markets which herdsmen said they had visited or in which they would consider selling their cattle, and the buyers to whom livestock were sold. For the second question, herders were asked about their knowledge of livestock prices, seasonal price trends, and general conditions prevailing in markets further down the marketing network. The factors which seemed relevant to evaluating constraints to free choice in marketing options are the use of credit or exchange in livestock transactions and the occurrence of exclusive dealing arrangements between herdsmen and traders (or intermediaries). Finally, the fourth question was evaluated by looking at the mechanics of trade: do herdsmen sell in front of witnesses? How are intermediaries used? Do herdsmen negotiate themselves? And are prices explicitly agreed upon in the case of direct exchange?

1. Marketing Alternatives: The choice of marketing strategy was found to vary with the type of animal sold, and the region. Table 13 summarizes the conditions under which the herder sample sold its livestock. In all three regions, it was assumed that herdsmen had four choices in deciding where to sell: 1) in the village or in the bush, outside of any formal market; 2) at a village or local periodic market; 3) at the major regional market; or 4) at a major market further down the marketing chain. Though the results show that the vast majority of all livestock was sold in organized markets, no herders ventured forth

TABLE 13  
SALE CONDITIONS FOR HERDER SAMPLE

	Djibo		Kaya		Pouytenga	
	Cattle	Small Ruminants	Cattle	Small Ruminants	Cattle	Small Ruminants
I. Location of Sale						
A. Regional Major Market <sup>a</sup>	83.4Z	14.0Z	22.9Z	5.2Z	92.0Z	84.2Z
B. Local Village Market	1.0Z	68.4Z	72.8Z	82.1Z	7.0Z	15.6Z
C. Outside of Market	14.7Z	17.6Z	4.3Z	12.7Z	1.0Z	0.2Z
II. Buyers						
A. Trader	75.9Z	76.0Z	74.8Z	63.9Z	68.7Z	66.2Z
B. Butcher	0.3Z	0.9Z	7.0Z	18.8Z	25.9Z	27.6Z
C. Sold through Intermediary	83.0Z	46.5Z	79.0Z	50.1Z	95.1Z	89.2Z
D. Other <sup>b</sup>	13.3Z	13.5Z	17.5Z	17.4Z	5.3Z	6.2Z
III. Nature of Exchange <sup>c</sup>						
A. Cash	96.0Z	96.0Z	98.0Z	98.0Z	100.0Z	100.0Z
B. Credit	1.0Z	4.0Z	3.0Z	6.3Z	0.0Z	0.0Z
C. Exchange for merchandise or animals	4.0Z	1.0Z	1.0Z	0.0Z	0.0Z	0.0Z
IV. Sold in Front of Witness	91.0Z	63.8Z	84.5Z	58.8Z	99.1Z	98.8Z
V. Sold by						
A. Herdsman	83.6Z	79.6Z	93.1Z	87.8Z	98.7Z	93.8Z
B. Other <sup>d</sup>	20.4Z	16.4Z	6.9Z	12.2Z	1.3Z	6.2Z

Sources: Field research, May 1976 - February 1977.

<sup>a</sup>Djibo, Kaya, Pouytenga

<sup>b</sup>Includes herders, farmers, civil servants, military.

<sup>c</sup>Some sales included combinations of credit, exchange, and cash.

<sup>d</sup>Includes relative, friend, intermediary: owner not present.

than the major market in their region.<sup>1</sup> Most herdsmen cited the inconvenience, length of trip, and high costs involved in moving cattle long distances as well as unfamiliarity with markets and intermediaries as the reasons for eschewing the admittedly higher paying alternative of selling cattle further down the marketing chain. Notably, some of the herdsmen pointed to the small number of animals they sell at one time (or even in a year) as the limiting factor in considering distant markets, indicating an awareness of the economies of scale in cattle marketing.

The pattern of sales exhibited in part I of Table 12 seems to indicate that herders are balancing the costs of taking livestock to different markets against the higher prices livestock bring where buying is competitive. The bush sale entails little cost but affords the herdsman limited options; prospective buyers are limited to other herdsmen or farmers, itinerant merchants who pass infrequently, or, in case of emergency sale make up a significant portion of both cattle (14.7 percent) and small ruminant (17.6 percent) sales. In Kaya, few cattle (4.3 percent) but a fair share of small ruminants (12.7 percent) were sold outside of formal markets. Pouytenga area herdsmen sold negligible amounts of livestock away from markets.

The cost of taking an animal to market is largely a function of distance. The benefits derived from going to various markets depends, of course, on the nature of demand. Local markets usually offer greater opportunities to sell small stock as opposed to cattle. The smaller cash requirements needed to enter the small ruminant trade result in an abundance of petty merchants in local goat and sheep markets. Also, demand for cattle by butchers in local markets is usually quite limited. These butchers usually prefer to slaughter small ruminants here because the demand for meat is limited and goats and sheep offer the butcher greater control over volume.

There are some local markets where one does find significant demand for cattle as well as for small ruminants. This occurs where the system

---

<sup>1</sup>This is not to say that herdsmen never travel far to sell their cattle. Market surveys showed many cases of Malian herdsmen selling in the Djibo market and several Djibo area herdsmen (though not among the sample) appeared in Kaya to sell.

of local periodic markets is strong, well organized, and where the markets are easily accessible by distant merchants. This was true in the Kaya region. Intermediaries from the Kaya livestock market also serviced two of the region's local markets (Pissila and Samtaba), both of which were on main roads. Both had a greater level of activity than the other village markets in the region and both often attracted livestock buyers from Ouagadougou -- something that rarely happened in the other local markets included in the survey in the Kaya or Pouytenga regions and never happened around Djibo.

The major regional markets afford the herdsman the widest and most competitive demand for his stock. Buyers include local butchers, butchers from nearby towns, petty traders and long distance traders, speculators and other herdsmen. Herdsmen are able to negotiate with several prospective buyers (usually through an intermediary) before selling. Against the likelihood of a better price, the herder must weigh the costs of traveling to this market, usually a day or more away from his village. It is clear from the data that he is more likely to take the time and incur the costs to sell cattle in regional major markets. In all three regions the proportion of cattle sold in the major market exceeds that of small ruminants. Only in Kaya did the samples sell more cattle in local markets than in the regional major market.

Almost as important as the site of the sale and the overall level of demand is the composition of buyers. Demand by local butchers strengthens the market for cull animals and others which are difficult and costly (because of risk) to trek to distant markets. Demand for young stock by herders & farmers for breeding, fattening, or traction raises the market value for those animals. And, of course, competition among traders ensures that the demand for cattle in other regions is transmitted through the marketing chain. Section II of Table 12 presents the composition of buyers for animals sold by the herder sample. The majority of cattle in Djibo and Kaya and almost all cattle sold by the Pouytenga sample were sold through intermediaries. In all cases fewer small ruminants were sold with the aid of intermediaries, though in Pouytenga the proportion is still very high (89.2 percent). Two other results should be noted. First, the number

of animals sold to butchers in Djibo is very small, reflecting the thin meat markets in Djibo and the surrounding local markets. This has a depressing effect on the price of cull cows and other animals which are difficult to trek to distant slaughter centers. Secondly, sales to non-commercial buyers (row D) in Poytenga are weak, indicating relatively few sales to herders and farmers in the region. This seems to conflict with the subjective observations of the author and others (including the veterinary agent in the Pouytenga market) that many young bulls are currently being purchased by individuals for growing out or fattening.

Reviewing the marketing alternatives faced by Voltaic herdsman, one notes that the willingness to move livestock through the marketing chain is a function of the value of the animal(s) and the likelihood of finding competition close to home. Herdsman are generally aware of the better prices to be found at distant markets but feel that the costs entailed in making the journey are not justified because of the limited number of livestock sold by the individual. The pattern that emerges shows the herder selling most of his livestock in organized markets. Few sales take place at the farm gate, where buyers are most likely to be able to wield monopsony power. Small ruminants are more likely to be sold in local markets, and cattle most likely to be taken to major regional markets where competition among buyers is strongest. Demand by butchers is weak in Djibo, thus depressing the market for cull (immediate slaughter) animals there.

2. Access to Market Information: As noted in the previous section, most herdsman claimed an awareness of spatial price variations. Most also reported that they thought prices rose following the rainy season to post harvest peaks and then fell through out the dry season. This simple pattern appears to be a very accurate reflection of the price trends outlined in a previous section. While few herdsman were up to date on immediate changes in the market conditions at the terminals of the marketing chain (Abidjan or Ouagadougou, for example), many seemed to have some awareness

of the general changes in market conditions that ultimately affected them.<sup>1</sup> All of this information traveled by word of mouth. The herdsmen's sources included merchants, intermediaries, veterinary agents, and friends and relatives. Information concerning local market conditions was transmitted similarly. Upon returning from a local market, a herdsman is obligated to share any information with others.

During each month's interview, herdsmen were asked whether they know the prices for cattle in the major market nearest them. The results are shown in Table 14. They show that most herdsmen claim to have information concerning prices even when they don't sell. Among cattle sellers, only in Kaya did a large number of herdsmen not know cattle prices in the Kaya market. It should be recalled that Kaya is the region where a majority of cattle sales took place in local markets. Table 14 also given the average price received from herdsmen claiming price information and for those not claiming this knowledge. While the differences should not be taken as a measure of the value of such information, in all three regions the mean price received by "informed" herdsmen was greater than the price received by those without market information.

3. Independence of Transactions: Livestock sales by herdsmen were found to be remarkably free of burdens which might have adversely affected the sellers' ability to exercise free choice among his marketing alternatives. As section III of Table 13 indicates, few transactions involved the use of credit or direct exchange of merchandise. This would seem to seek out the likelihood of monopsony power resulting from the provision of multiple economic services, for example, the marketing-moneylending-merchandising triad often found in rural economies (Wharton, 1962, pp. 34-35). No herdsman interviewed admitted to any type of exclusive dealing arrangement with traders, though many claimed to have regular relations with a traders or butchers. About the only tying relation likely to restrict the herder's choice of marketing alternatives is with the intermediary. Most herdsmen maintain a close relationship with one intermediary with whom there exists the mutual trust necessary for the herders to feel confident of receiving good advice, and for the intermediary to be willing to make the necessary



TABLE 14

ACCESS TO PRICE INFORMATION AND EFFECT ON CATTLE PRICES

	<u>Djibo</u>	<u>Kaya</u>	<u>Pongtenga</u>
<u>Herders claiming price information for nearest major market</u>			
All respondents	59%	49%	80%
Cattle sellers only	82%	65%	84%
<u>Average Cattle Prices</u>			
Claimed information	20,542	33,837	35,246
No information	15,895	24,704	27,102

guarantees on the part of the herder. Usually the intermediary comes from the same village or region as the herdsman. Though most herders claimed that they could change brokers if they desired, few admitted to having done so.

4. The Openness of Marketing Transactions: This final criteria for evaluating the market condition faced by herdsmen is based on the view that open transactions and explicitly agreed upon terms of trade are not conducive to exploitation of monoposony power by livestock buyers. Conversely, those characteristics of trade which tend to cloud the exact terms of market transactions encourage "hidden" monoposony gains. This is particularly true where two or more economic functions are linked, such as in the case of provision of multiple economic services. If an animal is sold on credit the duration may significantly reduce the real value of the price agreed upon.

As Table 13 indicated, almost all cattle and the majority of small ruminants are sold through intermediaries. Most herders attend the market themselves (see section V of Table 13) and discuss the price with the intermediary before the animal is actually sold. Even where the animal is not sold with the aid of a market intermediary, the sale usually takes place in front of other witnesses. These conditions tend to reduce the ability of the buyer to exploit herdsmen.

One fairly common allegation is that the intermediaries conspire with buyers to "cheat" herdsmen by reporting lower prices than are actually agreed upon (see for example, Dupire, 1968, pp. 348). Bargaining takes place openly in most Voltaic markets and buyers and intermediaries would be hard pressed to negotiate a secret arrangement. One problem that could arise, though, concerns the sale of cattle in lots. When several animals belonging to several different herdsmen are sold in a lot at a single price or constant unit price, it may be difficult for the broker to appropriate the funds among the sellers. Still, most herdsmen using a single intermediary know each other (often being related or from the same village) and can quickly ascertain whether the full price of the lot has been apportioned. The problem that arises is one of distribution among herdsmen, not exploitation of the group by the intermediary.

The characteristics of a transaction which often obscure the terms of sales usually involve the provision of multiple economic services. As noted earlier, this rarely occurs among livestock sales by herdsmen. Almost all sales are for cash. In the few instances where credit was involved, it was extended by the herdsman to the purchaser for short periods of time (usually less than two weeks). In several cases of merchandise exchange, no explicit price was agreed upon, but such arrangements were rare. Thus, there seems to be little opportunity for the purchaser to conceal exploitive gains in credit terms or in the price of merchandise exchange.

#### PRICE MODEL FOR FIRST-BUYER CATTLE SALES

This section presents a model of price variation for cattle sales by herders. It should be noted that this is not an attempt to estimate supply or demand functions; this is immediately evident by the absence of any quantity term in the equation. Rather, it is an attempt to estimate and test for effects on price by several important characteristics specific to the animal sold and the circumstances of the sale. The model is estimated using linear regression and sheds additional light on some of the issues raised earlier in this chapter.

The Model. -- Ideally, a model of price formulation should include four basic elements to accurately reflect price variation: 1) characteristics specific to the animal sold, 2) general supply conditions, 3) general demand conditions, and 4) characteristics of the transaction. The first group of variables regarding the physical characteristics of the animal should give some idea of the value of the animal in the next "stage of production." The value of cattle as inputs in various enterprises (slaughter, breeding and dairy, growing out or fattening, traction, and

trade<sup>1</sup>) is largely dependent upon physical characteristics such as breed, sex, age, weight, condition, and health. The factors appropriate to measuring general conditions of supply and demand are largely dependent upon the spatial and temporal parameters selected. It was assumed that the general levels of supply and demand were relatively constant over the period for which data was collected (April 1976 - March 1977) and that both spatial and temporal variations were reflected, to a large degree, in the seasonal and locational variables which were included as factors inherent in the transaction. Besides time and location of sale, other factors which have some bearing on the type of transaction include type of market, buyer (which also reflects the specific demand for the animal), type of seller, and prior knowledge of market conditions - especially price.

The data was collected from herders and did not allow for the inclusion of every relevant variable into the equation. Perhaps the most important omission was cattle weights. Age is assumed to reflect most of the effect of weight. Because of the vastly different demands for males and females, the model was estimated separately by sex. In general form then, the model can be written as:

$$\text{Price} = f(\text{Age, Sex, Region, Seller, Season, Seller Information, Buyer, Type of Market})$$

Several functional forms were considered. The most important consideration revolved around the age-weight (and thus the age-price) relationship and the use of interaction terms. Age was considered in both a linear and polynomial forms. The results yielded slightly better explanatory power in the latter case, though the effects on other coefficients were marginal. Because the objective of the estimation was to test for broad qualitative

---

<sup>1</sup>The demand for an animal purchased for trade is, of course, a derived demand, dependent upon the ultimate use to which the animal is to be put. Under an efficient marketing system, resources (cattle) should be allocated according to value in the most productive use and the derived demand should reflect that. The conditions that assure this include mobility of resources, for which transportability (condition and general health of the animal) is a major consideration.

effects of various sales characteristics rather than to specify the effect of every combination of sales condition, the model was kept simple; no interaction terms were employed and all variables except age were incorporated as shift factors, using dummy variables for the various characteristics.

The model was estimated using the following equations:

$$(1) \quad P = \alpha + \beta_1 A_i + \gamma C_i + \delta_1 R_{i2} + \delta_2 R_{i2} + \theta E_i + \psi_1 S_{i1} + \psi_2 S_{i2} \\ + i I_i + \lambda_1 B_{i2} + \lambda_2 B_{i2} + \pi_1 P_{i1} + \pi_2 P_{i2} + \epsilon_i$$

$$\text{and (2) } P = \alpha + \beta_1 A_i + \beta_2 A_i^2 + \beta_3 A_i^3 + \delta_1 R_{i1} + \dots + \pi_2 P_{i2} + \epsilon_i$$

where

- P = Price of animal sold (in CFA)
- A = Age of animal in years
- C = Dummy variable for castrated males
- R<sub>1</sub> = Dummy variable for Kaya subsample
- R<sub>2</sub> = Dummy variable for Pouytenga subsample
- E = Dummy variable for Fulani sellers
- S<sub>1</sub> = Dummy variable for harvest season sales (Oct.-Jan.)
- S<sub>2</sub> = Dummy variable for dry season sales (Feb.-May)
- I = Dummy variable for seller's claim to market information
- B<sub>1</sub> = Dummy variable for merchants as buyers
- B<sub>2</sub> = Dummy variable for butchers as buyers
- P<sub>1</sub> = Dummy variable for sales in local markets
- P<sub>2</sub> = Dummy variable for sales outside of markets
- ε = Error term

A discussion of the hypotheses associated with the model is found in the monograph upon which this chapter is based (Herman, 1979). What follows is a summary and brief interpretation of the regression results.

Estimation and Results. -- Table 15 presents the results of the estimation of the five forms of the model for males and females. As expected, the model explained much more of the variation in prices of males than females largely due to the effects of age. The results suggest that the functional forms used were not appropriate in the case of females; indeed, several other models and stratifications of the data for females yielded better results. These are presented in the full monograph. Still, these estimations yielded interesting results which are briefly discussed here.

a. Age. -- Most males were sold over a range of ages for which an age-weight relationship is well defined. Because of this and the fact that weight is the most important factor affecting prices for males (presumably because most were sold for slaughter), the age variables had the greatest impact upon price.<sup>1</sup> In the linear form, the model suggests that prices rise by slightly less than 5,000 CFA per year, significant at the .01 level. The polynomial case suggests that an S-shaped curve best fits the data (see Figure 7). In that estimation, the rate of price-gain increases from zero to 5.7 years (at which point  $\partial^2 P / \partial A^2 = 0$ ); prices rise at a diminishing rate through 11.4 years (where  $\partial P / \partial A = 0$ ); and prices fall after that point. Table 16 shows the changing price-age relationship at several points for the appropriate model.<sup>2</sup>

As noted above, the effect of age on the price of females was not as strong as in the case of males (the partial correlation coefficients for all age terms were low, .117 in the linear model). The linear model

---

<sup>1</sup>This is shown by an examination of partial correlation coefficients. In the linear model for males, the partial correlation coefficient for age was .73457, while the next highest value (signifying explanatory power for that variable) was the seasonal dummy for harvest time sales, -.20548.

<sup>2</sup>The appropriate model in this case omits the linear age terms since it was not significant at even the .1 level. Rerunning the regression without this term had little quantitative effect on any other coefficients and no effect on their significance levels. The new coefficients for age squared and age cubed were 1026.4 and -59.873, respectively.

TABLE 15  
ESTIMATED PARAMETERS OF PRICE MODEL FOR FIRST-BUYER CATTLE SALES  
BY DJIBO, KAYA, AND POUYTENGA HERDSMEN, 1976-1977

Variable	Coefficients <sup>a,b</sup>			
	Males	Males	Females	Females
Constant	7,646.0* (1,152.5)	12,314* (1,426)	24,601* (2,497.4)	29,126* (3,248.6)
Age Terms				
A (Age)	4,730.8* (138.5)	62.2 (707.2)	-292.05*** (125.48)	-3,268.4*** (1,506.1)
A <sup>2</sup> (Age squared)	-	1,017.2* (109.62)	-	347.06† (195.04)
A <sup>3</sup> (Age cubed)	-	-59.493* (5.046)	-	-11.308 (7.33)
Castrated Dummy (C)	1,361.4* (460.7)	1,422.3* (424.09)	-	-
Regional Dummies				
R <sub>1</sub> (Kaya)	-2,927.0* (942.71)	-3,032.1* (901.4)	402.21 (1,864.8)	1,293.1 (1,927.7)
R <sub>2</sub> (Pouytenga)	698.2 (1,083.6)	89.442 (1,023.5)	9,599.2* (1,892.0)	10,472* (2,073.6)
Ethnic Dummy, Fulani (E)	953.5 (787.2)	1,347.4† (722.3)	1,011.0 (1,456.8)	908.86 (1,455.4)
Seasonal Dummies				
S <sub>1</sub> (Oct.-Jan.)	-3,293.6* (497.1)	-3,287.3* (463.21)	-7,833.7* (1,022.1)	-7,297.0* (1,062.0)
S <sub>2</sub> (Feb.-May)	-2,331.6* (508.0)	-2,507.5* (467.36)	-10,328* (1,101.1)	-9,932.0* (1,051.0)
Seller Information (I)	-492.8 (695.8)	-298.45 (638.04)	4,366.6* (1,269.6)	4,707.8* (1,275.6)
Buyer Dummies				
B <sub>1</sub> (Cattle merchant)	2,031.7* (624.5)	1,350.8** (574.8)	-3,737.2*** (1,680.6)	-3,428.1*** (1,691.8)
B <sub>2</sub> (Butcher)	3,120.3** (1,232.5)	3,086.8* (1,129.7)	-7,887.0* (1,843.4)	-7,841.6* (1,838.9)
Market Type Dummies				
P <sub>1</sub> (Local market)	-1,002.0 (886.2)	-848.19 (814.61)	1,314.6 (2,326.1)	1,366.7 (2,329.4)
P <sub>2</sub> (Non-market sale)	-1,678.7*** (806.6)	-1,060.4 (741.44)	3,863.2* (1,433.6)	4,159.5* (1,435.1)
Number of Cases	1,009	1,009	401	401
R <sup>2</sup> <sub>1</sub> R <sup>2</sup> <sub>2</sub>	.776; .773	.812; .809	.334; .315	.342; .325

<sup>a</sup>Numbers in parentheses are standard errors of coefficients.

<sup>b</sup>Significance levels: \* Coefficient significantly different from zero at the .01 level

\*\* Coefficient significantly different from zero at the .07 level

\*\*\* Coefficient significantly different from zero at the .05 level

† Coefficient significantly different from zero at the .10 level

TABLE 16

RATES OF CHANGE IN PRICES OF CATTLE FOR SELECTED AGES FROM  
THIRD-ORDER POLYNOMIAL REGRESSION ( $\partial P/\partial A$ )

---

---

<u>Age</u>	<u><math>\partial P/\partial A</math></u>	
	<u>Males</u>	<u>Females</u>
2	3387	-2016
4	5337	-1035
6	5851	- 325
8	4927	113
10	2566	280
12	-1232	176
14	-	- 200

---



modestly suggests an overall slight decreasing trend in price over age. The nonlinear model suggests falling prices for females over young ages (with a minimum at 7.4 years) and very modestly rising prices through the local maximum at 13.1 years, with prices falling thereafter. The results show the highest prices paid for heifers (four years or younger) with a rather flat price-age curve after that.<sup>1</sup>

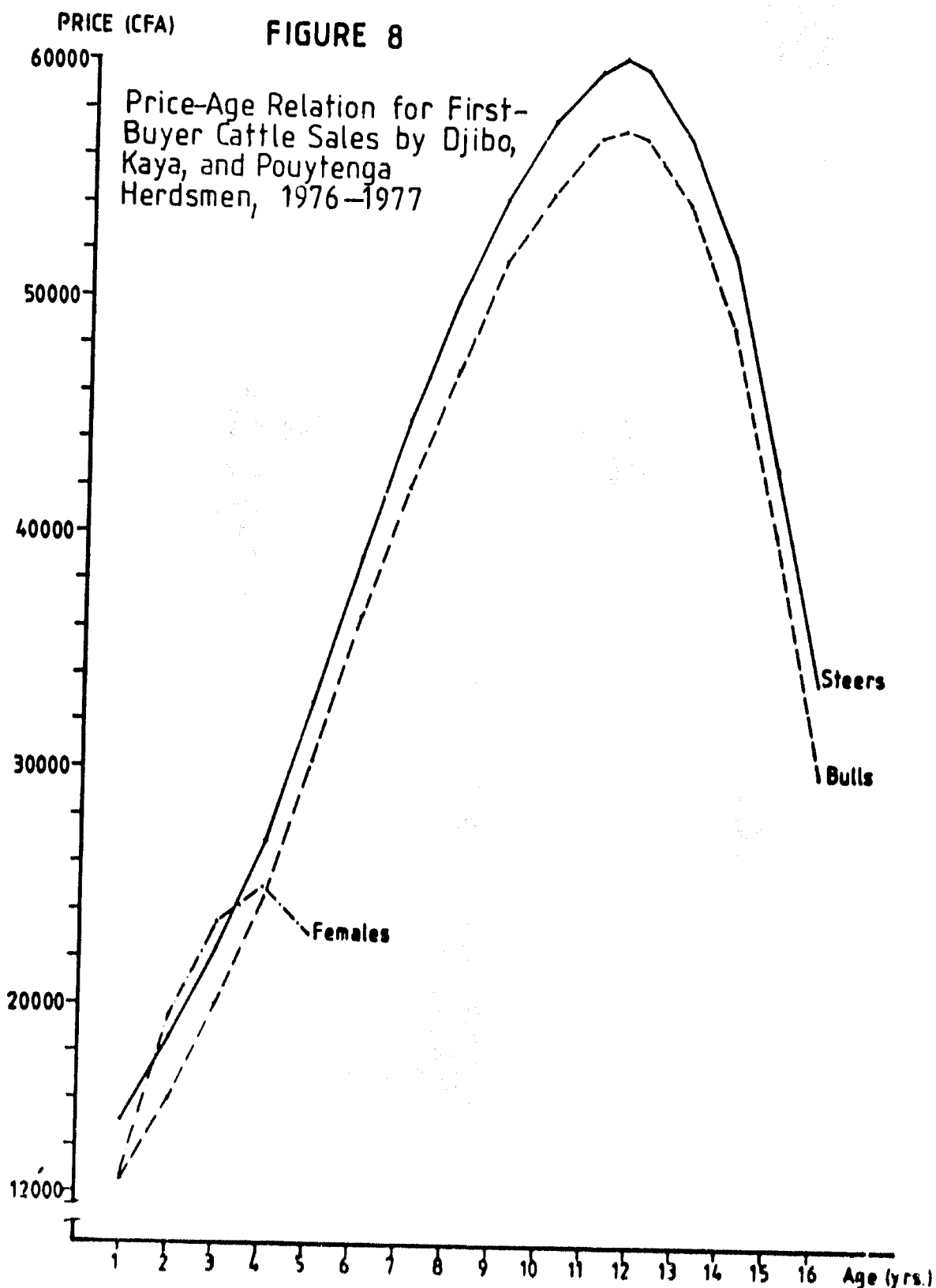
b. Castrated Males. -- The coefficient for the dummy variable for steers suggests that a premium of about 1,500 CFA is paid for steers over noncastrated males. This can be attributed to their desirability as work animals and the higher quality meat (more fat) associated with castrated males.

c. Regional Price Variation. -- The results of the regional dummies were ambiguous. The expectation that prices would be higher closer to major consumption and export centers (Kaya and Pouytenga) held true for females but not males. Cows brought significantly higher prices in Pouytenga than in Djibo. The difference between cow prices in Kaya and Djibo were not significant. However, the prices of males in those two regions indicate significant differences in prices favoring Djibo. These variations may be explained by different breed characteristics between northern (Djibo) and southern (Kaya and Pouytenga) stock, the preference for males by traders, and the limited demand for slaughter cattle in the Djibo region. These effects are discussed in greater detail in Herman, 1979.

d. Type of Seller. -- The dummy variable for ethnic affiliation of seller does not indicate significant differences between prices received by Fulani and Mossi herdsman.

---

<sup>1</sup> Other estimations which stratified the female sample into "heifers" (<5 years) and "cows" (>5) led to quite different results. The regressions do not suggest any significant price-age relationship for older cows, none of the age coefficients being significant at even the .1 level. When run on the heifer subsample, however, the regression yields results which suggest that price is an increasing function of age, up to four years. The age coefficients were both significant at the .01 level. The relationship for heifers is graphed in Figure 8.



Source: Males: Calculation from polynomial regressions, Table 15.  
Females: See footnote, page

e. Seasonal Price Variation. -- Both seasonal variables were significant at the .01 level for all equations. The coefficients show cow prices highest during the rainy season and lowest during the dry season, as one would expect. Males also brought highest prices during the rainy season but were lowest during the October through January period. The fact that prices did not continue to fall off during the dry season (February-May) may be due to the better ability of males to maintain weight during that season and to herders holding off sales, as explained in an earlier section.

f. Seller Access to Information. -- Market price information had no significant effect for prices of male cattle. However, herdsman claiming prior market information received significantly higher prices than did uninformed herdsman when selling females. This is perhaps due to the more competitive market for males. Where demand for cull cows is there (as in Djibo), the price the herder receives may be highly dependent on his bargaining ability, including his knowledge of market conditions.

g. Type of Buyer. -- The coefficients for the buyer dummy variables indicate that both traders and butchers pay premiums for males over prices paid by herders, farmers, and others (the excluded group). Surprisingly, the data show that butchers pay a higher premium than merchants, though the difference is not significant at the .05 level. For females, prices paid by merchants and butchers were significantly lower than those paid by herdsman and farmers, indicating that their productive value for breeding, dairy, or in agriculture exceeds their slaughter value. Butchers paid the lowest prices, significantly lower (at the .01 level) than those paid by traders.

h. Type of Market. -- The regressions yielded little significant results regarding the effect of market type on price. For males, the coefficients were of the expected signs and magnitudes, showing major market prices highest and non-market sales prices lowest, but the results (in the polynomial case) were not significant at the .1 level. For females, the results showed just the opposite effect; major market prices were lowest and non-market sales prices were highest, with the difference between the two being significant at the .01 level. These results suggest that non-market sales of females may be for productive cows sold to other herdsman or farmers who pay a premium for these animals over the price paid by merchants and butchers in organized markets.

## THE TRANSPORTATION SYSTEM FOR CATTLE

Because of the long distances livestock must be shipped between the production zones in the north and the major consumption zones along the West African coast, transportation costs are one of the most important elements in the formation of meat prices. This section looks at the transportation infrastructure, costs of transporting cattle, constraints to trade expansion, and areas of possible cost reduction.

### Transportation Methods and Infrastructure

As elsewhere in the Sahel, most cattle are moved on hoof within Upper Volta. In most instances there is little alternative to trekking cattle to market. Trekking livestock to market has the advantage of requiring low cash outlays and little infrastructure. The two major disadvantages to this mode of moving livestock are the slow turnaround time and increasing conflicts over trek routes. Cattle may be trekked at rates between fifteen and forty-five km per day, depending upon season and total distance. The government has demarcated several cattle trails with concrete pylons along a corridor running from the northeast to the center-south. There are plans for more cattle trails in the west. The trails are supposed to give drovers the right of way so as to reduce conflict with farmers. Drovers complain that water and pasture are often insufficient along the trail, and thus alter their routes. Good drovers pride themselves on their ability to move herds speedily, finding adequate water and pasture so the cattle arrive in good condition, and avoiding problems with farmers over crop damage. The government believes the cattle trails are necessary not only to reduce the level of crop damage but to reduce high mortality and weight losses for trekked cattle. However, until adequate water resources and forage are available along official trails, most long distance trekking is likely to follow traditional routes.

Trucking has yet to play a major role in Voltaic cattle transportation. The poor road conditions, inexperienced truck drivers unwilling to take on a cattle consignment, and low costs of trekking have resulted in no

cattle being transported by truck between domestic markets. A few shipments to export markets in Ghana and Togo are trucked, but even along these paved routes, trucking is considered expensive and usually unnecessary by merchants who prefer to walk their cattle across the border. While cattle exported to Ghana, Niger, and Nigeria are almost always sold at the border, cattle exports to Togo are usually shipped directly to Lomé. Merchants walk cattle across the border and then have the option of putting their herds on trucks in Dapango or Sokodé, depending upon season, market conditions, and truck rental rates. This flexibility is obviously not available to merchants who truck cattle directly from Upper Volta. One major problem that will have to be remedied if trucking is ever to catch on is the large number of unofficial charges that are levied on cattle trucks at the many check points which dot the routes to coastal markets.

The railroad from Ouagadougou through Bobo-Dioulasso to Abidjan plays an important role in the export of cattle and small ruminants to Ivory Coast, Upper Volta's largest cattle export market. The rail line allows for rapid evacuation of cattle from central and western Upper Volta and was the major reason for the dramatic rise in importance of the Ivorian market for Voltaic cattle exports in the sixties. Cattle are shipped from Ouagadougou to Abidjan in three to six days, in contrast to the two-month trek to coastal markets in Togo and Ghana. In addition, returning drovers are able to communicate market conditions to merchants in Voltaic markets immediately upon return, one day after leaving Abidjan. This results in remarkably efficient information flows and enables merchants to respond quickly to changing market conditions.

There are two major problems which plague train transportation. First, the condition of the cars used for transporting cattle and the lengthy delays which often more than double the time en route intensify the mortality and weight-loss problems which account for a significant share of transportation costs. Second, there are seasonal bottlenecks in the availability of cattle cars (the cars are used for merchandise transport south) during the peak export period. The results are long waits at the rail head and increased costs of holding and transporting cattle.

Transportation Costs

This subsection outlines the explicit and implicit costs of moving cattle within Upper Volta and from Upper Volta to several major export markets. Included are direct transportation costs, market charges, and government levies. Since different transportation methods rarely compete along the same route, there is no direct comparison of trekking versus train shipments. The figures are based on official charges, observation of costs by the author, and interviews with drovers and merchants. Because the sample of observations of truck shipments of cattle was limited to only two cases, few interviewed merchants claimed to have information on trucking costs, and truck rental rates for cattle are not fixed, no costs are presented for truck transportation.

1. Domestic Trekking. -- Table 17 presents the costs of trekking cattle to Ouagadougou. Costs are given per head and per herd of fifty animals. In principle, these are the costs that would be paid legally and traditionally. In reality, there are wide variations in actual costs due to avoidance of taxes, non-payment of salaries to family members acting as drovers, and the stochastic effects of mortality, lost animals, and forced sales.

It is assumed that traders employ three drovers per fifty head of cattle. During and just following the rainy season cattle are more difficult to control because of abundant water and pasture and the greater risk of crop damage. Extra drovers are often used during that period.

The evaluation of mortality and losses due to lost cattle and forced sales is based upon a survey of eighteen drovers who were interviewed immediately following their arrival in Ouagadougou with a herd. Based on these interviews, the following loss percentages were computed:

<u>Forced Sales</u>	<u>Escaped or Lost</u>	<u>Mortalities</u>
1.5%	2.6%	0.6%

The calculation of the appropriate value to assign to these factors assumed that animals sold en route recovered two-thirds of purchase price. It was assumed that one-quarter of the purchase price was recouped for animals that died en route since some are sold to bush butchers. Finally, because many escaped cattle are eventually recovered, it was assumed that only one-half of these animals were permanently lost. Thus, the expected loss from mortality, forced sales, and escaped cattle was evaluated as:

$$\begin{aligned} \text{Expected Loss} &= \text{Cost of purchase} \times [ (.015 \times 1/3) + (.026 \times 1/2) \\ &\quad + (.006 \times 3/4) ] = 30,000 \text{ CFA} \times .0225 \\ &= 675 \text{ CFA per head.} \end{aligned}$$

TABLE 17

**COSTS OF TREKKING CATTLE WITHIN UPPER VOLTA  
1976-1977 (PRICES IN F CFA)**

Herd size = 50 Head  
Average price = 30,000

Market of Origin:	Djibo		Markoye		Pouytenga	
Destination:	<u>Ouagadougou</u>		<u>Ouagadougou</u>		<u>Ouagadougou</u>	
Distance:	210 km		325 km		140 km	
Transit time:	8-12 days		15-20 days		3-7 days	
Distance traveled per day:	18-26 km		16-22 km		20-47 km	
<u>Costs</u>	<u>Per Head</u>	<u>Per Herd</u>	<u>Per Head</u>	<u>Per Herd</u>	<u>Per Head</u>	<u>Per Herd</u>
I. Purchase of cattle						
A. Intermediary's commission	250	12,500	500	25,500	250	12,500
B. Identification mark	-	-	-	-	10	500
C. Gardinage before export (a)	(b)	(b)	(b)	(b)	50	2,500
II. Taxes						
D. Patente (Trader's license)	83	4,150	83	4,150	83	4,150
E. Veterinary inspection	150	7,500	150	7,500	150	7,500
F. Certificate of origin	2	100	2	100	2	100
G. Local taxes	-	-	50 <sup>c</sup>	2,500	-	-
III. Transport costs						
H. Food and salary of drovers	240	12,000	360	18,000	180	9,000
I. Mortality, lost animals, forced sales	675	33,750	675	33,750	675	33,750
J. Return transport for selling agent	24	1,200	40	2,000	12	600



Table 17 continued

Market of Origin:	Djibo		Markoye		Pouytenga	
Destination:	<u>Ouagadougou</u>		<u>Ouagadougou</u>		<u>Ouagadougou</u>	
Distance:	210 km		325 km		140 km	
Transit time:	8-12 days		15-20 days		3-7 days	
Distance traveled per day:	18-26 km		16-22 km		20-47 km	
<u>Costs</u>	<u>Per Head</u>	<u>Per Herd</u>	<u>Per Head</u>	<u>Per Herd</u>	<u>Per Head</u>	<u>Per Herd</u>
IV. Costs in Ouagadougou						
K. Market tax	150	7,500	150	7,500	150	7,500
L. Gift to landlord	<u>100</u>	<u>5,000</u>	<u>100</u>	<u>5,000</u>	<u>100</u>	<u>5,000</u>
Total costs of domestic trekking	1,674	83,700	2,110	105,500	1,662	83,100
Cost per kilometer	8.0		6.5			

<sup>a</sup> Assumes assembly time of one week.

<sup>b</sup> Caring for animals is usually the responsibility of the intermediary in these markets.

<sup>c</sup> Transit tax for Gorom-Gorom.

Since there was no evidence of any correlation between losses and length of trek or transit time, this was assumed to be a fixed cost of trekking.

No costs were included for weight loss or crop damage. For the latter, no drover was willing to admit to any occurrence of conflict with farmers. Some acknowledged incidents in the past, but claimed that these were extremely rare and involved small sums as settlements.<sup>1</sup> There is very little information available on the subject of weight loss during trekking. Losses (or gains) en route are a function of season, the route traveled, and the expertise of the drovers. Though it is commonly held that weight loss accounts for a sizable portion of the total cost of transportation, there is evidence to be marshalled to the contrary (Caberet, 1973).

The portion of total costs of moving cattle between markets attributable directly to transportation is between 51 and 56 percent. The costs per kilometer per head of transport along ranges from 3.3 CFA for the Marhoye-Ouagadougou route to 6.2 CFA for the Pouytenga-Ouagadougou route. In all three cases transportation represented only 3 to 4 percent of the purchase price of the animal. Total marketing and transport costs account for 5-7 percent of purchase price.

2. Trekking to Export Markets. -- Table 18 lists the costs of exporting cattle on foot from three Voltaic markets to three different export markets. The figures used in section II, item H for Voltaic export taxes reflect the amount claimed to have been paid by exporters who were interviewed. They do not necessarily reflect the official export tax rate, which is not applied uniformly on herds crossing the border on foot. The same comments apply to market and import taxes in section IV, item M and N. Of the three routes, only Pouytenga-Lomé can be called long distance. Along that route, costs per kilometer were substantially lower than those for the two shorter routes to Ghana and Niger. Transportation costs alone make up between 12 and 21 percent of total export costs. Based on theoretical resale prices of 50,000 CFA in Lomé and 40,000 CFA in Tera and Pagá, transportation costs account for 5 percent and 2.5 percent

---

<sup>1</sup>This is not meant to imply that the social costs of crop damage are not worthy of serious consideration. There is much evidence to the effect that damage caused by commercial and transhumant herds is a serious problem in some regions.

TABLE 18  
 COSTS OF TREKKING CATTLE TO FOREIGN MARKETS  
 1976-1977 (PRICES IN F CFA)

Herd size = 50 Head  
 Average price = 30,000 F CFA

Market of Origin:	Pouytenga	Kaya	Ouagadougou
Destination:	Lomé (Togo)	Téra (Niger)	Paga (Ghana)
Distance:	860 km.	215 km.	170 km.
Time in transit:	45-75 days	9-18 days	8-12 days
Distance traveled per day:	12-20 km.	24-25 km.	14-21 km.
<u>Costs</u>	<u>Per Head</u>	<u>Per Head</u>	<u>Per Head</u>
I. Purchase of cattle			
A. Intermediary's commission	250	250	250
B. Identification mark	10	10	10
C. <u>Gardinage</u> before exports	50	50	100
	2,500	2,500	5,000
II. Taxes			
D. <u>Patente</u> (Trader's license)	83	83	83
E. Veterinary inspection	150	150	150
F. Certificate of origin	2	2	2
G. Authorization to export	4	4	4
H. Export tax	7,500	4,930	6,519
	375,000	246,500	325,950
III. Transport costs			
I. Vaccination of cattle (against Trypanosomiasis)	50	-	50
J. Salary and food for drovers and agent	1,650	330	200
K. Mortality, lost animals, forced sales	675	675	675
	33,750	33,750	33,750



Table 18 continued

Market of Origin:	Pouytenga		Kaya		Ouagadougou		
	Destination:	Lomé (Togo)	Téra (Niger)	Paga (Ghana)	Distance:	Time in transit:	Distance traveled per day:
	860 km.	215 km.	170 km.	8-12 days	14-21 km.		
	45-75 days	9-18 days	8-12 days				
	12-20 km.	24-25 km.					
<u>Costs</u>	<u>Per Head</u>	<u>Per Head</u>	<u>Per Head</u>	<u>Per Head</u>	<u>Per Head</u>	<u>Per Head</u>	<u>Per Herd</u>
L. Return transport for drovers and round trip transport for seller	400	20,000	-	-	80	4,000	
IV. Costs at terminal market							
M. Market tax	100	5,000 <sup>b</sup>	-	-	-	-	
N. Import tax (laissez-passer)	1,550	77,500	800	40,000	200	10,000	
O. Gift to landlord	500	25,000	500	25,000	n.a.	n.a.	
Total costs of exporting by trekking	12,964	648,200	7,784	389,200	8,323	416,150	
Cost per kilometer	15		36		49		

<sup>a</sup>Cost of herders to watch cattle while herd is constituted.

<sup>b</sup>Traders are charged 1,000 F CFA per day per herd as market tax.

of resale price in the former and latter cases, respectively; about one-quarter the share of export and import taxes. Total marketing costs account for between one-fifth and one-quarter of resale price.

3. Rail Transportation. -- The costs for shipping cattle by rail from Ouagadougou to Abidjan are shown in Table 19. Entries under Sections I and II are similar to those found in the table on trekking costs. Section III lists the specific costs of transportation. Cattle are loaded into the rail cars by Fulani and Mauritians who specialize in this difficult task. In addition to loading the cattle they also cut off the tips of the horns of some cattle to reduce the risk of injury. Before being loaded, the wagons are prepared with straw mats and loose straw placed upon the floor of the wagon.

The drover who rides with the cattle often acts as the agent for the trader, few of whom go down to Abidjan to sell the cattle themselves. For his services as selling agent, the drover may receive more than the usual salary of 5,000 CFA (plus 3,000 for food and expenses). Traders who do not rely on drovers to perform this function often pay higher commissions (in the form of gifts) to their broker in Abidjan.

The figure for losses due to mortality is calculated from the results of a survey of 94 herds. The rates of mortality and forced sales were:

<u>Mortalities (thrown from car)</u>	<u>Sold en Route</u>	<u>Arrived Dead</u>
1.35%	2.16%	0.65%

Losses were calculated assuming that cattle sold en route were sold at 50 percent of the Abidjan price and that those arriving dead were sold at two-thirds of the market price for healthy animals. Losses were evaluated as that portion of the purchase price and export costs not recovered through resale. The average loss per animal was calculated at 1,282 CFA.

Weight loss is a serious problem for cattle shipments by train. It is not included in Table 19 because of its implicit nature; however it is critical to calculate the costs and prices per kilogram. The data on shrinkage for rail transport are even more sparse than those on trekking.

TABLE 19

COSTS OF EXPORTING CATTLE BY RAIL,  
OUAGADOUGOU-ABIDJAN (CFA)  
(3-7 DAYS TRANSPORT TIME)

Item	Cost Per Herd <sup>a</sup>	Cost Per Head	Cost per Kilogram <sup>b</sup>	
	(25 Head)		135 kg	180 kg
I. Purchase of cattle	<u>10,500</u>	<u>420</u>	3.1	2.3
A. Intermediary's commission	6,250	250		
B. Identification mark	250	10		
C. Gardinage before export	4,000	160		
II. Voltaique taxes and duties	<u>169,108</u>	<u>6,764</u>	50.1	37.6
D. Patente (Trader's license)	2,083	83		
E. Veterinary inspection	3,750	150		
F. Certificate of origin	100	4		
G. Authorization to export	200	8		
H. Export tax	162,975	6,519		
III. Transport costs	<u>160,091</u>	<u>6,404+</u>	47.4	35.6
I. Loading cattle cars <sup>c</sup>	750	30		
J. Preparation of wagon	4,000	160		
K. Food and salary of drover	8,000+	320+		
L. Cattle car rental (RAN)	104,780	4,191		
M. Unofficial costs	0-20,000	0- 800		
N. Mortality	32,061	1,282		
O. Unloading cattle	500	20		
IV. Costs in Abidjan	<u>18,500</u>	<u>740+</u>	5.5	4.1
P. Watering and guarding cattle	1,000	40		
Q. Market tax	12,500	500		
R. Gift to landlord/broker	5,000+	200+		
Total costs of exporting excluding unofficial costs <sup>d,e</sup>	<u>358,199+</u>	<u>14,328+</u>	<u>106.1</u>	<u>79.6</u>

Table 19 continued

<u>Item</u>	<u>Cost Per Herd<sup>a</sup></u>	<u>Cost Per Head</u>	<u>Cost per Kilogram<sup>b</sup></u>	
	<u>(25 Head)</u>		<u>135 kg</u>	<u>180 kg</u>
Transportation costs, per kilometer	140	5.6	.04	.03
Total export costs per kilometer	313	12.5	.09	.07

<sup>a</sup>Normal herd size for wagons of type H 1200.

<sup>b</sup>Cost per kilogram arriving in Abidjan, net of weight loss.

<sup>c</sup>Includes 500 francs for loading, and 250 for cutting horns of cattle when needed.

<sup>d</sup>These costs may include payments to assure no delays in receiving cattle car, gratuities to douane officials, and small fees paid to RAN employees for moving cattle cars between Treichville and Port Bouct. Totals assume 10,000 CFA payment per herd.

<sup>e</sup>Shrinkage is not included in this table. The effect of weight lost by cattle in transit is to lower resale prices. As such, its inclusion here would be misleading.



Based on a Malian study on weight loss for truck transport and a Nigerian study on shrinkage during rail shipments of cattle there, an estimate of 10 percent was arrived at for weight lost by cattle shipped from Ouagadougou to Abidjan (Staatz, 1979, pp. 242-243). This cost can be viewed two ways:<sup>1</sup> first, the loss of 10 percent of the animal means that the purchase price of the animal and all export costs must be distributed over the net weight of the animal arriving in Abidjan. The total loss of the cost of meat which never arrives in Abidjan due to shrinkage for a 150-kg animal is 5,183 CFA or 38.39 CFA/kg of delivered meat. Alternatively, the loss may be evaluated in terms of revenue lost. In this case, the loss is the shrinkage times the expected resale price. Since the delivery of meat that is normally lost would increase supply, current prices in Abidjan set the upper bound (true only in the case of perfectly elastic demand) on the appropriate price to use. Given the Abidjan prices at the time of the study (407 CFA/kg of carcass weight) this method gives an upper bound of 6,105 CFA per head. Whichever method is used, it is clear that shrinkage is one of the largest costs of transporting cattle by train.

Excluding weight loss, transportation including mortality accounts for 45 percent of the total costs of shipping cattle from Ouagadougou to Abidjan. Based on a resale price of 407 CFA per kilogram in Abidjan, transportation costs from Ouagadougou make up 11.7 percent of the resale price of cattle delivered with a carcass weight of 135 kilograms and 8.7 percent of the resale price of 180-kilogram cattle. Total export costs account for 26 percent and 20 percent of cattle weighing 135 kg and 180 kg, respectively.

---

<sup>1</sup> Similarly, mortality costs could be evaluated in two ways: the actual cost to the trader (which was used) or revenue lost. The latter is perhaps more appropriate when evaluating projects which affect mortality or weight loss. In such an evaluation, these could be viewed as potential benefits.



LIVESTOCK MARKET STRUCTURE, CONDUCT, AND PERFORMANCE

Some alleged deficiencies in the livestock marketing system were noted in the first section of this chapter. They include charges of unnecessary transactions, excessive numbers of middlemen, monopsonistic power in the hands of traders and intermediaries, and the absence of modern market infrastructure and institutions to facilitate trade. These criticisms are typical of the view of many government officials and foreign advisors who assert that the indigenous market structure thwarts efficient market operation. In response to these charges, the Voltaic government has joined with several other West African countries to establish stricter control over marketing activity through a series of protocols concerning livestock and meat marketing.<sup>1</sup>

This section looks at the structure, conduct, and performance of the livestock marketing system in Upper Volta. It begins by looking at market concentration among livestock marketing professionals. Another structural dimension that is examined is the diffusion of and access to information on market conditions and prices. Market conduct is examined by looking at the role of intermediaries, evidence of collusion by traders, butchers or intermediaries to fix prices or restrict sales, and the tendency toward vertical integration. Finally, market performance is judged by looking at the ability of the marketing system to adjust to changing patterns of supply and demand, net margins and returns to labor and capital, and the broader issues of employment effects, the incidence of externalities, and social costs.

---

<sup>1</sup>Both the CEBV (Communauté Economique du Bétail et de la Viande, comprising the five Entente states) and the OCBV (Office Communautaire du Bétail et de la Viande, comprising the six member states of the CEAO) have signed similar agreements binding member states to stricter regulations to trade according to standards laid out in the protocols.

### Market Concentration Among Professions

Perhaps the single most important indicator of market power is the market share held by a buyer or seller. Table 20 presents the average number of active buyers per market session in four cattle markets by month. While they do not reflect market shares, the figures give an indication of the average number of competing sellers in each market. As one would expect, the number of active buyers is largest in markets with the largest volume. The very small number of butchers active in the Djibo market is reflected in slack demand for older cows.

Neither was it possible to compute concentration ratios for intermediaries active in each market. The total number of officially registered intermediaries operating in each market is relatively large: twenty-four in Djibo, thirty-two in Pouytenga, fifteen in Kaya, and eighteen in Ouagadougou. In Ouagadougou, however, not all of the intermediaries were active each market session. The number of different sellers entering the Ouagadougou market was usually lower than for other markets; but, unlike sellers in other markets, sellers in Ouagadougou often divide their herds among several different intermediaries for sale. It is not clear whether this is a voluntary act by the selling merchant or the result of "sub-contracting" by the intermediaries. In either case, the result is that in Ouagadougou, intermediaries represent fewer sellers at any one time than do intermediaries in other markets.

Market shares held by slaughtering butchers in several markets and cattle exporters operating out of Ouagadougou are shown in Table 21. They suggest relatively high degrees of competition everywhere but in Kaya, where the market is dominated by the two largest butchers, who share almost three-fourths of the wholesale meat market.

How should these measures of market shares be used? Certainly one must be careful not to place too much importance on market concentration alone, without considering the barriers to entry and possibilities for collusive activity by traders. Nevertheless, the data show relatively large numbers of competing merchants, intermediaries, and butchers at each stage of the marketing chain. In rural and small-town markets the

TABLE 20

NUMBER OF ACTIVE BUYERS IN VOLTAIC CATTLE MARKETS<sup>a</sup>, 1976-1977

Market	Type of Buyer	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March
Djibo <sup>b</sup>	Butchers	0	0	0	0	1	1	1	1	1	1	0
	Traders	4	3	3	5	5	8	12	9	8	8	7
Kaya <sup>c</sup>	Butchers <sup>f</sup>	-	8	4	5	7	3	8	7	9	11	13
	Traders	-	5	6	8	15	7	14	14	11	11	5
Pouytenga <sup>d</sup>	Butchers <sup>f</sup>	-	-	23	28	17	11	9	14	13	13	13
	Traders	-	-	24	23	21	18	19	13	11	10	12
Ouagadougou <sup>e</sup>	Butchers	9	17	20	19	28	22	21	21	25	26	22
	Traders	3	6	10	11	15	11	11	11	14	10	9

<sup>a</sup>Average number of different buyers per market session each month. Does not include butchers or traders who attended market but failed to buy.

<sup>b</sup>It should be noted that the Djibo market is frequented by a large number of herders who buy cattle for raising. Average number of cattle sold per market: 71; market meets weekly.

<sup>c</sup>Average number of cattle sold per market: 90; market meets every three days.

<sup>d</sup>Average number of cattle sold per market: 199; market meets every three days.

<sup>e</sup>Average number of cattle sold per market: 89; market meets daily.

<sup>f</sup>Many of the buyers classified as butchers in the Kaya and Pouytenga surveys are Ouagadougou butchers who buy not only for their own use but also resell to other butchers in Ouagadougou.

TABLE 21  
CONCENTRATION RATIOS FOR CATTLE SLAUGHTERERS AND EXPORTERS

	<u>Pouytenga</u> <sup>a</sup>	<u>Kaya</u> <sup>a</sup>	<u>Ouagadougou</u> <sup>a</sup> <u>By</u> <u>No. of Head</u>	<u>Ouagadougou</u> <sup>b</sup> <u>By Kilograms of</u> <u>Meat Delivered</u>	<u>Exporters</u> <sup>c</sup>
Total No. of active butchers or traders	39	7	75	75	77
Largest	9%	45%	7.8%	8.4	18.6
Largest 4	31%	96%	22.7%	22.9	40.7
Largest 8	52%	100%	37.1%	37.1	60.6
Largest 20	85%	-	63.1%	63.4	84.8
Average monthly slaughter or exports (head of cattle)	153	95	1,863	1,708	1,740

<sup>a</sup>Percentage of total sales by number of head.

<sup>b</sup>Percentage of total sales by weight.

<sup>c</sup>Percentage of total exports by rail from Ouagadougou to the Ivory Coast by rail from August 1976 through January 1977.

level of demand for meat is often so limited as to only support one or several cattle slaughterers. Their market power in the cattle market is limited, however, by competition from traders or exporters who purchase cattle for shipment farther along in the marketing circuit. It is usually only in the purchase of old or weak cattle which might not stand up well to long distance trekking that such butchers wield considerable monopsony power. In wholesale and retail meat markets such butchers face competition from small ruminant slaughterers who are usually more numerous, thus effectively limiting their market power on the resale end.

In larger markets, the number of sellers and buyers is usually large. Even in Ouagadougou, where the number of sellers appearing daily may be small, sellers have difficulty exploiting their seemingly short-run monopoly position, for two reasons. First, many butchers maintain buffer stock of cattle during most of the year, which enables them to consider supply over a broader time frame than just one day, thus reducing their susceptibility to day-to-day fluctuations in supply. Second, butchers and exporters holding stocks of cattle are present in the market as potential competitors, ready to intervene by selling off parts of their reserve herds should prices rise much above the prevailing "normal" price. It should be noted that during the dry season butchers' and exporters' stocks of reserve cattle are very small, which makes buyers much more susceptible to irregular arrivals of cattle during that season.

In general, then, the large number of buyers and sellers at almost every level of the livestock marketing circuit in itself suggests a highly competitive market structure. The following subsection describes another condition of market structure which serves to foster competition.

#### Information Flows

In order for the large number of buyers and sellers to effectively compete, they must be aware of market conditions and prices. In the Voltaic Livestock marketing system, this information flows easily and quickly, and is readily accessible at little cost. Within markets, information on prices is almost instantaneously transmitted.

Bargaining is done in the open. Buyers pass from intermediary to intermediary, making offers and considering the responses. When a major purchase is made, the news spreads rapidly. The only requirements for being able to obtain and use the continuous outpouring of market information are that one speak a common language, spend time in the market, and be able to evaluate the animals visually.

Information between markets is usually transmitted by drovers and traders. Perhaps one of the most remarkable aspects of the marketing system is how quickly this information is transmitted. News of market conditions and general price levels in the Abidjan market is furnished daily by returning drovers who describe in detail the events that took place during the time they spent at the Abidjan market. The delay is rarely more than 48 hours. Within Upper Volta, information between markets serviced by common traders also flows extremely fast. And though news of conditions in northern markets does not travel as quickly, the passage of drovers and traders between central and northern markets assures regular exchange of market information.

### The Role of Intermediaries

Though commonly assailed as being "parasites" on the marketing system, the research showed that market intermediaries play an important role in facilitating trade in livestock. Among the services often provided by these brokers<sup>1</sup> are:

1. Provision of lodging for nonlocal buyers and sellers.
2. Arrangement for cattle to be cared for before and after the sale.
3. Guaranteeing the buyer that the animal is neither sick (unless                   evident) or stolen.
4. Negotiating prices between buyer and seller.
5. Guaranteeing credit.

---

<sup>1</sup>In French, courtier. The Dioulla word used throughout West Africa is dillali.

6. Serving as conduit for market information and advising clients.
7. Stabilizing market prices over short-run periods of surplus or shortage.

In payment for these services the Voltaic intermediary usually receives a sum between 350 and 500 CFA per transaction, amounting to between 0.5 and 2 percent of the purchase price. Thus, even in the case where an animal is sold three times before reaching its final destination, intermediaries' commissions usually account for less than 5 percent of the total cost.

### Vertical Integration

Many market participants find it worthwhile to engage in several levels of trade at the same time. The study attempted to categorize market participants involved in the wholesale trade into five classifications: long and short-distance domestic traders, cattle exporters, wholesale butchers, and intermediaries. Table 22 shows the degree of vertical integration and diversification for fifty-two market participants interviewed during the study. Intermediaries show the lowest tendency to engage in other forms of trade. The vast majority of other market participants complemented their major occupation with some other marketing activity. In some instances, the distinctions between trades was arbitrary, so that the participant considered himself to have a single occupation while he was classified as having two or three. This was especially true for the first three categories and for butchers. Besides wholesale butchers who sold meat in retail markets, the most common crossover was to short-distance trade. This occurred when Ouagadougou-based butchers or exporters would travel to markets in Kaya or Pouytenga to purchase cattle, and later resell some of these purchases to other merchants or butchers in Ouagadougou. In effect, they were acting as spatial arbitrageurs. Category F, speculation in livestock, was included for those merchants and butchers who regularly maintained larger stocks of cattle than they required for their major activity and resold animals to other buyers during periods of short-run shortage.

TABLE 22  
VERTICAL INTEGRATION AND DIVERSIFICATION AMONG  
MARKET PARTICIPANTS

<u>Major Occupation</u>	<u>Total</u>	<u>Secondary Occupation<sup>a</sup></u>								<u>None</u>
		<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>E</u>	<u>F</u>	<u>G</u>	<u>H</u>	
(A) Short-distance Trader	3	-	1	0	0	2	0	0	0	1
(B) Long-distance Trader	6	3	-	4	0	0	1	0	0	0
(C) Exporter	13	9	2	-	2	0	2	0	0	3
(D) Wholesale Butcher	19	0	0	5	-	0	1	15	3	0
(E) Intermediary	<u>11</u>	0	0	3	0	-	0	0	0	8
	<b>52</b>									
(F) Speculation in Livestock										
(G) Retail Butcher										
(H) Meat Exporter										

<sup>a</sup>Some participants engaged in several secondary activities; thus row totals may not add up to total.

Collusive Behavior by Market Professionals

To the extent that traders or butchers are able to coordinate their marketing strategy, they may effectively "defeat" the efficient properties of a competitive market structure. In general that did not appear to be the case in livestock marketing in Upper Volta. The large number of buyers and sellers described earlier would seem to make any collusive arrangements inherently unstable. In most markets, both the buyers and sellers are heterogeneous groups, consisting of locals and strangers -- many different ethnic groups -- performing different economic functions. Thus, explicit agreements among buyers or sellers in any market to raise prices (for sellers) or lower prices are not likely to be enforceable. Indeed, such arrangements appeared to be absent in the markets investigated.



Butchers would seem to have the greatest ability to maintain collusive agreements since they are all local residents and buy and sell in the same markets. Even here, the scope for successful collusion is limited; on the cattle buying side the butchers still face competition from traders and exporters; on the meat side, competition from sellers of other types of meat limit the gains to be made. Indeed, in Ouagadougou, the failure of the butchers' union to promote any type of cooperation among the meat professionals has been labeled one of the major factors in their supposed inability to adopt modern efficient meat marketing practices.

Throughout the livestock and meat marketing system, intermediaries appear to make up the only group which has had any success in coordinating marketing strategy, but their scope for enhancing their gain is also quite limited. Except in the rare case where the intermediary is involved in some other aspect of the trade (see Table 22) they may only gain by raising the official commission. To do so, however, makes the intermediaries particularly susceptible to losses elsewhere. A portion of the broker's fee is paid as a discretionary gift by sellers and buyers, which intermediaries would risk if they were to raise commissions. In addition, intermediaries, who are already under considerable attack by many government officials, would risk increased government regulation<sup>1</sup> were they to show too much power.

### Market Performance

How good a job does the current marketing system do? In general, the answer would have to be very positive. The system has responded well to the changes in supply and demand patterns of the past decade. It has dealt with the effects of the drought, closing of the border, disintegration of the Ghanaian market, competition from extra-African meat on the coast, and the opening of the Nigerian market. Through all this, trade has continued and adapted. Considering the distances and the problems of communication and transportation, the proven ability of the system to purchase,

---

<sup>1</sup>Some localities already nominally retain the right to regulate official commissions.

transport, redistribute, export, or slaughter close to 250,000 head of cattle each year is remarkable. This is, however, only one of the criteria on which the system should be judged.

Economic efficiency also requires that this redistribution be done at low cost. In fact, gross margins for cattle transported over long distances are generally high. Large portions of the gross margin are attributable to government taxes, transportation costs, and other direct costs. Table 23 shows the composition of cattle meat prices as the various shares are distributed over the marketing chain for cattle shipped from Djibo to Ouagadougou and Abidjan. The gross marketing margin is calculated only to the wholesale level. If retail margins (gross) are 10-15 percent of resale price, then the gross margin for meat delivered in Ouagadougou would be around 34 percent (reducing producers' share to 66 percent) and about 50 percent for cattle shipped to and sold as meat in Abidjan (with a corresponding 50 percent farm share).

In both cases, the net margins are returns to four factors: 1) the labor provided by the trader or butcher; 2) overhead costs not directly included here; 3) returns to capital; and 4) profits, or returns to the trader for his entrepreneurial skills and assumption of risk. How net margins are distributed over these four items is a difficult issue; the rate of return they suggest is highly dependent upon the implicit wage rate, correct assessment of necessary overhead costs, and the rotation rate for capital. Bearing these in mind, returns to capital and entrepreneurial ability do not appear excessive, with two exceptions.

Returns to exporters who shipped cattle by train from Ouagadougou to Abidjan enjoyed far superior rates of return on their capital than domestic traders or than traders who shipped cattle to the coast on foot. This higher rate of return seems largely to be the result of transportation constraints and the riskiness of shipping cattle to the coast. During periods of highest profitability for exporting cattle, the rail car rental mechanism operates quite imperfectly, placing "regular" shippers in substantially advantageous positions to procure space. Thus, the monopoly gains appear not to be so much the result of market structure or conduct, but more the result of the allocation mechanism used by the RAN.

TABLE 23

COMPOSITION OF WHOLESALE PRICES FOR CATTLE & BEEF DELIVERED, OUAGADOUGOU & ABIDJAN<sup>a</sup>

	Beef Delivered In Ouagadougou		Cattle Delivered in Abidjan	
	CFA	% of Wholesale Price	CFA	% of Wholesale Price
Return to Producer	29,900 <sup>b</sup>	76.1 <sup>b</sup>	38,122 <sup>c</sup>	59.0 <sup>c</sup>
Intermediaries Fees	700	1.8	1,050 <sup>d</sup>	1.6 <sup>d</sup>
Labor <sup>e</sup>	540	1.4	820	1.3
Taxes	1,585	4.1	7,649	11.8
Transportation <sup>f</sup>	(1,249)	(3.2)	(7,132)	(11.9)
Direct	424	1.1	5,175	8.0
Mortality	675	1.7	1,957	3.0
Shrinkage and Condemnation	150	0.4	[7,175] <sup>g</sup>	[11.1] <sup>g</sup>
Net Margin	(5,326)	(13.5)	(9,802)	(15.2)
Djibo-Ouagadougou	2,026	5.1	3,954	6.1
Wholesale Butcher	3,300 <sup>h</sup>	8.4 <sup>h</sup>	--	--
Ouagadougou Abidjan	--	--	5,848	9.1
Wholesale Meat Price	39,300	100.0	--	--
Carcass	33,000	16.0	--	--
Fifth Quarter	6,300	84.0	--	--
Wholesale Cattle Price (Abidjan)	--	--	64,575 <sup>i</sup>	100.0

<sup>a</sup>Based on cattle prices in Djibo, Ouagadougou, and Abidjan, Wholesale meat prices in Ouagadougou, and average costs during 1977, as collected during survey period. Margins calculated as residuals.

<sup>b</sup>Assumes 200 CFA/kg. carcass weight at 150 kg.

<sup>c</sup>Assumes 218 CFA/kg. carcass weight at 175 kg.

<sup>d</sup>Does not include commission paid by wholesale butcher in Abidjan.

<sup>e</sup>Salaries paid to herders, drovers, convoyeurs, loaders, and meat handlers (calculated wholesale share only).

<sup>f</sup>Does not include direct labor share.

<sup>g</sup>Cost of shrinkage for trekked cattle assumed to be minimal. Weight loss for rail shipments assumed to be 10%. Transportation shrinkage is not included in calculation of margin since it is already included implicitly in the lower delivered price.

<sup>h</sup>Most butchers typically sell both wholesale and retail, thus these margin calculations may in fact be artificially inflated.

<sup>i</sup>Based on resale price of 410 CFA/kg. carcass weight at 157.5 kg. (John Staats, personal communication).

Second, the net margins of butchers supplying the high-quality meat markets in Ouagadougou (supermarkets, butcher shops, and restaurants) were significantly higher than those of the majority of butchers who sold lower quality meat on the popular market. The reasons for the semi-exclusive arrangements between these wholesalers and institutions were not obvious, though there may be significant barriers to entry into this specialized trade because of high capital requirements and institutional ties.

Other than these two examples, evidence of monopoly or monopsony power is lacking in terms of market structure, conduct, and performance. Does this mean that the marketing system is efficient? The answer would have to be a qualified yes. Within the range of technology available to the marketing participants, cattle and meat appear to be delivered at relatively low cost. Most areas of potential cost reduction are outside of the control of traders or butchers: taxes, improved transportation infrastructure or methods, and the incidence of unofficial charges which are prevalent throughout the system.

The traditional marketing system has also been efficient in its use of low-cost labor, something governments should seriously consider before opting for so-called modern methods of marketing which often involve heavy capital requirements and significantly reduce employment in the sector. One area that could be significantly improved upon concerns the imposition of social costs upon the community. Health conditions in livestock and meat marketing could be greatly improved, but improvements are unlikely without government intervention. Additionally, the conflicts between farmers and traders trekking cattle to market suggest that some of the costs of trekking are currently being borne by farmers or villagers, rather than consumers.

In summary, then, the traditional system seems to be performing well according to most criteria of efficiency. The next section briefly explores the potential for improving marketing efficiency by means of government intervention.

## CONCLUSIONS AND POLICY RECOMMENDATIONS

### A Summary: The Marketing System in a Changing Environment

The first two sections of this chapter presented an overview of the current situation of the Voltaic livestock sector. It should be clear that in terms of both production and marketing, the sector is undergoing major transformations. On the production side, the effect of the drought in altering herd structure and distribution was the major factor in the drastic fall in exports in the mid-seventies. Most importantly, the drought caused a redistribution of cattle, both geographically and in terms of ownership, resulting in an increase in production in the south by nontraditional herdsmen. Animal production in the Sahel ORD, once the source of almost the entirety of Voltaic livestock exports (in terms of surplus production) was severely hurt by the drought, and recovery there appears to be slow in coming. On one hand, this development means that this region cannot be counted on to produce the bulk of mature, export quality cattle as it once did. On the other hand, the young ages at which large stock are being sold by northern pastoralists seem to open vast possibilities for implementation of the government's declared policy of stratification of production.

At the same time, traditional pastoralists are increasingly pressured by the expansion of agriculture, thus reducing the availability of open rangeland and straining relations between the herdsmen and sedentary populations. An additional factor affecting supply has been the elimination of imports and transits as additions to domestic production. All of these elements have and will continue to affect supply patterns, necessitating appropriate adjustments in marketing.

On the export demand side, the major adjustment of the seventies has been a redirection of trade. The traditional market for Voltaic cattle exports in Ghana has practically vanished as a result of Ghanaian financial and market organizational difficulties. The Ivorian market has diminished markedly, though for far different reasons. In Ivory Coast, Voltaic and

other Sahelian suppliers now find themselves competing against world market beef suppliers. Still, the proximity of the large Abidjan market and the advantages of quick rail transport out of Ouagadougou are major factors in assuring that Ivory Coast will continue to be a major outlet for Voltaic cattle exports destined for the general beef market. Finally, an alternative export market in Nigeria has opened up to Voltaic exporters. The volume of current flows of cattle in this direction can only be speculated, since verification of exports along the southeastern border is currently negligible. The speed with which Voltaic traders responded to changes in market conditions, contrasted with the fact that through 1977 official government reports failed to acknowledge the existence of the new Nigerian flows, speaks well of the ability of the private marketing system to respond and adapt to changing supply and demand patterns.

In addition to these adjustments in supply and demand patterns, the past decade has seen considerable changes in government intervention in the livestock marketing sector. The major thrust at "market reorganization" has yet to be implemented, though new institutions, infrastructure, and regulations have been created. The most significant development was the creation of ONERA (Office National de l'Exploitation des Ressources Animales) as the government's coordinating body for development of livestock and meat marketing. To the extent that ONERA is able to facilitate and redirect trade, reduce costs, and strengthen established market weaknesses without destroying the basic marketing structure, it will provide the major impetus for marketing improvements in the 1980s. Unfortunately, the experience of marketing agencies in general throughout the developing world has been that intervention is often more disruptive than beneficial.

There have also been several changes in market infrastructure and regulation which have been aimed to correcting many of the alleged deficiencies in livestock and meat marketing. Construction of stockyards equipped with fences, scales, loading ramps, and communications facilities throughout the country is aimed at "modernizing" the marketing circuit and making market information more accessible. The establishment of livestock trails is intended to reduce some of the negative externalities of shipping cattle on foot. Construction of a capital intensive abattoir with

chilling and freezing facilities in Ouagadougou and plans for a similar facility in Bobo-Dioulasso are directed at improving hygiene and encouraging chilled meat exports. There is also increasing interest by the government to more directly regulate livestock and meat marketing; Upper Volta is party to two sets of agreements which call for increased regulation of marketing professionals (butchers, traders, intermediaries) and the standardization of marketing policies.<sup>1</sup>

The benefits that have been derived from basic infrastructure and regulatory changes made throughout the past decade are not at all clear. Livestock markets which were constructed at high cost are largely underutilized. Though some livestock trails have been demarcated, the corresponding water and pasture requirements have yet to be put in place. The result is that drovers keeping to the trails risk higher shrinkage for their herds than when they are able to follow trails which were initially selected because of water and forage availability. Though the modern abattoir in Ouagadougou has probably improved slaughter hygiene (wholesale and retail meat sales still take place under relatively unsanitary conditions) it has yet to live up to its promise of stimulating meat exports. Up to now, the major effect of the capital intensive facility has been a decrease in slaughter-related employment. In general, construction of livestock marketing infrastructure has been of marginal value, often not well suited to the marketing conditions which currently exist.

Many of the proposed changes in marketing regulations seem similarly ill-suited to the needs of the marketing system. While most of the proposals would indeed afford officials a higher degree of control over marketing, the benefits in terms of improved efficiency are limited while potential costs are great. Erecting barriers to entering the livestock and meat marketing trades by invoking strict licensing requirements is likely to reduce the competitive pressures which have kept prices and net margins low.

---

<sup>1</sup>One of the sets of agreements is with the Entente states (Benin, Ivory Coast, Niger, Togo, and Upper Volta) and the other with the members of the CEAO (Ivory Coast, Mali, Mauritania, Niger, Senegal, and Upper Volta). The protocols approved by each are similar and are intended to standardize livestock health and marketing policy. A summary and discussion of the agreements can be found in an appendix to Herman, 1979.

Imposing new methods of marketing (weighing cattle, grading meat, etc.) may satisfy the bureaucrat's inclination to reorganize trade along more verifiable lines but often does little to improve marketing efficiency and may have harmful effects by disrupting trade and raising marketing costs.

### Policy Recommendations

Two points dominate the conclusions of the research relevant to the selection and implementation of marketing policy by the Voltaic government. First, market interventions should take into account the proven capability of the marketing network to move cattle long distances at relatively low cost and to adjust to changing market conditions. Policies should be aimed at working with the current structure, not replacing it. Second, projects must be based on more concrete objectives than the commonly referred to "rationalization" of trade, all too often a catchword for conforming marketing techniques to some modern model.

The following recommendations then are based on the assumptions that government policy objectives include 1) continued reliance on the private sector to carry out most marketing functions, 2) reduction of gross marketing margins, 3) maintenance of a system responsive to changing supply and demand patterns, 4) expansion of livestock and meat exports, 5) reduction of negative marketing externalities and improvement of the social welfare aspects of livestock and meat marketing, 6) encouraging the use of labor intensive marketing techniques and locally produced capital where possible, and 7) improvement of marketing data collection. More specific objectives (e.g., holding down consumer prices or increasing marketing related government revenues) require more specific measures and are not considered here.

Livestock Market Infrastructure.-- These projects should be better justified in the future than they have been in the past. Scales are currently of no use in livestock markets to any one other than researchers; nor are they likely to be in the near future. Attempts to disseminate market information through radio broadcasts are of questionable value.



Herdsman and marketing participants already seem to have good access to such information through traditional sources. On the other hand, collection of statistics and market taxes are appropriate governmental objectives and should be explicitly stated. Thus, markets should be designed to facilitate these goals without disrupting the traditional functioning of the market.

Reorganization of Trade.-- Based on the research findings that marketing is generally competitive and fairly efficient, officials should refrain from restrictive regulation of traders, butchers, and intermediaries which serve to limit competition and increase monopoly power. Instead, policy should be aimed at encouraging competition and reducing barriers to entry. Paperwork and marketing taxes could be streamlined. Not only does the current system encourage fraud and illicit arrangements, it also serves as a barrier to entry.

The data indicate that where major markets are accessible to producers, herdsman rarely choose to sell their cattle to collectors. Thus, where such markets are lacking, the government could take steps to establish markets by: providing modest infrastructure needs, improving access (waiving patentes, local taxes, or veterinary inspection fees) as inducements to traders to service the new market. The inaccessibility of northern markets during the rainy season limits competition in those markets at that time. Improving road conditions to northern markets would certainly increase competition pressures and provide northern herdsman with better opportunities to sell during the rainy season.

Transportation.-- Livestock and meat transport is an area for promising interventions. Once again, though, programs should be justified on functional and economic grounds.

(a) Trek Routes.-- These projects are not likely to lower costs or increase trade. Traditionally, drovers have trekked cattle at very low cost without pistes de bétail. The claim of significant weight loss on treks has never been proven. Their usefulness lies in lessening conflicts with agriculturalists and improving enumeration of marketing activity. Provision of adequate water resources on the route will encourage drovers to follow the trails.

(b) Truck Transportation.-- Truck transport of cattle, especially to export markets, will undoubtedly gain acceptance as roads are paved and trucking costs decrease. Harassment of truckers by officials should be kept to a minimum.

(c) Rail Transport.-- Improved rail transport presents real possibilities for cost reduction. The most serious problems result from seasonal constraints in rail car availability, excessive duration of shipments, and mechanical problems for refrigerated meat exports. Infrastructure improvements could significantly reduce travel time and improve conditions in the cattle cars. With mortality, forced sales, and shrinkage losses estimated at above 12 percent, there are considerable benefits to be gained from programs which improve the condition of the cattle cars and decrease the time cattle spend in the cars.

Because cattle car rental rates don't reflect seasonal demand, black market deals and/or long waits at the rail head are common during the peak season. Increased rotation of cars during the peak season could relieve the constraint. Lower charges during the off season could encourage exports during that period. Finally, mechanical breakdowns in refrigerated equipment were responsible for a falloff in meat exports in the late sixties and early seventies. However, the dramatic decline in the mid-seventies was more due to non-Sahelian competition in the Ivorian elite market. Whether improvements in transportation technology such as those likely to result from the creation of SATRAF (Société Africaine de Transport Frigorifique) will be enough to enable Upper Volta to recapture a significant share of that market is not known.

Meat Marketing and Abattoir Construction.-- The lessons of the Abattoir Frigorifique de Ouagadougou should be well heeded. Meat export schemes should play a minor role in total marketing policy. West Africa is no longer isolated from world meat market conditions. The advantage of Sahelian producers lies in the live animal exports. Emphasis on high quality meat exports leaves Upper Volta vulnerable to: world market conditions, efforts at self-sufficiency by coastal countries, high costs of producing high quality beef (usually from expensive fattening operations), transportation problems, and the problem of profitably disposing of the fifth quarter.

Furthermore, the modern slaughterhouse involved huge imports of capital goods and resulted in serious disemployment problems in the butcher sector. One must question whether these social costs were considered when the project was evaluated. Certainly they should be, in the future.

Programs to improve market infrastructure in urban meat markets are justified by the social benefits associated with improved sanitary conditions. The possibility of providing clean market stalls, water, public cold rooms close to markets, and slaughter slabs in small town and village markets should be investigated. Current high levels of competition among butchers do not indicate any pressing need to alter sales methods by requiring weighing of meat.

In summary then, improvements in marketing efficiency can best be brought about by fostering healthy competition and providing necessary and appropriate infrastructure. A general reorganization of trade is not necessary: in fact, officials would do well to communicate more effectively with market participants to ascertain their views on marketing needs, project design, and how to effectively implement government policy.

LIST OF REFERENCES

- Abbott, J.C., "The Development of Marketing Institutions," Agricultural Development Economic Growth, ed. Herman M. Southworth and Bruce F. Johnston, pp. 365-398. Ithaca, New York: Cornell University Press, 1967.
- \_\_\_\_\_. "The Role of Marketing in the Development of Backward Agricultural Economies," Journal of Farm Economics 44 (May 1962): 349-362.
- Bain, Joe S., Industrial Organization. 2nd. ed. New York: John Wiley & Sons, Inc., 1968.
- Barral, Henri. Les Populations D'Eleveurs et Les Problemes Pastoraux dans le Nord-Est de la Haute Volta. Paris: Office de la Recherche Scientifique et Technique Outre Mer (ORSTOM) 1967.
- Bary, Sitta. "Production et Commercialisation de la Viande en Haute-Volta." Thèse de D.V.M., Ecole Nationale Veterinaire de Toulouse, Université Paul Sabatier, Toulouse, France.
- Bauer, P.T. West African Trade: A Study of Competition, Oligopoly and Monopoly in a Changing Economy. Cambridge: University Press, 1954.
- \_\_\_\_\_. and Yamey, B.S. Markets, Market Control and Marketing Reform. London: Weidenfeld and Nicolson, 1968.
- Bishop, Dwight. Livestock and Meat Marketing Patterns and Cost in the Entente and Adjoining Countries. Ouagadougou, Upper Volta: CEBV, September 1972.
- Bohannon, Paul and Dalton, George. Markets in Africa. Evanston, Illinois: Northwestern University Press, 1962.
- Chaturvedi, J.N. The Theory of Marketing in Underdeveloped Countries. India: Kitab Mahal (W.D.) Pvt. Ltd., 1964.
- Delgado, Christopher. "Economic Interactions Between Peasants and Herders in the West African Savannah; A Case Study from Tenkodogo, Upper Volta." Report to USAID. Ann Arbor: Center for Research on Economic Development, University of Michigan, 1977.
- Dupire, Marguerite. "The Economy of the Nomadic Fulani," Markets in Africa, ed. Paul Bohannon and George Dalton. Evanston, Illinois: Northwestern University Press, 1968.
- EDIAFRIC. La Documentation Africaine L'Agriculture Africaine. L'Economie Voltaïque. 1st ed. Paris: Edition Africain (EDIAFRIC) 1971.

International Bank for Reconstruction and Development (IBRD). Situation Economique et Perspectives de Développement de la Haute-Volta. Rapport No. 564a-UV. Washington D.C., 1975.

\_\_\_\_\_. Appraisal of a Livestock Development Project: Upper Volta, Report No. 674a-UV. Washington, D.C. 1975(b).

\_\_\_\_\_. World Tables 1976. Baltimore: The John Hopkins University Press, 1976.

International Monetary Fund (IMF). Surveys of African Economies, Vol. 3. Washington, D.C. 1970.

\_\_\_\_\_. Upper Volta: Recent Economic Developments. 1973.

Johnson, Walton. "Final Report: Livestock and Range Development in the Dilly Area. Sociological and Communications Aspects." August 1977. (Unpublished).

\_\_\_\_\_. "Anthropology and Development in the Sahel: A Case of Applied Ethnography." 1978. Preliminary draft, unpublished.

Jones, William O. Marketing Staple Food Crops in Tropical Africa. Ithaca, New York: Cornell University Press, 1972.

McLeroy, George B. Suggested Guidelines for Improving the Livestock Marketing Information Service of Mali. USAID, Office of Food and Agriculture, January, 1974.

Osseindowski, Ferdinand. Slaves of the Sun. New York: E.P. Dalton and Co., Inc., 1928.

Peretti, M. Projet Mise en Place de l'ORD du Sahel. Ministère du Développement Rural, Direction des Services de l'Élevage et des Industries Animales, December 1976.

Péron, Yves and Zalacain, Victoire. Les Atlas Jeune Afrique, Haute Volta. Holland: Jeune Afrique, 1975.

Republique de Haute Volta, Ministère de Développement Rural (MDR), Office National d'Exploitation des Ressources Animales (ONERA). Rapport de Mission d'Etude sur les Sous-Produits Argo-Industriels, Aliment du Bétail, dans l'ORD des Hauts-Bassins. March 1977.

\_\_\_\_\_. Sous-Commission de la Production Animale: Programme de Production Animale pour le 3<sup>e</sup> Plan 1977-81. Ouagadougou: 1976.

\_\_\_\_\_. Commercialisation du Bétail: Etude de Pré-Inventivité des Pistes à Bétail. Projet de Développement de l'Élevage, Ouest Volta (PEOV). Bobo-Dioulasso: 1978.

- \_\_\_\_\_. Direction des Services de l'Elevage et Industries Animales.  
"Statistiques des Industries Animales." 1970-77. Unpublished.
- Riesman, Paul, 1974. Société et Liberté Chez les Peul Djelgôbe de Haute-Volta. Paris: Mouton (Cahiers de l'Homme).
- Robinet, A.H. Situation et Perspectives de Développement de la Production Animale Voltaïque. UNDP. March 1973.
- Rochette, R. Les Eleveurs Peuls Pendant L'Hivernage 1976 Dans Les Blocs A.V.V. de Wayn, Rapadama, Rapadama Sud, Mogtedo et Mogtedo-Bomboré. Autorité des Amenagements des Vallées des Volta. Ouagadougou, Upper Volta: July 14, 1976.
- Rupp, Marianne. "Anthropology of the Maures, Peul, Guera, Bambara, and Soniuke in the Nara-Niono Plain." UNDP Project Mali 523. Unofficial translation by U.S. Department of State. 1975.
- Société Centrale Pour l'Equipement du Territoire Internationale. (SCET International). La Production Animale Voltaïque, 2 volumes. 1972.
- Société d'Etudes pour le Développement Economique et Social (SEDES). Approvisionnement en Viandes de l'Afrique Centre Ouest. Paris: 1969.
- \_\_\_\_\_. Introduction aux Comptes Economiques de la Production Animales: Application aux Pays Sahéliens. Tome I: Etudes Methodologiques. 2nd edition. Paris: 1974.
- \_\_\_\_\_. L'Elevage en Haute-Volta: Analyse et Propositions d'Orientation. Paris: 1975.
- \_\_\_\_\_. Recueil Statistique de la Production Animale: Haute-Volta. Paris: 1975.
- Simpson, Morag C. "The Problems of Cattle Marketing in Developing Countries," Beef Cattle Production in Developing Countries, ed. A.J. Smith, 426-429. Scotland: University of Edinburgh, Centre for Tropical Veterinary Medicine. 1976.
- Staatz, John. "Cattle and Beef Marketing in the Ivory Coast." Report to USAID. Ann Arbor: Center for Research on Economic Development, University of Michigan. 1977.
- Staatz, John. The Economics of Cattle and Meat Marketing in Ivory Coast. Ann Arbor: USAID and Center for Research on Economic Development, University of Michigan, 1979.
- Stryker, J. Dirck. "Livestock Production and Distribution in the Malian Economy" report prepared for USAID. 1973.

- Tomek, William G. and Robinson, Kenneth L. Agricultural Product Prices. Ithaca, New York: Cornell University Press, 1972.
- United States Agency for International Development. Development Assistance Program, FY 1975, Upper Volta and Niger. 1975.
- Wharton, Clifton R. "Marketing, Merchandising, and Moneylending, A Note on Middleman Monopsony in Malaya," The Malayan Economic Review VII (October 1962): 24-44.

## CHAPTER 6

### LIVESTOCK PRODUCTION AND MARKETING IN THE ENTENTE STATES OF WEST AFRICA: ANNOTATED BIBLIOGRAPHY

by Aimée Ergas

#### INTRODUCTION

This bibliography is a natural consequence of the three-year research project on livestock in the Entente States of West Africa. The source materials included were gathered from private and university libraries in the United States, Europe, and West Africa. These range from journal articles, monographs, and dissertations to documents of the U.S. Government, foreign governments and international agencies. The majority of these materials are in English or French.

Because the project itself was concerned with livestock development in a specific area of West Africa, the bulk of sources included here are related to that region. The organization of the bibliography emphasizes countries of the research area for easy reference. Other works are categorized under the headings "Other Nations" or "General". The former section includes materials dealing with nations other than the five mentioned above. The "General" heading includes works about several countries or dealing with the broad theories and issues of livestock development.

We feel that our Entente Livestock collection is unusual in its size and scope. In addition to the works included in this bibliography, interested researchers should also consult the bibliographies included with the monographs and working papers from the project. Some entries found here are also found in the bibliography included in Working Paper #1 by Donald Ferguson and are so noted. Given the enormity of the subject and its corollary fields, we cannot claim that this bibliography is comprehensive or even current. We hope that it brings together some of the most important literature available and that it will serve as a valuable tool for future research.

There are many people who provided valuable help and encouragement for this undertaking, especially the research, administrative and secretarial staff of the Center for Research on Economic Development. Project Director Kenneth Shapiro deserves special thanks for his guidance. Nicole Roger-Hogan was responsible for reading and abstracting most of the documents in French. Her skill and dedication were much appreciated. The work of Sandra Levine was invaluable in organizing, reading, and abstracting the materials in this bibliography. Her contribution of assistance and friendship went far beyond the call of duty.



- A-1. ALLUNSON, M. Etude Générale de la Région de Man, Tome 2, Rapport de Synthèse Economique and Tome 4, Etude Sociologique et Démographique. Prepared for the Ministry of Planning (Ivory Coast), Bureau pour le Développement de la Production Agricole, Paris, 1963.

Volume 2 is divided into three main parts: 1) the economic situation in 1963, 2) proposal concerning rural modernization and equipment (surveys related to marketing and handicraft) and 3) outline of the economic situation at the end of the time period (economic accounts). The first part of Volume 4 gives a general picture of the socio-economic development of Man and its inhabitants (important migration movements, antagonism between clans and villages, opposition between traditionalism and modernism, integration problems for outsiders and social potential of a development program). The second part is more specific and includes five full documented appendices: report from a demographic survey, social structures, populations, dowries and marriage problems and education and training.

- A-2. ANNUAIRE STATISTIQUE DE LA COTE D'IVOIRE. La Côte d'Ivoire en Chiffres. Report prepared for the Planning Ministry, Republic of Ivory Coast, Abidjan, 1975, 277 pp.

This work gives us detailed figures about the economic situation in the Ivory Coast. There are four main parts: 1) general data (geographical, human, political and economic framework), 2) agriculture (food, industrial and export crops, forestry and fishing), 3) industry (heavy and light, building trade and public works, handicraft) and 4) infrastructure, equipment and services (transportation, tourism, telecommunications, banks and social and cultural equipment).

- A-3. Bollinger, D. Le Marché Ivoirien des volailles, des oeufs, des porcs et de la charcuterie for Ministère de la Production Animale de Côte d'Ivoire, 2 volumes, France, 1975.

Following a decrease in different sources of supply of animal proteins, the Ivorian Ministry of Animal Production gave priority to development of short-cycle animal production (pork and poultry) and of byproducts ("charcuterie" --sausages etc.-- and eggs). This was the basis of this marketing study which had as objectives to determine the size of the trade in certain animals, which animals could be traded on a larger scale and advertising necessary to stimulate sales. The study concludes that a growth in poultry and egg consumption was certain (and possible in the case of pork) if appropriate measures are set up. Another finding is that, outside of large cities, other meat products (sausages, etc.) might not find buyers unless prices are substantially lowered.

- A-4. BUREAU NATIONAL D'ETUDES ET DE DEVELOPPEMENT (BNETD). Recensement du Cheptel Zébu de Côte d'Ivoire, 3 vols. Ministère de la Production Animale, Abidjan, 1975.

Volume 1 is a scrupulous study concerning the different steps relevant to livestock census taking (among which is the vaccination campaign), the quality of results (their exhaustive characteristics) and methodology regarding the use of gross data. This study also makes a presentation of the overall result, that is to say, the actual situation of Northern Zébu livestock (base data and imbalance of qualitative analysis) linked with deplorable sanitary conditions and the various solutions which could be suggested (food and ecological improvements). Volume 2 makes an inventory of Zébu cattle according to owners, villages, countries and departments. Volume 3 is a topographical summary.

- A-5. BNETD. Hydraulique Pastorale dans le Nord de la Côte d'Ivoire - Notice Explicative. Report prepared for the Republic of Ivory Coast, Planning Ministry, July 1972.

Within the framework of this study (which concerns the present situation of cattle raising and its development possibilities in the north of the Ivory Coast), the Planning Ministry asked the BNETD to emphasize the problems of watering activities. For this purpose, two maps were made: one, done at 1/500,000, covers most of the northern area and the other, done at 1/200,000, relates to the Korhogo zone. This work was to be based on the use and gathering of existing documents. It includes: 1) General Account plus Annex 1, Bibliographical elements and Annex 2, Mission Report and 2) Conclusion.

- A-6. COHEN, Monique. Market Trading in a West African City, Abidjan: A Case Study. Master's Thesis, Department of Geography, McGill University, December 1972, 141 pp.

This thesis begins with a history and description of markets, especially in West Africa. The development of Abidjan is discussed in terms of population, land use and retail activity. The study examines possible patterns of retailing, relating market places in Abidjan to one another. Many factors are analyzed including range of goods, internal activities and external influences, the role of vendors, demand for goods, etc. Conclusions are drawn about the 3-level hierarchical system of this market and the "spatial dualism" which exists. The author reviews the applicability of theoretical studies to the case of Abidjan.

- A-7. DE BECKER, R. Enquête sur le prix de viande et sur les importations de bétail et de viande en Côte d'Ivoire. Document No. 64, FAO/UNDP for Office Malien du Bétail et de la Viande, September 1975.

This study presents: 1) quantities and prices of meat imported from non-West African countries; 2) Ivorian cattle imports; 3) the major points of the Ivorian livestock development program and 4) the trend of official meat prices in Abidjan. Two conclusions can be drawn: first, according to the estimates covering the period up to 1980, the meat deficit will get worse; secondly, the Ivory Coast will find it necessary to import more meat and to launch an extensive cattle development program.

- A-8. DELESTRE, Thierry. "Le Marché de la Viande en Côte d'Ivoire." Thèse Doctorale Non Publiée, Université de Besançon, Institut de Géographie, Mai 1974, 116 pp.

This thesis explains the evolution of meat marketing in the Ivory Coast from a traditional to a modern structure. This gives the market a character of formal economic activity in which management is more rational and consumption is an active factor in production, given the fact that marketing policy is presently oriented towards production and equilibrium (equalizing prices and better distribution).

- A-9. DESPLECHIN, Jacques. Stratégie du Développement de l'Élevage. Ministère de l'Économie et des Finances et Ministère de la Production Animale de la République de Côte d'Ivoire, 1973.

As a consequence of the rate of development of the Ivory Coast and the growth in the standard of living, that country faces an increasing deficit in animal products. As it is most important to reserve foreign currencies for capital equipment purchases, import policy must give way to a policy of structural changes in consumption patterns. A development strategy is therefore recommended with the objective of a sharp reduction in imports. It consists of both urgent measures (on prices, organizations and structures) and wide ranging projects (assistance and promotion of production, improvements in the transformation and distribution sectors, education). One of the central goals of this strategy is to intensify pork, poultry and sheep raising relative to livestock raising.

- A-10. INSTITUT D'ELEVAGE ET DE MEDICINE VETERINAIRE DES PAYS TROPICAUX (IEMVT). Etude Agrostologique du Ranch de Sipilou, Etude Agrostologique, No.14, 2 vols. Work prepared for the Ministère de la Production Animale, Republic of Ivory Coast, September 1966, 155 pp.

The Sipilou ranch is the topic of this report, although its completion (in the Man area) has not yet been achieved. Its purpose is to undertake the reproduction of animals that would be kept for further distribution. The work includes a detailed study of the environment, the vegetation, the fodder potential and proposals concerning use of the ranch.

- A-11. LACROUTS, M. Considérations sur l'approvisionnement en viandes de la Côte d'Ivoire. Ministère de la Production Animale en collaboration avec le Bureau National d'Etudes Techniques et de Développement et l'Institut d'Elevage et de Médecine Vétérinaire des Pays Tropicaux, Avril 1975.

This study is a diagnostic assessment of the problem of meat supplying in the Ivory Coast taking into account the obstacles to developing animal production and the difficulties encountered in Sahelian livestock raising during the period of the drought. Thus, to permit national production to progress under economic conditions favorable to the producer, a reorganization is necessary for professional organizations as well as for the marketing and financial structures for meat (the creation of a para-statal organization for intervention and modern slaughterhouses at Abidjan and Bamako).

- A-12. LATINOCONSULT, S.A. Description de plusieurs types d'entreprises d'élevage bovin réalisables en Côte d'Ivoire. Report prepared for the Ministry of Planning, Ivory Coast, Argentina, July 1973.

This study was done in order to guide private investments and efforts in the livestock sector. Therefore, the study reviews the current situation and future prospects of this sector, the five typical structures of livestock enterprises and proposals for breeding development (size of farms, necessary investments, computation of profitability).

- A-13. LE CHAU. "Le Commerce dans la région de Bouaké (Côte d'Ivoire): Une étude économique du commerce régional et interrégional dans l'Ouest-Africain." Cahiers ORSTROM, Séries Sciences Humaines, 1964, 3(3): 3-104.

This is an economic study of marketing. Its objectives are to supply complementary economic marketing information and to suggest organizational measures related to the local market. These measures would strengthen the market and make it able to comply with the demands of Ivorian socio-economic development. In order to achieve this goal, quantitative and qualitative surveys were done concerning the total commercial and para-commercial activities of the area (distribution network of general merchandise, local markets, road and rail transport and marketing of special goods).

- A-14. MINISTERE DES AFFAIRES ECONOMIQUES ET FINANCIERES, Direction de la Statistique. Bulletin Mensuel de Statistique, No. 6, Juin 1968 et Supplément Trimestriel, No. 3, 3<sup>eme</sup> Trimestre 1969.

This work includes: 1) general data, 2) vegetable food products, 3) imported products and 4) butchery products and fish found within the two areas. The supplement offers two topics for the city of Abidjan: 1) general outlook on prices and 2) retail price indexes.

- A-15. MINISTERE DES FINANCES DES AFFAIRES ECONOMIQUES ET DU PLAN, Direction de la Statistique et des Etudes Economiques et Démographiques. Situation Economique de la Côte d'Ivoire, 1961. Abidjan, Juillet 1962.

The main purpose of the "Economic Situation" is, considering the available information, to give an outlook as objective as possible on the Ivory Coast's main activity sectors as well as the final results of the year 1961. This work includes: primary outputs, energy, industries, transportation, national trade, international relations, labor, education-health, public enterprise, prices, public finances and change-credit.

- A-16. MINISTERE DU PLAN. Projet du Plan Quinquennal de Développement Economique, Social et Culturel 1976-1980, 6 vols., (Vol. III, Part 1, Chapter 2: "L'Elevage"). Abidjan, 1976.

This chapter of the Plan, dedicated to cattle breeding, presents: 1) the current situation - a strong dependence on foreign supply; the impossibility of pursuing such a policy, 2) the problem - the necessity of a major development of breeding cattle, with time considerations; 3) the objectives - to cover most national needs by 1990; research on integrated development of meat production in West Africa; 4) the means - the creation of an international professional consultants' organization; the creation of breeding units of industrial size; encouragement for development and modernization of the sector; and 5) the costs.

- A-17. MINISTERE DU PLAN, Bureau de Conception, de Coordination et d'Exploitation des Etudes Régionales. Méthodologie Générale des Etudes Régionales de la Région de Bouaké, 1962-1964, Tome 1: Le Peuplement, Tome 2: L'Economie et Tome 10: Tableaux Statistiques de Base. République de Côte d'Ivoire, Ministère du Plan, Février 1962 à Décembre 1963.

This study analyzes the socio-economic situation in the Bouaké area from 1730 to the present. Its social organization, based on family groups and their interaction, is dominated by a matrilineal system of succession. Its political organization as well as its territorial structure are influenced by two factors: 1) the complexity of the extended family and 2) the strong link that exists between politics and religion within the rural world. Finally, this study presents a demographic analysis of the present population. Volume 2 undertakes an exhaustive study of the economic situation of the Bouaké area. It presents five main parts: 1) description of the physical environment, 2) agricultural activities and output, 3) activities relating to crafts and industries, 4) activities relating to the tertiary sector and 5) rural budget and consumption. Volume 10 is a statistical study which is devoted to three topics: 1) population estimate of the area studied according to townships, 2) prices and 3) table of food composition - Center area of the Ivory Coast.

- A-18. MINISTERE DE LA PRODUCTION ANIMALE. "Note sur le prix du bétail et de la viande en Côte d'Ivoire." Abidjan, 1977, 27 pp.

The object of this note is to draw attention to and to justify the necessity of: a) revising current edicts fixing the price of beef produced in African countries while taking into account factors of price increases since 1974; b) lining up prices of non-African beef imported at unreasonable prices with prices of fairly compensated local production. These measures have as objectives to avoid both decreases in Ivorian cattle development and the socio-economic consequences of a sudden sharp price rise, inevitable unless true costs can be established at once.

- A-19. MINISTERE DE LA PRODUCTION ANIMALE, Bureau des Projets. L'Elevage en Côte d'Ivoire: Programme de Développement. Abidjan, 1976.

The Ivory Coast suffers, especially since the drought, from an increasing meat deficit. This paper surveys current actions in order to solve this plight, presents future programs in that same perspective and several cattle development scenarios for the next fifteen years.

- A-20. MONTGOMERY, Roger D. "Baisse de la Consommation de Viande de Boeuf à Abidjan." CIRES: Cahiers Ivoiriens de Recherche Economique et Sociale (Université d'Abidjan), October - December 1975, 7 and 8: 29-68.

This study explains how meat consumption dropped by 50% in the past eight years and how the lack of proteins in the diet increased due to an insufficient supply of substitute products and a bad economic situation in Abidjan. In fact, as is clearly laid out, the urban population, lacking any increase in their real income and having to sustain repaid price increases, had no choice: only cheap food products remained as a source of proteins. Finally, a concise but explanatory presentation of an econometric model as well as a complementary bibliography concludes the study.

- A-21. **SERRES, Henri**; Hubl, Klaus and Roider, Werner. Etudes des Possibilités d'Embouche Bovine en Côte d'Ivoire, 3 vols. Office Allemand de Coopération Technique, Institut d'Elevage et de Médecine Vétérinaire des Pays Tropicaux, Ministère de la Coopération (France) for Ministère de la Production Animale et Ministère de l'Agriculture (Ivory Coast), Feb. 1975.

At the request of the Ministries of Animal Production and of Agriculture, a joint mission of the FAC and German Technical Assistance went to Ivory Coast in order to study the possibilities of cattle fattening. Ivory Coast depends on foreign countries for 80% of its meat consumption. It wants to free itself from this situation and one of the more feasible means of increasing production, both in the short and in the medium run, is through cattle fattening. Therefore, several projects and their profitability are studied: they cover different regions, several livestock breeds and various types of agricultural organizations.

- A-22. **SERVICE DES STATISTIQUES (France)** and Service de la Statistique et de mécanographie (Territory of the Ivory Coast). Etude démographique du 1<sup>er</sup> secteur agricole de la Côte d'Ivoire: résultats provisoires. Paris, December 1958. 36 pp.

This study introduces us to two agricultural sample surveys done in four Ivoirian areas. The villages it concerns are those in the bush whose populations have been ranked (totally or partially) according to birth, fertility and mortality rates (according to age and sex). Finally, and as a conclusion, this study presents life expectation statistics as well as gross and net reproduction rates.

- A-23. **SERVICE DE LA STATISTIQUE ET DE LA MECANOGRAPHIE**. Enquête nutrition - niveau de vie: subdivision de Bongouanou, 1955-1956. Paris, 1958, 193 pp.

The purpose of this work was to produce quantitative and statistical data and also to provide a sufficient understanding of the Agni economic structure. The characteristics of human geography forced the survey to undergo a tripple accounting (made difficult due to population movements between villages and camps): 1) Agni village, 2) foreign groups and 3) cultivation camps. The study presents data on food consumption.



- A-24. SOCIETE D'ECONOMIE ET DE MATHEMATIQUE APPLIQUEES (SEMA). Etude Socio-Economique de la zone urbaine d'Abidjan. Rapport No. 3: Etat de la population d'Abidjan en 1963, Tome 2 Analyse des Résultats. Prepared for the Ministry of Finance, Economics and Planning, Ivory Coast, Paris, Oct. 1964.

This report describes the demographic situation of Abidjan as it appeared in 1963. The main characteristic was its strong growth rate due to a significant migration movement. The study is divided into three parts: 1) the total population (young with a strong male majority), 2) the African population (young with migrants coming from rural backgrounds of great ethnic, religious and educational diversity) and 3) the non-African population (Europeans and Syrio-Lebanese).

- A-25. SOCIETE D'ETUDES POUR LE DEVELOPPEMENT ECONOMIQUE ET SOCIAL (SEDES). La commercialisation de produits vivriers: étude économique, 3 volumes. Report prepared for the République de Côte d'Ivoire, Ministère du Plan, Direction des Etudes de Développement, Paris, December 1972.

During the year from April 1, 1971 to April 1, 1972, SEDES prepared for the Planning Ministry an economic study of marketing of the principal food crops in the Ivory Coast: rice, maize, millet/sorghum, yams, manioc, plantaines, oranges, and groundnuts. To these eight crops is added the cola nut which, while not usually considered a food crop, has been an important part of traditional marketing. The results of this work are incorporated in a three volume report: the first consists of the general report; the second, of statistical appendices and the third presents the results and conclusions of the cola nut study.

- A-26. SEDES. Côte d'Ivoire 1965: Population. Report prepared for the Planning Ministry, Abidjan, 1967.

This work consists of: 1) Summary, 2) Structural Data, 3) Migration Data, 4) Population Characteristics and Demographic Perspectives, 5) Conclusions and 6) Annexes.

- A-27. SEDES. L'Elevage Bovin dans le Nord de la Côte d'Ivoire, 2 vols. République de Côte d'Ivoire, Ministère du Plan, Paris, Avril 1972, 182 pp.

This is a "diagnostic" study mainly concerned with the evaluation of present trends in the demographic development and productivity of cattle. From emerging trends, the study projects for the next ten years changes in cattle and in herd composition, annual and cumulative production expressed in physical amounts as well as in values, and finally, in cumulative real values.

- A-28. SEDES. Note sur le Transport des Viandes par Chemin de Fer entre la Haute-Volta et la Côte d'Ivoire, Etude effectuée par J.E. DeMieulle pour le Secrétariat d'Etat aux Affaires Etrangères, Fonds d'Aide et de Coopération (Paris) et le Conseil de l'Entente, Paris, 1973, 44 pp.

This study deals with the reorganization of the meat network existing between Upper Volta and the Ivory Coast. The present poor conditions of transportation (old rolling stock and tremendous weight losses) already have negative consequences on supply in Abidjan and the operation of the Voltaic refrigerated slaughterhouses (price differentials according to the type of product shipped, unequal opportunities for Voltaic shippers and Ivorian wholesale butchers). In collaboration with professionals and with the agreement of the two existing transport societies - RAN and CODAPAG, the necessary reforms should accompany the establishment of an infrastructure required for the creation of a new system that would be responsible for meat shipping and marketing.

- A-29. SEDES. "Projet de reconstruction de l'abattoir frigorifique d'Abidjan: étude économique et financière." Report prepared for Ministère de la Production Animale (Ivory Coast) and Secrétariat d'Etat aux Affaires Etrangères (France), Paris, 1971, 79pp.

This study analyzes the economic and financial aspects of the project concerning the refrigerated slaughterhouse at Abidjan. It includes four parts: the refrigerated slaughterhouse, the delivery-transport system, the cattle market and results gathered from these three services. Many tables of demographic and consumption statistics are included.

- A-30. SEDES. Région du Sud-Est - Etude socio-économique, Tome 1; La Démographie par Roussel Louis et Tome 5: Les Budgets Familiaux par M. Pescay et B. Reynard. Paris: Ministère du Plan, 1976, 468 pp.

Volume I supplies general data about the area, presents collective and individual data about the rural environment, makes a few probable hypotheses about the working population and, finally and as a conclusion, formulates cautious perspectives about the demographic evolution for the next ten years. The purpose of Volume V is to supply the necessary information about the level, structures and variations in household consumption and resources. It also provides information on the population's economic behavior as well as on its standard of living in the region.

- A-31. SOCIETE IVOIRIENNE DE GESTION D'ETUDES ET DE SERVICES (SIGES). Aspects de la Commercialisation du Bétail sur Pied et de la Viande en Côte d'Ivoire. Abidjan, Décembre 1971.

This study focuses on three aspects of the Ivorian meat trade: import volumes (until 1966); consumption in rural, semi-urban and urban centers and marketing costs. Several points arise from this study: the continued, if not growing, Ivorian dependence on supplying countries; problems arising from the decay and poor operation of butcheries and slaughterhouses; questions relative to the efficiency of livestock and meat marketing agents and networks (elements of tradition within these networks and their dependence on supplying countries).

- A-32. SOCIETE DE LA PRODUCTION ANIMALE (SODEPRA), Opération Encadrement Nord, Cellule Statistique. "Commercialisation et Prix du bétail dans les troupeaux encadrés." Korhogo, 1977, 16 pp.

This statistical compilation includes animal sales and purchases (males younger than females) by farmers, purchases undertaken by SODEPRA within the extension pasture lands, as well as prices applied in the slaughterhouses. This shows how important it is to set a weight control policy in order to limit current price variations in the private sector.

- A-33. SODEPRA. Opération Encadrement Nord, Cellule Statistique.  
"Enquête dans les Abattoirs de: Odienné, Boundiali, Bouna,  
de juin à décembre 1976." Korhogo, 1977, 30 pp.

This survey, carried out by the statistics department, leads to a better understanding of the livestock economy of the northern part of Ivory Coast. Each slaughterhouse is specialized in a specific breed (N'dama in Odienné; Zébus in Boundiali and Baoulés in Bouna) and the characteristics of each slaughterhouse are outlined. It becomes clear that the supply problems (local as well as foreign) make it impossible to satisfy the needs of the population.

- A-34. SODEPRA. Opération Encadrement Nord, Cellule Statistique.  
"Récapitulatif par zone des données chiffrées enregistrées de juillet 76 à mars 77 dans les parcs encadrés." Korhogo, 1977, 37 pp.

This summary collection of tables gives a good representation of the evolutionary development of livestock herds: size (counting birth and death); number of births, deaths, abortions, stillborns; rate of death according to age (male, female); distribution of births as related to the cow's age and finally, various treatments (prophylaxis, disinfection and branding).

- A-35. STAATZ, J. and Lawani, L. "Note sur les Coûts de Transports de Bovins entre Ouaga et Abidjan." Document de travail No 4. Centre Ivoirien de Recherche Economique et Social, Abidjan, March 1977.

This paper presents several preliminary results of a study on beef marketing in the Ivory Coast. It is a partial analysis of statistical data from November 1976 to February 1977 on the composition of transportation costs between Ouaga and Abidjan. Two conclusions can be drawn: 1) the importance of weight losses and therefore the necessity to transport animals by train and 2) the high customs rates which could be lowered.

- B-1. A.I.D./GOM TEAM. A Conceptual Program to Increase Meat Production. Mali Livestock Design Study, March 1973, 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 their future development and to conduct studies and research in support of the livestock sector.

- B-2. BOCOUM, Kolado. "Mémoire de Fin d'Etudes: Etude des coûts à l'exportation du Bétail." République du Mali, Ministère de la Production, Bamako, n.d.

The author presents an analysis of the commercialization of livestock, in particular, cattle, according to different types of transportation. He determines the costs of studies, the purchase prices of livestock, the export fees and defines the commercial margin by means of conveyance. Finally, the author compares different types of transportation, while analyzing the costs of commercialization and the margins.

- B-3. COULOMB, J. et al. Projet de Développement de l'Elevage dans la Région de Mopti (République du Mali: Etude de Troupeau. Maisons-Alfort, France: I.E.M.V.T./FED, 1972, 184 pp.

The objective of this study was to show how joint action on the environment and on livestock can be beneficial for livestock raising conditions. It consists of four main parts including many statistics: animal health, herd demography, feeding and conclusions.

- B-4. DE GONNEVILLE, Tselika, Tyč and Gaillais. Projet de Développement dans la Région de Mopti: Rapport de Synthèse. Annexe B: Résultats de l'Enquête Economique sur le Commerce du Bétail dans la Région de Mopti. Bamako, SEDES, 1972, 99 pp.

This study is an economic table representing livestock activity in Mopti. It was achieved through a survey over an eight month period. It analyzed the activity of the main cattle markets, slaughterhouses and export situations. Major sections are: cattle markets and characteristics of cattle herds; slaughterhouses and characteristics of herds slaughtered; exports and characteristics of herds exported and cattle prices.

- B-5. ERIKSEN, John H. "A Regional Analysis of the Livestock Subsector of the Malian Economy; Problems and Potential." Master's thesis, Cornell University, January 1977.

From author's abstract:

Cattle production is studied as a traditional occupation in the Republic of Mali and the pattern of marketed offtake from the national herd is elaborated for both internal and export markets...The study investigates the financial returns and costs of modernizing cattle production through two basic management systems: smallholder on-farm feeding of cattle using agricultural byproducts, and larger, more capital intensive feedlot operations. Main findings and conclusions: 1) Information indicates that effective demand for beef and beef products in Mali's domestic and major export markets will remain strong through 1980 and a rising price trend will be sustained; 2) The traditional capacity for offtake from the Malian national herd is expected to diminish sharply. Mali will be unable to maintain its traditional share of the West African Beef market using present husbandry practices and 3) Preliminary analyses indicate that smallholder on-farm beef fattening operations hold out better financial prospects than intensive centralized feedlots.

- B-6. GALLAIS, Jean. Pasteurs et Paysans du Gourma: La Condition Sahélienne. Mémoire du Centre d'Etudes de Géographie Tropicale, Paris, C.N.R.S., 1975, 239 pp.

This study is dominated by the country's structural dualism as well as by a certain number of important contradictions. These are specific to numerous areas located on the same latitude in the Sahel and within which originate the reasons for the dramatic situation of the Sahel drought. This document contains five sections: 1) The Sahelian Nature, 2) The Kel Tamacheq Pastoral Space, 3) A Migratory Space: Old and New Dogon Country, 4) Sedentary Networks and Small Associated Nomads from the Mountainous Gourma and 5) The Sahelian Condition.

- B-7. GRAYZEL, John Aron. "Cattle Raisers and Cattle Raising in the Doukoloma Forest Area: October 1974 - September 1975," Mali: OMBEVI and USAID, 1978, 51 pp.

This report concerns cattle raising practices in the Doukoloma area and focuses on supplying very specific data on various processes and activities observed during the year of the study. It includes herd demography, herding patterns, consistency and variation in cattle raising, sedentary versus migratory herding, cattle as savings versus cattle as investment, acquisition and ownership of cattle, exploitation and divestiture, commercial sales and obligations and dynamics of cattle ownership.

- B-8. LACROUTS, M, Sarniguet, J. and Tyč, J. Exploitation du Cheptel Bovin au Mali. Bamako: Ministère du Développement (Mali) and Secrétariat aux Affaires Etrangères (France), 1965, 298 pp.

The objective of this study was to examine the problems arising from the use of a new refrigerated slaughterhouse built in Bamako. Topics discussed are cattle raising in Mali; cattle and meat marketing - national consumption and exports; refrigerated slaughterhouses; and international markets and the future of meat exports.

- B-9. MINISTERE DU DEVELOPPEMENT RURAL. Statistiques du Bétail et de la Viande, 1974 and 1975, 2 vols. Bamako, OMBEVI, 1974 and 1975.

Statistics for the year 1974 are arranged according to output, marketing and consumption. For 1975, there are five main sections: herd statistics, national slaughtering, activity of the refrigerated slaughterhouse at Bamako, animal and meat prices and exports.

- B-10. OFFICE MALIEN DU BÉTAIL ET DE LA VIANDE (OMBEVI). "La Commercialisation des Animaux d'embouche de l'ECIBEV," Document No. 80, Economie, April 1977. FAO/UNDP project.

This paper presents ECIBEV's methods of sale and problems connected with them and recommendations in that perspective (policy of intervention of ECIBEV in both local and export markets - policy of information to traders). To illustrate these points, several estimates of profitability are presented.



- B-11. OMBEVI/FAO/UNDP. "Premier Essai d'Analyse de la Politique des Prix de la Viande." Mali, Avril 1972, 16 pp.

This study was done in order to help solve the crisis facing Bamako's meat supply. It includes four parts: General Review of the Situation, Current Price Policy, Data Analysis and Proposals.

- B-12. OMBEVI. "Prix du Bétail Vivant et de Viandes à Kati et Bamako: Juillet 1974 à Juin 1975." Mali, Décembre 1975, mimeo, 20 pp.

The purpose of this study, done over a twelve month period, is to present an exhaustive analysis of the evolution of cattle prices. Included are data on cattle, cattle meat, sheep and goats, and sheep and goat meat.

- B-13. SERVICE DE COOPERATION DE L'INSTITUT NATIONAL DE STATISTIQUE ET DES ETUDES ECONOMIQUE, MISSION SOCIO-ECONOMIQUE. Enquête budgétaire dans le delta central nigérien (Zone inondée - Office du Niger). Bamako: République du Mali, Janvier 1961.

This socio-economic mission deals with the study of rural budgets within the Macina (traditional zone) and the Mopti (regional office for agricultural colonization) circles. This sample survey study was made after each of the two regions had been divided into homogeneous sectors. It reveals their activities and main ethnic groups as well as the overall results shown from the budgets of 300 households.

- B-14. STREBELLE, J. and Diallo, S. "Politique des Prix de la Viande et d'Assainissement des Marchés en Quatre Etapes." Bamako: OMBEVI and FAO, Avril 1975, 29 pp.

This report analyzes the difficulties encountered by wholesale butchers. Its main purpose is to recommend a series of reforms which would be applied according to a four-step method. The document includes five parts and three annexes: Raising of Cattle Prices, Wholesale Butchers; Economic Problems, SOMBEPEC Difficulties, Four-step Reform Proposals and Improvement of Meat Markets.



- C-1. ARNAL, J.P. and Garcia, M. "Evaluation des Pertes sur le Bétail dues à la Sécheresse: Rapport Provisoire de Mission Effectuée au Niger." Niamey: CEBV, 1973, 34 pp.

This report studies the consequences of the drought on Niger's livestock and meat supply. It discusses the situation inherited from the last drought and possible remedies for the present.

- C-2. BERNUS, Edmond. "L'Evolution Récente des Relations entre Eleveurs et Agriculteurs en Afrique Tropicale: l'Exemple du Sahel Nigérien." Cahiers ORSTOM, Séries Sciences Humaines, 1974, 11(2): 137-143.

From author's abstract:

The Niger Sahel zone is a favored meeting place for farmers and shepherds. This contact brings out the complementary character of the agricultural and pastoral economies, but tensions and conflicts arise frequently. A law was passed to attempt to preserve the rights of the two parties. The Tuareg society gives a good example of the evolution of the Sahel zone of agro-pastoral colonization.

- C-3. BISSON, Jean. "Eleveurs-Caravaniers et Vieux Sédentaires de l'Air Sud-Oriental." Travaux d'Institut de Recherches Sahariennes, 1964, 23: 95-110.

From author's abstract:

Anthropo-geographical observations in a mountainous district on the southern border of the Sahara. Tuareg populations practising stock-breeding, trading by caravans and, in more numerous cases, farming. Importance of caravan trading owing to geographical situation of the district, although the volume of exchanges depends for a good part upon the wheat-crop in Air.

- C-4. COULOMB, J.; Lamarque, G. and Pagot, J. "Zone de Modernisation Pastorale du Niger: Economie du Troupeau." SEDES and IEMVT pour le Ministère de l'Economie Rurale, Niger. France, 1971, 178 pp.

The objective of this study was to produce a socio-economic report which specified: 1) herd structure according to regions and major ethnic groups 2) factors dominating cattle production (fertility, mortality) and 3) probable herd evolution (quantity and quality) within current conditions and prospective changes for the region.

- C-5. DUPIRE, Marguerite. Peuls Nomades: Etude Descriptive des Wodaabe du Sahel Nigérien. Travaux et Mémoires de l'Institut d'Ethnologie (Université de Paris) Vol. LXIV (1962), 336 pp.

This study concerns a very traditional population with an entirely pastoral economy which, through its extreme specialization, finds itself totally dependent on the agriculture and the handicraft of neighboring societies. Its monetary economy is weak and unadapted (the cattle property not being regarded as a marketable one) because the nomad produces without concern for the foreign demand and uses his own resources up to a maximum (bartering millet, milk and butter for clothes, sugar, tea and pottery). The Peul will only resign himself to part with his cattle under economic and social pressure. Livestock satisfy his physical and social needs by providing the basic elements for economic transactions and human relations (the cattle well-being and the human fertility are closely linked by parallel rites).

- C-6. FENN, M.G. Développement de la production animale et des ressources en eaux dans l'est du Niger: perspectives en matière d'investissements et d'expansion. Prepared for FAO/UNDP, Rome, 1969, 44 pp.

This report was done in the framework of a project for the development of animal production in the eastern part of Niger. After a review of this sector, the report studies the proposals relating to the creation of a large grazing ranch and draws a negative conclusion concerning its creation.

- C-7. GALLAIS, J. Le Delta Intérieur du Niger: Etude de Géographie Régionale, Tome 1. Mémoires de l'Institut Fondamental d'Afrique Noire, No. 79. Ifan-Dakar: Université de Dakar, 1967, 621 pp.

The objective of this study is to convey the uniqueness of the area. It shows: 1) the environmental difficulties (inadequate irrigation in the Northwest as opposed to the Southeast), 2) the social diversity (the Peul are a widely dispersed, nomadic population who are cattle-breeders and fishermen, while the Marka are a densely settled, sedentary and farming population), 3) technical problems (outdated rice cultivation techniques, mediocre water management system, and a still very primitive agriculture) and 4) land tenure problems (the ties linking man and land remain strongly traditional). Despite this variety, the delta can display highly integrated agricultural and pastoral economies, a well-organized territorial system and a future-oriented economic trilogy (rice-fish-livestock). Finally, this still-developing area already has a strong marketing organization and an active and graded market network geared toward the most dynamic center of the delta: Mopti.

- C-8. GRANIER, P. "Factibilité de deux ranches au Niger." Travaux agrostologiques en sous-traitance, No. 22. IEMVT, Mars 1974.

This study was written after an agrostological inspection was performed in order to estimate the nutritive value of pastures as well as their seasonal flows of cattle. It contains two parts: I. Developmental Bases for a Ranch located in the Sahelian Zone (using traditional methods then recommended patterns of farming and intensification of fodder output) and II. Study of the Proposed Areas (North Gouré, North Dakoro and Dosso Zone).

- C-9. GRANIER, P., Mensil, J.G., and Keita, I. Rapport d'Activités Agropastorales en République du Niger. IEMVT for République du Niger, Direction de l'Élevage. Oct. 1975, 140 pp.

This study presents the work that has been done concerning the improvement of pastureland management and the feeding of cattle. Trial bases have been spread out from north to south according to different ecosystems in which livestock play an important role or in which they need to be integrated to maintain an agro-pastoral equilibrium.

- C-10. INSTITUT NATIONAL DE LA STATISTIQUE ET DES ETUDES ECONOMIQUES (INSEE), Ministère de Coopération, (France). Les Budgets Familiaux Africains à Niamey, 1961-62 for Service de Statistiques, Niger. Paris, 1964, 75 pp.

This publication contains the survey of the family budget which was done in Niamey for the period March 1961 through April 1962. The survey was done within the framework of a socio-economic inventory. An appendix on planning completes the volume.

- C-11. INSEE, Ministère de Coopération, (France). Enquête Agricole au Niger for République du Niger, Paris, 1970, 199 pp.

This is a survey of the main characteristics of Nigerien agriculture. The survey was done in the framework of the world agricultural census foreseen by the FAO in 1960. The major categories are: cultivated lands, crops and mixed cultures, structures of farms, characteristics of plots and the study of density and output of major crops.

- C-12. INSEE and SEDES. Etude démographique et économique en milieu nomade, 2 vols. Paris, 1966.

These two surveys in these volumes are pastoral economic missions executed collectively. The first presents four parts done over a two year period (1962-64): Methodology, Demographic Survey, Budget Survey and Consumption Survey. The second study lasted only one year (1963) but attempted to present a census as complete as possible concerning the cattle of the two ethnic groups (Peuls and Tuareg). It also includes four very detailed sections on cattle, camels, other animals and several annexes.

- C-13. NICOLAS, Francis. Tamesna: Les Ioullemmeden de l'Est ou Touâreg "Kel Dinnik." Paris: Imprimerie Nationale, 1950, 279 pp.

This work is a reference on all aspects of Tuareg life. It is the result of a detailed field study of the Tuareg and Arab inhabitants of the Sahelian and Sudanese regions (Colony of Niger). It contains long lists of relevant vocabulary which are translated into French as well as many photographs and detailed drawings. The main topics covered are geography, history, demography, technology, production and law. The section on production gives especially detailed descriptions of animal herding (including transhumance and animal diseases), agriculture and consumption.

- C-14. NICOLAS, G. "Aspects de la vie économique dans un canton du Niger: Kantché." Cahiers de l'Institut de Science Economique Appliquée, 1962, 5 (5): 104-188.

This study presents several aspects of economic life in a district of sedentary farmers. It is not intended to be a systematic study but rather to analyse data on the situation and economic problems of local inhabitants in the perspective of their attitudes, expectations and life styles. Agriculture and livestock raising are the main economic activities of the region. The organization of production and the problem of balancing these two activities are discussed.

- C-15. PEYRE DE FABREGUES, G. Lexique de noms vernaculaires de plantes du Niger, 2 volumes. IEMVT, 1972.

This is a dictionary of the Hausa Nigerien dialect, the elaboration of which is made difficult by numerous changes in the language. Therefore, all the words in this lexicon are solely based on the phonetic transcription of words transmitted orally (using French sounds).

- C-16. RAYNAUT, Claude. "Transformation du système de production et inégalité économique: le cas d'un village haoussa (Niger)." Revue Canadienne des Etudes Africaines, 10(2): 279-306.

From author's abstract:

Supported by data collected in a Hausa village in Niger, this paper analyses the changes which affect the social organization of agricultural production. The main points outlined are: the breaking up of traditional family estates; the increasing number of commercial operations dealing with the land and the generalization of hired farm-labor. This evolution, which entails a rapid spreading of merchant relationships, raises the question of the role which money plays in a global economic system ruled by groundnut trading. In such a socio-economic context, strong inequality-producing mechanisms are at work: the merchant-oriented "circulation" of land and labor tends to increase the vulnerability of the poorest and the advantages of the richest. Whereas the gap is widening between peasant producers and members of the urban "bourgeoisie," a detailed analysis shows that it still remains moderate among the village community. This is basically linked to the low development level of the producing forces which in turn is a consequence of the weak profit-making capacity of agriculture where most surpluses go outside the rural community.

- C-17. RIPPSTEIN, G. and Peyre de Fabrègués, B. "Secteur B - Sud Tamesna." Modernisation de la Zone Pastorale du Niger: Etude Agrostologique, No. 33. IIMVT and Laboratoire National de l'Elevage et de Recherche Vétérinaire. Niamey, Jan. 1972.

This study refers to the sectors of South Tamesna, North Dakoro and the Tadress Plateau where pastoralism is traditionally carried on by Tuaregs and Peuls. However, social pressure and herd growth have led to an evolution from which various proposals have been expressed concerning the improvement of certain areas: water (creation of new water-holes), fires (efficient legislation and creation of fire-belts and fire-cuttings) and pastures (improvement of their management, maintaining of transhumance, protection of water-holes and guarding of herds).

- C-18. ROBINET, A.H. "La Chèvre Rousse de Maradi: son exploitation et sa place dans l'économie et l'élevage de la République du Niger," Revue d'Elevage et de Médecine Vétérinaire des Pays Tropicaux, 20 (1): 129-186.

The main objectives of Livestock Service policy are described in this study: 1) spreading of the red goat outside of its original environment, 2) search for the best conditions within which the best hereditary characteristics can be bred, 3) study of the goat parasitic and infectious pathology and preparation of an economical and efficient vaccination, 4) multiplication of wells, slaughterhouses, dryer units, 5) training of specialized staff and 6) Creation of a primary manufacturing industry.

- C-19. SECRETARIAT D'ETAT AUX AFFAIRES ETRANGERES CHARGE DE LA COOPERATION (Direction de l'Aide au Développement). Dossier d'Information Economique: Niger 1971-1972. Paris, October 1973, 61 pp. plus 79 Annexes.

This study presents an outline of all of the unfavorable conditions facing the Republic of Niger (geography; climate; demography; lack of economic, administrative and technical substructure) as well as the effort made toward its economic recovery. Indeed, due to important foreign aid (especially from France), Niger has been able to construct a small industrial sector and a minimum communication network. This report includes four parts and 79 annexes: 1) Men, 2) Output, 3) Barter and 4) Public Finances.

C-20. SEDES. Projet de Modernisation de l'Elevage en Zone Pastorale  
(Rapport Synthèse). Paris, July 1973.

This study is a synthesis of all studies since 1969 which were made to modernize the pastoral zone of Niger. It defines the development framework applicable to cattle raising on a national scale. It also provides an animal production policy that will fit current economic demands. The report includes four chapters: 1) Analysis of Livestock Situation, 2) Prospects for Livestock development, 3) Proposals and 4) Evaluation of the Present Proposal and Its Economic Justification.

- D-1. ABALU, George O.I. "A Note on Crop Mixtures under Indigenous Conditions in Northern Nigeria." Journal of Development Studies, 1976, 12(3): 212-220.

This note contends that crop mixtures are employed by farmers primarily as risk precautions and that the immediate objective of farmers is not only one of profit maximization but also of stability of income. The results of an income stability model, employed to verify this hypothesis, seem to agree relatively well with existing information in parts of Northern Nigeria.

- D-2. ANTHONIO, Q.B.O. "Food Consumption and Income Relationship in Nigeria: Egel's Curve Functions." Bulletin of Rural Economics and Sociology (Ibadan), 1966, 2(1): 52-67.

From author's introduction:

Two interrelated objectives prompted this study. The first is to subject a series of family-budget data to three types of functions (linear, power and inverse); and the second objective is to determine the income elasticities for food in general and for different food classes (as staples, animal protein, oils and fats and vegetables). Related to the objective of determination of income elasticities is the subsidiary aim of approximating the marginal propensity to consume for the area (Nigeria) from which the family-budget data was obtained.

- D-3. DE LEEUW, P.N. "The Role of Savanna in Nomadic Pastoralism: Some Observations from Western Bornu, Nigeria." Samaru Research Bulletin, No. 62 (Samaru, Zaria: Ahmadu Bello University), 1966.

From author's summary:

The vegetation of Western Bornu Northern Nigeria, its environment, physiognomy and composition of the flora are described. This savanna vegetation has developed under the combined influence of a severe dry season, shifting cultivation, grazing and the resulting annual fires. The savanna constitutes the grazing orbit of nomadic pastoralists who have adapted their system of cattle husbandry to the seasonal variation of the grazing land by a cyclic transhumance pattern of their families and herds.



- D-4. FEDERAL OFFICE OF STATISTICS. Annual Abstract of Statistics 1960, 1964, 1967, 1970 and 1971, Lagos.

These reports include the following subjects: population and area; public finance; external trade; power, fuel and minerals; agricultural products; retail price indices; education; cooperative societies; migration; climatological statistics; balance of payments; capital formation and employment.

- D-5. FERGUSON, D.S. "The Nigerian Beef Industry." Cornell International Agriculture Development Bulletin, No. 9, 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.

- D-6. FOOD AND AGRICULTURE ORGANIZATION (FAO). Kainji Lake Research Project, Nigeria. The Fish Population of Newly Impounded Kainji Lake. Based on the work of Jerry L. Turner. Technical Report No. 1. Rome, 1970, 59 pp.

From author's abstract:

A survey of the fish population of Kainji Lake, Nigeria was carried out from June 1969 to April 1970. Fish collections were made at seventeen stations on the lake. The catch rate of experimental gill nets showed an inverse relationship to the water level, the probable explanation being the higher concentration of fish during low water. The fishery potential of the lake appears to be limited by low nutrient content of inflowing waters, declining available nutrients from the lake basin and the high rate of water displacement. The present character of the foodweb tending towards primary consumer species realizes the greatest potential of the lake.

- D-7. FAO. Kainji Lake Research Project, Nigeria. Fish Population of Kainji Lake, Trends in Their Development and Utilization. Based on the work of A. Lelek. Technical Report No. 2. Rome, 1972, 121 pp.

From author's abstract:

The objectives of this study were to select, compile and analyze information on the biological characteristics of the major commercial fish and the factors that affected their production and exploitation. After the creation of the lake, the number of fishermen doubled, but this increased fishing effort did not result in a higher yield. The fisheries were dependent on the formerly abundant group of citharinids which were fished by gill nets. The report suggests that a variety of fishing methods be employed so as to crop all harvestable groups of fish in the lake.

- D-8. FAO. Kainji Lake Research Project, Nigeria. Pelagic Primary Production in Kainji Lake. Based on the work of S.G. Karlman. Technical Report No. 3. Rome, 1973, 59 pp.

From author's abstract:

Pelagic primary production in Kainji Lake was studied from December 1970 to September 1972. Production per volume of water and per unit surface area was estimated. Seasonal variations in solar radiation transparency, temperature and composition of subsurface light were also measured. An attempt has been made to relate the pelagic primary production to fish production. This estimate, while of no higher accuracy than other estimates is the lowest so far proposed.

- D-9. HILL, Polly. "Landlords and Brokers: A West African Trading System (with a Note on Kumasi Butchers)." Cahiers d'Etudes Africaines, 1966, 6(3): 349-366.

This is a summary article dealing with the West African landlord system of trade, the workings of a Nigerian cattle market (at Kumasi) and the organization of Hausa butchers in this market. The author describes the many roles of the "landlord" - broker, contractor, landlord - describing him as the "pillar of the market structure." The organization and functioning of the cattle market are described, including the bargaining process. The article concludes with comments on the Hausa butchers - their status and power, traditions and competitiveness of the field. A glossary of terms relating to livestock markets and butchers is included.

- D-10. KELLOGG, Earl Duane. "A Temporal and Spatial Model to Assist in Evaluating Investments in the Nigerian Beef Distribution System." Ph.D. Dissertation, Michigan State University, 295 pp.

From author's abstract:

The purpose of this study was to develop and illustrate the use of a model that would help evaluate the consequences of alternative investments that might be made in the Nigerian beef distribution system. These investments are needed to reduce the large shrinkage, salvage and death losses that are presently incurred in the distribution of beef from producers to consumers in Nigeria.

- D-11. MACLENNAN, K.J.R. "A Consideration of Environmental Consequences following anti-Tsetse Operations in Nigeria." Tropical Animal Health and Production, 1973, 5(1): 40-45.

From author's abstract:

Aspects of the local impact of tsetse reclamation operations on the environment are discussed. Some of the direct consequences of insecticidal applications and the indirect results of the subsequent ingress of man and livestock into the wilderness are reviewed. As so far determined, the persisting insecticides used in a very selective manner do not appear of themselves to be causing changes in the fauna of sufficient magnitude to render such usage undesirable.

- D-12. MINISTRY OF ECONOMIC PLANNING AND SOCIAL DEVELOPMENT, Statistics Division. Trade and Traffic Flows in Western Nigeria (A Road Survey Report), Ibadan, 1966 (?), 96 pp.

A statistical bulletin compiling results of a survey which measured the flow of traffic in goods within Western Nigeria and between that region and other regions of the country. Goods included are food crops, cash crops, manufactured food and drink, other manufactured goods and miscellaneous goods.

- D-13. NATIONAL OFFICE OF STATISTICS. Rural Economic Survey of Statistics, Livestock Enquiry - 1963/64 and 1964/65. Lagos, Nigeria.

The Livestock Enquiry is a part of the multi-purpose Rural Economic Survey conducted annually by the National Office of Statistics, covering all of rural Nigeria on a sample basis. It was designed to provide basic data on various important aspects of the rural economy of the country such as household characteristics, consumption, farm acreages and production and prices paid and received by farmers. The survey contains data on livestock held by rural households; percentages of households holding different kinds of livestock; and livestock births, deaths, slaughters, purchases and sales. It excludes livestock held by the migratory population, such as the Fulanis of the North. In view of the migratory character of these persons and the cattle owned by them, methods are proposed to be developed towards designing a suitable sample survey for the purpose.

- D-14. NIGERIAN COLONIAL GOVERNMENT. Proceedings of a Conference called to consider the Report of the Nigerian Livestock Mission (Lagos, September 1952). Lagos, 1953.

The Conference discussed the following topics: cattle markets; slaughter arrangements; stock routes; transport of animals by rail; and livestock and meat marketing organization.

- D-15. OLAYIDE, S. Olajuwon. "Some Aspects of Beef Production in Nigeria." Factors of Agricultural Growth in West Africa, I.M. Ofou, ed. ISSER, Lagos, 1973, p. 240-250.

From author's introduction:  
This paper is devoted to an appraisal of some aspects of beef production in Nigeria including the livestock country and population, primitive and modern production methods and a discussion and appraisal of domestic production problems. One section assesses the effects of interterritorial movement of beef cattle on domestic production, while another examines new competitive roles posed by other sources of meat. Research and government policy aspects of production are also considered.

- D-16. \_\_\_\_\_. "Agricultural Productivity and Increased Food Production under Economic Development in Nigeria." In Rural Development in Nigeria: Proceedings of the 1972 Annual Conference of the Nigerian Economic Society. Ibadan: Ibadan University Press, 1973, 45-76 pp.

This article contains a short section on the Nigerian livestock industry which discusses livestock and productivity; structure, conduct and performance; livestock density; and population and land use.

- D-17. \_\_\_\_\_, and Oni, S.A. "Short-Run Demand for Beef in Western Nigeria." Nigerian Journal of Economic and Social Studies, 1969, 11(2): 165-172.

From author's introduction:

In this study, an attempt is made to analyze aggregate intrastate demand for beef on retail market. Section two deals with the market for beef in Western State. In section three, an attempt is made to discuss, very succinctly, the rationale of the empirical approach employed. The nature and adequacy of the data used form the substance of section four. Other sections discuss the methodology adopted and the empirical results.

- D-18. \_\_\_\_\_. "Statistical Analysis of the Demand for Beef in Lagos." Bulletin of Rural Economics and Sociology, 1972, 7(1): 103-25.

From author's introduction:

The central problem of this article is to analyze the price-quantity relations for retail beef with major emphasis on possible monthly and quarterly shifts in consumer demand. A graphical picture of the structure of monthly demand for beef for the period 1964-1967 is presented. Section three explores illustrative uses of trend and zero-one variables in empirical demand analysis, followed by a discussion of the methodology and the main explanatory variables used. The estimating equations are analyzed in section five, while the last section comprises the summary and conclusions of the analysis.

- D-19. OYENUGA, V.A. "The Level of Nigerian Livestock Industry." World Review of Animal Production, 1966 (January-March, 1966), 91-104 pp.

From author's summary:

The shortage of animal protein in the Nigerian diet is due to the low efficiency of the available livestock and lack of organized and scientific feeding regime. By far the most important and pressing problem facing the livestock industry, in Nigeria, is the need to provide better quality feed in greater quantities. Breeding should aim at evolving an improved type of animal which can take advantage of the better environment arising from increased introduction of science and technology into the livestock and agricultural industries.

- D-20. RAAJ, H.G.T. van. Rural Planning in a Savannah Region. Rotterdam University Press, 1975.

From author's introduction:

This study attempts a planning-oriented analysis of the Fulani pastoralists in northern Nigeria. Certain rural problems associated with a society and economy in transition are assessed. Major environmental, organizational, social-psychological and technological constraints and potentialities for development are examined and applied to a problem-solving context.

- D-21. \_\_\_\_\_. "Some Suggestions for the Future of Cattle Husbandry in Northern Nigeria." Samaru Agricultural Newsletter, Institute for Agricultural Research, Ahmadu Bello University (Nigeria), 1969, 11(6): 66-70.

The author asserts that it is a widely held assumption that a reform of the cattle industry in northern Nigeria is both inevitable and desirable. However, such reform should be assessed in terms of the existing natural and cultural situation. This account examines the following cultural implications: the ethnic distribution of cattle rearing; the social organization of the cattle rearing population; the main orientation of the cattle rearing economy and the system of cattle management. The paper further suggests mixed farming as an answer to current problems and future needs.

- D-22. \_\_\_\_\_, and de Leeuw, P.N. "The Importance of Crop Residues as Fodder: A Resource Analysis in Katsina Province, Nigeria." Samaru Research Bulletin, 139, Institute for Agricultural Research, Samaru (Zaria, Nigeria: Ahmadu Bello University), 1971, pp. 136-147.

From author's introduction:

The value of crop residues as fodder has been recognized in several studies on the rural economy of northern Nigeria, but as yet, the various crop residues have not been specified, nor has any attempt been made to measure their importance quantitatively. As the savanna location of the greater portion of Nigeria's livestock population imposes serious feeding problems in the dry season, an estimate of the available sources of fodder is believed to be imperative for the achievement of a fuller utilization of the animal potentialities. This account examines yields of crop residues and their fodder potential in Katsina Province and also indicates some practical implications of crop residues for the livestock industry.

- D-23. STENNING, Derrick J. Savannah Nomads: A Study of the Wodaabe Pastoral Fulani of Western Bornu Province, Northern Region, Nigeria. Published for the International African Institute by Oxford University Press, 1959.

Stenning's book on the Wodaabe pastoral Fulani of Nigeria is of interest both to the anthropologist and the policy-maker. His ultimate concern is with the degree to which Fulani pastoralism can be effectively integrated into a more developed economic order, where mixed farming is encouraged. He begins with a vivid ethnographic description of the Fulani peoples, then attempts to reconstruct some of the more significant political and economic changes that affected Fulani pastoralism within the past century. He deals extensively with the existing structural and ecological realities of both household and kinship systems, and patterns of transhumance and cattle movement. Although the book is concerned primarily with the effects of changing historical circumstances upon Wodaabe social organization, Stenning leaves us with a glimpse into the future role of the Fulani pastoralism. He explores some of the implications of possible administrative pastoral reforms and offers the reader insight into some of the critical ways in which the savannah nomads can be effectively integrated into the economic and political mainstream of modern Nigeria.

- E-1. AGENCY FOR INTERNATIONAL DEVELOPMENT (AID). "Upper Volta Eastern ORD." Project Proposal Outline, n.p., 1974.

From author's introduction:

This project paper recommends the initiation of an integrated rural development project. The project was designed with its potential replicability in mind; to devise technical and administrative approaches that are positive responses to on-going currents of change and supportive of the social structure. This outline contains both a description and an analysis of the project.

- E-2. BARRAL, Henri. "Mobilité et Cloisonnement chez les Eleveurs du Nord de la Haute-Volta: Les Zones Dites 'd'Endodromie Pastorale'." Cahiers ORSTOM, Séries Sciences Humaines, 1974 11(2): 127-135.

From author's abstract:

In the Upper Volta Sahel zone, the Oudalan area is inhabited by nomads (Tuaregs and people assimilated to them, Peuls) and by a sedentary minority (mostly Songhay). Within this area one can mark the boundaries of so-called "endodromie pastorale" zones, which compose an equal number of territories, cultivated according to an annual cycle from several points of continually flowing waters by sedentary or nomadic stock-breeders. A well understood nomadism within the framework of a rational cultivation of the pastures allows the preservation of the pastoral potential of a given zone.

- E-3. \_\_\_\_\_ . "Les Populations d'Eleveurs et les Problèmes Pastoraux dans le Nord-Est de la Haute-Volta (Cercle de Dori - Subdivision de l'Oudalan), 1963-1964." Cahiers ORSTOM Séries Sciences Humaines, 1967 4 (1).

Oudalan is the most specifically pastoral area of Upper Volta. This is due to its geographical situation (its latitude places it outside of the tsetse zone), its low population density (Tuareg, Bella and Peul) as well as its efficiency in cattle raising. However, cattle increases (vaccination and political emancipation for the Bella), combined with the reluctance of breeders for marketing the herds (animals are either too old or sterile) and crop extension (the Bella use the best manured pastures located near water holes) have all contributed to endangering livestock development.



- E-4. BOUTILLIER, J.L. "Les Structures Foncières en Haute-Volta." Etudes Voltaïques, No. 5. Ouagadougou, République de Haute Volta, 1964, 183 pp.

Voltaic land tenure is based on unwritten law which is passed on orally and thus represents the immediate expression of present situations. A strong link relates its rules to the ones governing other areas within social life (economy, family and religion). Indeed, this land tenure system finds its origins within the functions of the land leader, within collective land ownership and the individual appropriation of the right to use it, and also within the loose and almost free loan practices. The gradual improvement of agricultural techniques within the family farm unit, on the one hand, and the flexibility attached to the collective organization of production, on the other, seem to be the best solutions offered. These improvements would be brought up within the framework of an agrarian reform and might also serve to solve the antagonism existing between individual families and family groups.

- E-5. DIRECTION DE LA STATISTIQUE DES ETUDES ECONOMIQUES. Bulletin Mensuel de Statistique 1962, 1964, 1966, 1967 and 1972, (several volumes). Report prepared for the Ministère de l'Economie Nationale du Développement et de la Statistique, Ouagadougou.

These reports include: climatology; population; transportation; marketing, output and industry; prices and price indexes; money and credit; public finances and health; and international statistics.

- E-6. EDIAFRIC. LA DOCUMENTATION AFRICAINE L'AGRICULTURE AFRICAINE L'Economie Africaine. 1<sup>ère</sup> édition. 1971. (EDIAFRIC). Paris: Edition Africain.

Development programs and organizations and their achievements in the economy of Upper Volta feature prominently in this work on recent economic development. Most of the data included are from the late 1960's with particular emphasis on the plan period 1967-1970. Agricultural and industrial production are analyzed and the effect of government intervention is noted. There are also data and analyses of trade and public finance. The details of the 1967-70 plan, its results and a description of the interim 1971 plan conclude the study.

- E-7. FAO. L'Amélioration des Pâturages et de la Production Fourragère. Rapport au gouvernement de la Haute-Volta No. 1873. Rome, 1964, 38 pp.

This report presents a work program which will lead to better use of existing pastures as well as develop an association between agriculture and livestock. In order to implement this rural planning program, three types of proposals have been presented: 1) improvement of pastoral hydraulics, 2) farming of deserted areas and 3) association between agriculture and livestock.

- E-8. KABORE, Lamoussa. L'Elevage de la Poule en Pays Mossi, n.p., n.d., (typewritten manuscript).

This report, the result of a study made in Surgu, Upper Volta, describes the customs and practices concerning chickens but offers no precise data. Some of the areas covered concern races and varieties, techniques of raising chickens, consumption (mostly ceremonial) and sale. The author concludes that because these animals are so important in Mossi regions, modern methods of production should be encouraged. In particular, ceremonial sacrifices which contribute no value to the village should cease.

- E-9. MORRIS, W.H.M. and OTTLEY, Rex. Upper Volta Livestock Sector. USAID, November 1974.

From author's summary:  
The current plan has five key programs for the livestock sector: 1) modernization of the transhumant part of the sector, including marketing and processing; 2) integrating livestock and crop production in the sedentary part of the sector; 3) starting the Volta Valley project with a real integration of crop and livestock production; 4) design and implementation of Sahel ORD program and 5) implement the Fada ORD program, including evolution of traditional herding into sedentary mixed farming. The paper discusses the livestock sector, its milieu, its producers, its marketing and its performance.

- E-10. OUEDRAOGO, Marie-Michele. "L'approvisionnement de Ouagadougou en produits vivriers, en eau et en bois." Ph.D. Dissertation, Université de Bordeaux III, C.V.R.S., 1974, 359 pp.

This study concerns the problematic issue of supplying the urban population of Ouagadougou (whose growth rate is spectacular) in a country where the phenomenon of urbanization has not followed the development of production. The problems raised by supplying the city with the appropriate food are doubled when water and wood supplies are considered. Moreover, with the demand for food being higher than the supply, the urban population is obliged to produce food and a spiraling price rise is provoked. This report is made up of three parts: General Conditions of Supply, the Urban Supply, and Manufactured Products and Urban Markets.

- E-11. REMY, Gérard. "La Culture Attelée en Pays Mossi: Notes de Lecture." Notes et Documents Voltaïques, 1972, 6(1): 44-54.

In 1962, SATEC had the responsibility of promoting a large program to popularize new agricultural techniques, but the program failed. These notes are those of three researchers who observed the effects of the operation, looked for the weaknesses and analyzed the difficulties found during the operation.

- E-12. SKINNER, Elliot P. African Urban Life: The Transformation of Ouagadougou. Princeton University Press, 1974.

This work is a description of the progress of urbanization from an anthropological point of view. The data for this study was collected in 1964-1965 and additional observations were made while the author was U.S. Ambassador to the Republic of Upper Volta. Several theories of migration are advanced, but are not developed. Skinner's main theme is that modernization and urbanization are characterized by conscious manipulation and change of existing institutions by urban dwellers. In support of this, he provides copious descriptive material.

- E-13. UPPER VOLTA, Republic of. Plan Cadre 1967-1970, 2 vols. Ouagadougou, 1967.

This report includes: rural and modern development; economic substructure; social sector; information; statistics; studies and surveys; scientific research; investments and their financing; planning structures and results.

- F-1. BOTSWANA, Republic of, Ministry of Finance and Development Planning, Central Statistics Office. The Rural Income Distribution Survey in Botswana 1974/75, n.p.

The objective of this survey was to measure the statistical distribution of annual incomes among households in the rural areas of Botswana with the aim of using the results for rural development planning. Several chapters are devoted to methodology (background, planning, design and execution of the survey). Actual results are given in sections on income distribution, income profiles, distribution of estimated household income and distribution of cattle-owning households (55% of households surveyed). A large appendix of various documents and a bibliography are included.

- F-2. CRUZ DE CARVALHO, Eduardo. "'Traditional' and 'Modern' Patterns of Cattle Raising in Southwestern Angola: A Critical Evaluation of Change from Pastoralism to Ranching." Journal of Developing Areas, 1974, 8(2): 199-229.

The author presents an excellent, detailed analysis of traditional pastoralism vs. modern ranching schemes in Angola. He 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.

- F-3. DRONNE, M. "Problèmes humains du développement de l'élevage en zone sud du Tchad." Machinisme Agricole Tropical, 1970, 29:19-21.

The author discusses the sociological and economic problems caused by the introduction of animal traction and livestock development.

- F-4. FERGUSON, D.S. and Poleman, T.T. Modernizing African Animal Production: The Uganda Tick Control Project. Cornell University, Cornell International Agriculture Mimeograph 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.

- F-5. FAO. Beef Industry Development, Kenya. Meat Processing Costs at the Kenya Meat Commission. Technical Report 1. Prepared for the Government of Kenya, based on the work of G. Beddoes. Rome: FAO/UNDP, 1971.

From author's abstract:

The Government of the Republic of Kenya, with the assistance of the United Nations Development Programme (Special Fund Sector) and the Food and Agriculture Organization of the United Nations began studies in November 1968 on stock feeding and management for increased beef production in order to determine the most efficient techniques. The activities discussed in the present report were carried out from 6 October 1969 to 4 March 1971 and were for the purposes of providing information to the Project on the costs of processing various qualities of beef carcasses for sale in both foreign and domestic markets and of assisting the Kenya Meat Commission (KMC) in analyzing its costs.

- F-6. FAO. Beef Industry Development, Kenya. Studies in Forage Production. Based on the work of D.G. Miles, H.A. Squire, D. Destro and M.J. Creek. Rome, 1972, 40 pp.

From author's abstract:

In this report, the production of forage as a prerequisite to beef-feeding trials is examined. The production and utilization of maize forage is evaluated, as well as the potential of other forage crops. Maize forage agronomy, maize forage costs and preliminary studies in alternative forage crops are described. The broad aims of the study are presented and discussions as to how they may be met are drawn from the observations.

- F-7. FAO. Improvement of Livestock and Dairy Industry, Malawi. Development and Utilization of Wild Life Resources, (Technical Report No. 1). Based on the work of A.S. Mossman. Rome, 1970, 38 pp.

From author's abstract:

This report, to assist the Government of Malawi in its wild-life utilization program, gives these conclusions and recommendations: 1) A higher intake of animal protein and increased income from tourism could result from better wild-life management, 2) A public relations campaign should be initiated to convince the people of Malawi that wild-life management is in their own interest and 3) Tourist facilities, which have a good prospect of earning substantial sums in foreign currency, should be developed.



- F-8. FAO. Improvement of Livestock and Dairy Industry, Malawi. Development of the Dairy Industry, Technical Report No. 2. Based on the work of M.G. O'Keeffe. Rome, 1970, 31 pp.

From author's abstract:

In this report, the dairy industry in Malawi is reviewed for the purpose of planning its future development. To stem the growth of imports of dairy products and to conserve foreign exchange, it is recommended that two milk factories be established. It is recommended that the improved livestock breeding program be expanded. It is proposed that a Milk Board be formed to take over the commercial operations of the dairy industry and be responsible for the milk plants, payment, collection and distribution of milk.

- F-9. FAO. Improvement of Livestock and Dairy Industry Project, Malawi. Pasture and Range Conditions, Technical Report No. 3. Based on the network of H.H. Heady. Rome, 1970, 15 pp.

From author's abstract:

In this report, the husbandry of government ranches and crossbreeding centers, dambo areas and smallholdings are reviewed and recommendations made for their improvement. The most important recommendations are that a wider variety of grasses plus legumes be introduced in order to increase the quality and amount of fodder for livestock. Practices unfavorable to the production of good carcasses, such as herding cattle at night into bomas and trekking to market, should eventually be abolished. Smallholdings should have integration of livestock with crops. Soil improvement by such practices as irrigation, flushing and drainage should be adopted and fencing done in order that a greater variety and production of crops can be obtained.

- F-10. FAO. Improvement of Livestock and Dairy Industry, Malawi. Second Report on Pasture and Range Conditions, Technical Report No. 4. Based on the work of H.H. Heady. Rome, 1971, 12 pp.

From author's abstract:

In this report, the pasture husbandry of estates, holding grounds, livestock expansion centers, smallholdings with little management and smallholdings with intensive management are reviewed and recommendations made for their improvement. The most important recommendation for pastures improved with introduced species concerns their grazing management. Procedures for increasing seed and planting stock are suggested. Increased efforts to train staff and to develop written specifications for the seeding and management of grazing resources are recommended.

- F-11. GARLICK, Peter C. African Traders and Economic Development in Ghana. Oxford: Clarendon Press, 1971, 172 pp.

This monograph attempts to explain some problems of economic development in Ghana by studying the behavior and social background of the biggest African traders in manufactured goods in the distribution sector. The purpose of the study was to formulate a picture of one area of private enterprise by Africans in Ghana to discover what factors prevented individual businesses from expanding. The conclusions indicate that a number of reasons, mainly economic and social ones, prevent such expansion. The social environment of Ghana, including government policies, encourages the tendency to keep businesses to a size which one person can handle and to put profits into no- or low-risk areas such as land and consumer durables.

- F-12. HEYER, Judith; Maitha, J.K. and Senga, W.M. Agricultural Development in Kenya: An Economic Assessment. Nairobi: Oxford University Press, 1976.

This book is a general survey of the agricultural sector in Kenya. One chapter is devoted to the development of rangeland areas. The author presents the case for developing Kenya's range land potential, arguing that most of the capital is already present in the form of wild and domestic animals and considerable skills for livestock production. An attempt is made to classify rangeland in terms of land occupancy and land usage. The role of management, choice of organizational structure and government policies are discussed.

- F-13. HIRST, S.M. and Catto, G.G. "Current Status and Future Utilization Potential of Wild Ungulates on Natural Savanna Rangeland in the Tranvaal Lowveld, South Africa." World Conference on Animal Production. Melbourne, Australia, 1973, 6 pp.

From the article:

This article discusses a number of ecological and economic factors which appear to be involved in attempting to determine rational utilization of ungulates in the Transvaal Lowveld. The overriding factor is human attitudes.

- F-14. HOPEN, C. Edward. The Pastoral Fulbe Family in Gwadu. Oxford, London, 1958.

The author seeks to provide the reader with an extensive account of the interdependence of the family and its herd among the pastoral Fulani of Gwadu, exploring the ecological and social context of pastoral life. He discusses the family, intra-familial relations, marriage patterns, clan and lineage organization, the significance of cattle and patterns of transhumance. He offers an historical overview of the rise and disintegration of the Fulani empire, its pacification and control by the British, and the extent to which the Fulani have undergone internal structural changes as a response to recent conditions. Against this historical background, the reader is better able to appreciate some of the factors underlying the tenacity with which the pastoral Fulani have maintained their ethnic and social separateness, and some of the difficulties which have inevitably emerged in attempts to integrate the pastoral way of life into the wider political and economic context. The analysis is an essentially descriptive one and ultimately an attempt to fill in the gaps of current anthropological literature.

- F-15. JARVIS, Lowell Stuber. "Cattle as Capital Goods and Ranchers as Portfolio Managers: An Application to the Argentine Cattle Sector." Journal of Political Economy, 1974, 82: 489-520.

From author's introduction:  
Microeconomic models, treating cattle as capital goods and producers as portfolio managers, provide a theoretical framework for an econometric model of the Argentine cattle sector. Argentine agricultural stagnation has been partially attributed to a lack of producer price response. This paper shows that the cattle sector exhibits strong price response and that producers correctly differentiate their behavior toward animals of different age and sex. The long-run price response of slaughter is positive, but the short-run response is negative because animals must be withheld to permit increases in future output. This negative short-run response implies that devaluation is unlikely to increase beef exports for at least two years.



- F-16. \_\_\_\_\_. "Supply Response in the Cattle Industry. The Argentine Case: 1937/38 - 1966/67." Ph.D. Dissertation, M.I.T., 1969, 551 pp.

From author's abstract:

This thesis constructs several micro-economic models to develop a theory on which an econometric model of the cattle sector can be based using the Argentine cattle industry. These models show the difference between the uses and capital values of animals of different age and sex. They indicate that the equations explaining slaughter and other factors should be disaggregated by categories of animals to obtain a meaningful explanation of producers' responses to various changes. Underlying assumptions and empirical work are described in detail. The impact of the Peron era on agriculture and some important policy questions are discussed in some detail.

- F-17. KIVUNJA, Charles Dickens. "The Economics of Cattle and Beef Marketing in Kenya." Master's thesis, University of Nairobi, 1976.

From author's abstract:

Cattle constitute about one-third of all national Gross Farm Revenue. This paper emphasizes the production characteristics among the different cattle producers; the traditional supply and demand relationship in the cattle industry; the economic interrelationships between per capita demand for beef and beef prices, other meat prices, and personal real income; the role of the different cattle and beef marketing agencies in this industry; and the aggressive and protective policies and strategies which should be adopted for the amelioration of the technical and economic efficiency of the performance of this industry. The thesis further presents a review of the literature on the Kenyan cattle industry, a familiarization with the general Kenyan environment, and the Kenyan Beef Balance Sheet for the last fifteen years.

- F-18. KOHOUT, José Carlos. "A Price and Allocation Decision Model for the Beef Economy in Argentina." Ph.D. Dissertation, University of Illinois, 1969, 268 pp.

From author's abstract:

The study has two objectives: 1) to investigate the past and present cattle situation in Argentina and 2) to implement a model designed to measure the impact of price changes on cattle production in the Pampean region.

- F-19. LATTIMORE, Ralph Gerard. "An Econometric Study of the Brazilian Beef Sector." Ph.D. Dissertation, Purdue University, 1974, 176 pp.

From author's abstract:

This is a study of the structure of the Brazilian beef economy over the past 25 years. The first part consists of a description of the wide range of government policy that has influenced the beef sector over the period and an evaluation of the key factors influencing beef policy. The hypotheses formed in this part of the study, together with various theories presented in recent studies of this type for other countries, form the basis for specifying an empirical model of the Brazilian beef economy as a whole.

- F-20. LOW, A.R.C. "Small Farm Improvement Strategies - the Implications of a Computer Simulation Study of Indigenous Farming in Southeast Ghana." Journal of Development Studies, 1976, 12(4).

From author's introduction:

This paper outlines the methodology and findings of a village level farm management study in southeast Ghana. A linear programming model is used to investigate the production response of farmers to the introduction of mechanization, crop technology and credit innovations. The results are presented and their research, extension and policy implications are discussed. The results suggest that the present states of technological knowledge and research orientation are biased in favor of the better-off farmers and, as such, do not provide a suitable basis for recommendations consistent with equality which governments profess to be their objective.

- F-21. MEEK, John James. "Simulation of the Cattle-Calves Sub-Sector in a Developed Economy with Special Reference to the Canadian Cattle Herd." Ph.D. Dissertation, Michigan State University, 1975, 414 pp.

From author's abstract:

The study has three basic objectives: The first is to identify the structure and develop a model of the Canadian cattle herd consistent with specified design parameters. The second is to identify, assemble and explicitly evaluate such data as are required to build and validate the model. The model must be tested and found to be valid by specific validation criteria. The third objective includes generation of plausible disaggregations of published population and slaughter data.

- F-22. MILLER, S.F. and Halter, A.N. "Systems-Simulation in a Practical Policy-Making Setting: The Venezuelan Cattle Industry." American Journal of Agricultural Economics, August 1973, 420-432 pp.

From author's introduction:

The aim of this study is to formulate policy to shift the Venezuelan cattle industry from traditional to modern production. A systems-simulation model shows the consequences, through time, of the current set of policies and hypothesizes the consequences of other policy alternatives. Validity of the model was established, on the basis of the decision-maker's criterion, through a game of "hide-and-go-seek." Interaction between the researchers and decision-makers brought together the relevant positive and normative information before a policy was established.

- F-23. NORES, Gustavo Adolfo. "Quarterly Structure of the Argentine Beef Cattle Economy: A Short Run Model 1960-1970." Ph.D. Dissertation, Purdue University, 1972, 212 pp.

From author's abstract:

This study focuses on the analysis of the industry's short-run structure in an effort to understand its dynamic characteristics and to explain the observed price fluctuations. Special attention is given to the evaluation of specific policies such as exchange rate policy, rationing, maximum retail prices and credit policy which has been implemented during the last decade.

- F-24. ORGANISATION COMMUNE AFRICAINE ET MALAGACHE (OCAM). Colloque sur l'Elevage: Fort Lamy, Tchad, 8 au 13 Décembre 1969. Maisons-Alford, France: IEMVT, 1969, 950 pp.

This work states the problems encountered by the economies of the OCAM member states concerning livestock and development. Its five main topics are animal production, technical and economic aspects of this production, veterinary teaching and training concerning livestock. The objective of this work is to survey the modern methods available for developing livestock and for planning for it (marketing and market organization, industrialization and equipments). Finally, it offers the opportunity to compare experiences and tries to achieve program

- F-25. ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT (OECD). Forecasts of the Dairy and Beef Situations in 1975 and 1978. Paris, 1974.

From author's introduction:

This report sets out the expected outlook for milk and beef production, consumption, and trade in 1975 and 1978 in OECD member countries. The country chapters present the expectations of individual member countries as to what is likely to occur. The data are forecasts rather than projections of past trends, though past trends may have been projected when countries thought these would continue.

- F-26. OTRERA, Wylilian Rolando. "An Econometric Model for Analyzing Argentine Beef Export Potentials." Ph.D. Dissertation, Texas A & M University, 1966, 132 pp.

From author's abstract:

The general purpose of this study is to provide some information for the decision-makers in government related to the Argentine beef economy. An econometric model was constructed with an objective of estimating the Argentine beef export potential. The specific objective of this dissertation was to estimate the following equations: 1) the supply and demand functions of beef cattle, 2) the supply function of dressed beef, 3) the domestic demand for dressed beef, 4) the demand for beef to be exported and 5) the beef cattle inventory relationship.

- F-27. PARKER, I.S.C. and Graham, A.D. "Commercial Use of Thomson's Gazelle (*Gazella thomsonii* Gunther) and Impala (*Aepyceros melampus* Lichtenstein) on a Kenya Beef Ranch." Paper presented at Third World Conference on Animal Production. Melbourne, Australia, 1973.

From author's introduction:

This paper describes the first successful attempt in Kenya to produce wild animal carcasses commercially to the same standards of hygiene as applied to domestic livestock in a modern abattoir. The two species concerned were Thomson's gazelle and Impala. The motive was to establish an economically viable, sustainable supplement to the ranch's cattle production.

- F-28. FOSADA, Alvaro. "A Simulation Analysis of Policies for the Northern Columbia Beef Cattle Industry." Ph.D. Dissertation, Michigan State University, 1974, 427 pp.

From author's abstract:

The primary purpose of this study was to develop a system simulation model to analyze the effects of production incentives on the decision of farmers to adopt new production methods, and to estimate the effects of the expanded regional production on the income of farmers, government revenues, Colombian beef consumption and sustained level of exports.

- F-29. REUSSE, Eberhard and Lawson, Rowena M. "The Effect of Economic Development on Metropolitan Food Marketing: A Case Study of Food Retail Trade in Accra." East African Journal of Rural Development (Kampala), 1969, 2(1): 35-55.

This study concludes that public markets play a significant role in Accra; 74% of a family's food budget is spent there. There is growing trade by hawkers and street-side sellers' sales of prepared foods are high and supermarket trade has developed rapidly. The reasons why marketing services are better in the urban areas than in the rural centers are discussed.

- F-30. SCHNEIDER, Harold K. The Wahi Wanyaturu: Economics in an African Society. Chicago: Aldine Publishing Co., 1970.

This anthropological study is a result of fifteen months of field work in two villages of the Wahi subtribe of the Wanyaturu of Tanzania (formerly Tanganyika) in 1959 and 1960. The author addresses the following subjects: the competitive approach to African society; people, habitat and production techniques; kinship and lineage; relations of authority; the market system; individual and corporate rights; people as wealth; women in the past and present.

- F-31. SMITH, John Newton. "A Dynamic Model of the Cattle Industry of Argentina." Ph.D. Dissertation, University of Maryland, 1968.

This dissertation describes three types of beef operations predominant in Argentina. Meat processing, government policies and quality of statistical information are discussed. Developing a model of supply and demand, key values are projected to 1975. The model reveals the Argentine cattle industry to be inefficient in its present extensive system of production.

- F-32. SPENCER, Paul. Nomads in Alliance: Symbiosis and Growth among the Rendille and Samburu of Kenya. London: Oxford University Press, 1973, 230 pp.

This volume is intended to supplement The Samburu, an earlier work by the author. He includes the two tribes in one volume because, despite linguistic, economic and administrative divisions, they are bound together by strong traditional links of political alliance and by ties of kinship to an extent that they do not share with any other tribes of the area. The author does not concentrate on the historical processes that may have linked the tribes together, but rather, on the present factors which serve to maintain their simultaneous interdependence and separateness.

- F-33. TACHER, G; Nicolas, F. and Lachaux, P. "Les bovins de culture attelée au Tchad." Machinisme Agricole Tropical, 1969, 29:16-18.

This article gives a historical presentation of the Chadian livestock situation before describing two problems challenging the success of animal traction - animal pathology and low-income economics.

- F-34. UNITED STATES DEPARTMENT OF AGRICULTURE ECONOMIC RESEARCH SERVICE. "Argentina: Growth Potential of the Grain and Livestock Sectors." Foreign Agricultural Economic Report, No. 78, Washington, D.C., May 1972, 123 pp.

This study evaluates Argentina's potential production of grain and livestock by 1975 under alternative price levels. Resource availability and possible technological innovations were considered in each projection. Major production trends, government policies, supply response to price changes and export trends are considered. Many statistical tables and a bibliography are included.

- F-35. WHITNEY, Joseph. "Striking a Blow against Desertification: Cooperative Initiative in Chungwei County, Ninghsia-Hui Autonomous Region, China." Economic Geography, 1977, 53(4).

This is a narrative story about a party member of the Sun Chihhui production brigade. It describes the difficulties encountered when the people of the Ninghsia-Hui Autonomous Region attempted to prevent the encroachment of the Tegri Desert upon their lands. The narrator describes their successful methodology which left the Region with highly fertile land.

- F-36. YVER, Raul E. "The Investment Behavior and the Supply Response of the Cattle Industry in Argentina." Ph.D. Dissertation, University of Chicago, 1971.

The main purpose of this study is to elucidate the nature of the response over time of the cattle industry to different changes in market conditions. To this end, a theory of investment behavior in the cattle industry is developed. The empirical testing of the propositions developed is discussed and the main conclusions of the analysis are summarized.



- G-1. **ABERCROMBIE, Frank D.** Range Development and Management in Africa. Agency for International Development, Washington, August, 1974.

From author's introduction:

The purpose of this report is to present information for the preparation of range development plans and feasibility studies on rangeland in Africa. The overall objective is to expand present grazing areas and conserve this natural resource in the years ahead, at a rate dependent on the economic development of water and elimination of the hazards of fire, overgrazing, disease and pests. More specific goals are to: 1) assess the carrying capacity of the range and formulate plans for utilization of natural resources for optimum development of the range, 2) provide necessary information on water resources in support of the expansion of rangelands and 3) bring potential rangeland into production by elimination of constraints such as tsetse fly, disease bush encroachment and erosion.

- G-2. **AGENCY FOR INTERNATIONAL DEVELOPMENT (AID).** Development Assistance Program: Central West Africa Region, Section 3, 3 volumes. Washington, D.C., March 1975.

These volumes represent the basic statement of the AID approach toward U.S. economic assistance to the francophone West and Central African area. Volume 1 covers Togo, Dahomey, Ivory Coast; Volume 2, Senegal, Mali, Mauritania and Volume 3, Chad, Cameroon, Central African Republic and Gabon. Each country is reviewed on a macro-economic basis, then specific sector such as agriculture, livestock, health and education are discussed. Many tables of statistics are included.

- G-3. **ALAGOA, E.J.** "Long Distance Trade and States in the Niger Delta." Journal of African History, 1970, 11(3): 319-329.

It is stressed that the discussion of the admittedly great influence of European trade on the internal development of states in the Niger Delta needs to be qualified by an understanding of the prior existence of these states in some form, and of the internal long-distance trade in agricultural produce, salt, fish and other goods that might have exercised similar great influence in the distant past.



- G-4. **ALLAN, William. The African Husbandsman. New York: Barnes and Noble, 1965.**

From volume's forward:

The basic problems of African development still reside in peasant agriculture: the problems of soil and climate, of agricultural tools and innovation, and of the social relations which organize production, distribution and consumption within the family and in networks of kinfolk. This book is an introduction to the complexity of these problems, and sets out in scientific methodology formulae by which that complexity can be simplified and handled in theoretical terms. It also provides answers to many practical problems. The major areas dealt with are: the basis of African land use, environments and systems of land use, hunters and herdsmen and change and development.

- G-5. **ALLSOPP, W.H.L. "African Fisheries: Their Problems and Opportunities and Their Role in the Sahelian Famine." Paper prepared for the UN Special Sahelian Office. July 1974.**

The problems of the fisheries in the drought-stricken countries are described in relation to their normal level of operations in pre-drought conditions and under current conditions. The economic impact of the fish trade is described; traditional supplies have been severely diminished and competitive supplies from marine sources have increased. Suggestions are made for immediate and medium to long-term measures to hasten the recovery of the fisheries of the lakes and rivers.

- G-6. **ARIZA-NINO, Edgar Julio. "Beef Cattle Production. A Microeconomic Growth Curve Model with Special Reference to Sire Evaluation under Tropical Conditions." Ph.D. Dissertation, University of Wisconsin, 1974.**

From author's introduction:

The economic problem for the cattleman, and in particular for the cattle feeder, is to decide on the most advantageous growth path - either genetic or nutritional - and the corresponding rationale to attain it. In outlining a procedure to find an optimum rate of gain, this thesis makes use of growth functions to trace the development of beef cattle over time. Specifically, the study attempts to develop a simulation model incorporating certain features of cattle production in the tropics. A variety of issues pertaining to beef cattle management are explored, such as determining age at sale, determining profits per head at a given age, pasture selection and feeding intensity.

- G-7. ARNAL, J.P. Transport frigorifique sur les axes Ouagadougou-Bobo-Abidjan et Bamako-Bobo-Abidjan, 3 volumes. Conseil de l'Entente, Communauté Economique du Bétail et de la Viande, Abidjan, Novembre 1974, 305 pp.

This study, which originally focused on the extremely bad situation of refrigerated transport of chilled or frozen meat between Upper Volta, Ivory Coast and Mali, broadened its scope to include other perishable goods. The study is reorganized around three main areas: 1) the recent development of the meat trade and potential return freight (fruit, vegetables, frozen fish and fresh goods), 2) technically achievable solutions (cold containers and the Kangourou system) and 3) possible arrangement at the financial and legal levels (creation of a multinational company for road and rail transport of meat and food products as well as other frozen goods). The appendices relate to all the practical, financial, legal and economic aspects of refrigerated transport.

- G-8. ARNON, I. Crop Production in Dry Regions, 2 volumes. London: Leonard Hill, 1972.

The objective of these volumes is to condense the mass of information being gathered on problems of development in arid regions specifically relevant to crop production. The first volume surveys general principles and practices, discussion background information on the history, environment and traditional land-use of drylands and the semi-arid fringes. The basic principles of arid-land crop production are grouped in three main sections: rational use of water, basic agronomic principles and plant protection problems. Volume 2 is a discussion of specific principal crops, cultivation techniques and economic significance, including wheat, barley, sorghum and millet, maize, rice, pulses or grain legumes and industrial crops. A final section concerns forage supply.

- G-9. BAKER, Randall. "The Sahel: An Information Crisis." Disasters, 1977, 1(1): 13-22.

From author's introduction:

This paper examines some of the lessons that might be learned from the Sahel situation with regard to planning and suggests areas of weakness in the system. The author evaluates the quantity and quality of information available and gives various interpretations of this knowledge. Guidelines for future planning are proposed.

- G-10. BANQUE CENTRALE DES ETATS DE L'AFRIQUE DE L'OUEST. "La Communauté Economique du Bétail et de la Viande entre les Etats de l'Entente." L'Economie Ouest Africaine, No. 188, October 1971, 6 pp.

This pamphlet briefly describes the establishment, goals and organization of the Economic Community for Livestock and Meat between the Entente States of West Africa. It reprints the text of the agreement signed in 1970 by representatives of each state to establish the Community.

- G-11. \_\_\_\_\_ . Notes d'Informations et statistiques, No. 188. Paris, October 1971.

This group of pamphlets briefly discusses the following subjects: the meeting of the Board of Directors of IBRD and IMF; the situation and predictions for agricultural production exported from West Africa; economic indicators for West Africa and specifically for Togo; money circulation; production, exchange and development; and the legislative report on political institutions and public services.

- G-12. BARTLETT, E.T.; Evans, Gary R. and Bement, R.E. "A Serial Optimization Model for Ranch Management." Journal of Range Management, 27: 233-239 pp.

From author's introduction:

A linear program resource management model is described. This model is used to aid in the decision-making process of developing basic ranch management plans. A simple, one-year-at-a-time ranch management plan for the Central Plains Experimental Range was developed. The model uses discrete continuity equations to facilitate the flow of resources and products through seasons of the year. Management strategies based on the amount of initial operating capital (\$20,000 to unlimited) are discussed.

- G-13. BAUER, P.T. West African Trade. London: Routledge and Kegan Paul, Ltd., 1963.

Beginning with a discussion of the general aspects of West African economies and the role of trade, this classic study analyzes the import trade, monopolistic and competitive influences in external trade, the export trade, marketing boards and internal trade. Country case studies include Sierra Leone, the Gambia, Nigeria, and the Gold Coast.

- G-14. BECKER, John A. An Analysis and Forecast of Cereals Availability in the Sahelian Entente States of West Africa. AID, Jan. 1974.

The purpose of this report is to provide a perspective of cereals availability in Niger and Upper Volta, describing the past, assessing the future and considering alternative assistance efforts in alleviating future food crises.

- G-15. BERG, Elliot. The Recent Economic Evolution of the Sahel. Center for Research on Economic Development, University of Michigan, 1975.

In an attempt to remedy a lack of knowledge about the effects of drought on the Sahelian economies, this paper first records and explains these effects in conventional economic terms - production, budgets, balance of payments, income distribution, etc. The report then brings together a large body of basic data on recent economic developments in the Sahel, creating an historical presentation, marking trends and changes over time of significant economic variables. Data is brought together from official reports, published literature and from the field (as of 1975). It is synthesized and made consistent so as to present, in one place and one form, a useful set of economic indicators.

- G-16. BISHOP, Dwight R. "Livestock and Meat Marketing Patterns and Costs in the Entente and Adjoining Countries." Report prepared for the Council of the Entente. Ouagadougou, September 1972.

The author was Chief of Commerce and Transportation Division of the Livestock Community, 1970-1972. 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, slaughtering and meat processing facilities. Estimates are also given of livestock numbers and trade and of taxes imposed on cattle. (Ferguson)

- G-17. BOAHEN, A. Adu. "The Caravan-Trade in the Nineteenth Century." Journal of African History, 1962, 3(2): 349-359.

This article discusses the ancient trade routes binding "the Barbary, the Sahara and the Negro territories." Traffic on these routes was determined by two factors, political conditions in Sudan and security of routes in the Sahara. Many major routes are discussed - their political history, the goods carried over them (gold, textiles and rugs, arms, ivory, slaves, leather goods, etc.) and their decline because of instability in the area and colonialism.

- G-18. BODENHEIMER, F.S. "The Ecology of Mammals in Arid Zones." In Arid Zone Research, Vol 8: Human and Animal Ecology, Reviews of Research, 100-137 pp. Edited by UNESCO, 1957.

"Arid zones: refer here, to regions where rainfall is wanting during a prolonged warm season thereby restricting plant and animal life to forms which during this season either have regular access to drinking water of rivers or lakes, or which are satisfied with the water derived from their food (as free water or as metabolic water). The objects of this study are the ecological and physiological adaptations needed for survival in such an environment.

- G-19. BOECKM, E; Bremand, O.; Dumas, R; Huhn, J.E. and Comfere, R. "Study of the Actual Situation of Livestock Breeding in the Country (sic) of the Sahel and Preventive Measures to be Considered." Prepared for FED, Commission of the European Community, Feb. 1974, 293 pp.

This is an analysis of the effect of the drought on the Sahel, which considers herd inventory and losses; the health situation; water supplies; pastures and forage; the problems and attitudes of stockbreeders. Breeding operations and modernization are discussed as well as marketing and budgeting. There is a diagnosis for each topic and the paper makes proposals for improvements. A statistical annex is included.

- G-20. BOHANNAN, Paul and Dalton, George, editors. Markets in Africa: Eight Subsistence Economies in Transition. New York: Anchor Natural History Library, 1965, 373 pp.

From authors' introduction:

The essays in this book describe the technology, social and economic organization and culture of small-scale African communities. They are of interest to two fields of social science: economic anthropology and economic development.

- G-21. BREMAUD, O. and Pagot, J. "Grazing Lands, Nomadism and Transhumance in the Sahel." In Problems of the Arid Zone, 311-324 pp. Arid Zone Research, Vol. XVIII. Paris: UNESCO, 1962.

This article begins with a review of the geology, climatology and vegetation of the Sahel and a discussion of the botanical characteristics of various areas of the Sahel. Livestock are discussed in relation to their grazing transhumant and sedentary life in the Sahel and ways of improving conditions in the Sahel are proposed. They conclude that nomadism and transhumance in this area are imposed by the ecological situation and that the transhumance cycle is determined by variations in availability of grazing land and water. They propose improving pastoralists' standards of living by education and by improving sales possibilities rather than by improving breeds and pasturage.

- G-22. CALDWELL, John C. The Sahelian Drought and Its Demographic Implications. American Council on Education, Overseas Liaison Committee, Paper No. 8, December 1975, 88 pp.

This report, based on observations of the author, who is a demographer, gives a general review of the geographic and demographic characteristics of the Sahel. The author describes the development and impact of the recent drought, particularly on cattle. The gathering and accuracy of livestock data are discussed. Other sections of the report deal with demographic data concerning nomads, ecological effects, health and nutrition. Changes caused by the drought in diet, food prices, selling of livestock, and nomadic movements are discussed. Some prospects for the future are considered.

- G-23. CAPOT-REY, R. "The Present State of Nomadism in the Sahara." In Problems of the Arid Zone, 301-310 pp. Arid Zone Research, Vol. XVIII. Paris: UNESCO, 1962.

A general overview of traditional nomadic life concentrating on the traditional economy and living standards of nomads. The author discusses some of the effects which political and economic changes over the preceding 50 years have had on the balance between pastoral peoples and the desert environment. The trend towards settling is becoming "general and irreversible." Several problems caused by settling are discussed - lack of arable land, few other employment outlets for former nomads and loss of food supplies. The author discusses steps which could be taken to preserve nomadic cultures or to integrate nomads smoothly into the economic and political life of the state.

- G-24. CHAPERON, P. "Quatres Années de Sécheresse au Sahel - Données Pluviométriques et Hydrauliques en Mauritanie et au Sénégal." Report prepared for La Sécheresse en Afrique - Projets de Développement. Dakar, November 1973, 18 pp.

This article introduces us to the climatic characteristics associated with Mauritania and Senegal, gives an idea of the rainfall and water data for the period studied, outlines the geographic range of the phenomenon and gives a concise summary of the basic data previously known. The author tries to give a satisfactory answer to the problems of lack of water and rainfall caused by the drought.

- G-25. COHEN, William B. Rulers of Empire: The French Colonial Service in Africa. Hoover Institution Press, Stanford University, 1971.

This book depicts the administration of colonies of French West Africa from the beginning of the colonial period until 1960. In particular, the individual governors and administrators in Paris and in the colonies are discussed and how their experiences, personalities and actions influenced events. This work is, in part, a history of the Ecole Coloniale and its importance. The book includes an extensive bibliography, maps and photographs.

- G-26. COMMUNAUTE ECONOMIQUE DE L'AFRIQUE DE L'OUEST (CEAO). "Document 6: Note concernant l'évaluation du fonds communautaire de développement et celle de la contribution des états membres à son financement," n.d., 7 pp. (mimeo).

This document quotes the legal clauses that have been established in order to determine CEAO financial arrangements as well as measures concerning each one of the seven member countries.

- G-27. CEAO. "Document Statistique, Nos. 2,3,4,5,6,8." Séries 1969-70.

Document 2 gives statistics relating to exchanges (imports-exports) between the seven member countries. Document 3 indicates the distribution of imported and exported products among the countries, the marketing of which is mainly with the EEC. Document 4 attempts to determine the value of exchanges between each country and its CEAO partners. This is achieved by making a distinction between raw and industrial products. Document 5 presents quantitative and qualitative tables concerning commercial exchanges as well as tables relating to tariffs due to the EEC and CEAO. Document 6 follows a pattern similar to Document 4 with oil products added. Document 8 gives a detailed analysis, in terms of quantity and value, of the cattle and sheep imports and exports within CEAO.

- G-28. CONSEIL DE L'ENTENTE. "Accord Portant Organisation et Réglementation des Professions Touchant au Commerce du Bétail et de la Viande dans les Etats de la Communauté." "Accord Portant Harmonisation de la Réglementation Douanière Applicable aux Importations, Exportations et Transit du Bétail et de la Viande dans les Etats de la Communauté." Ouagadougou: CEBV, 1974.

These two documents reprint agreements of the Entente states concerning regulation of meat marketing professions and standardization of import, export and transit tariffs.



- G-29. DAHL, Gudrun and Hjort, Anders. Having Herds: Pastoral Herd Growth and Household Economy. Stockholm 1976.

The authors attempt to disprove the concept that pastoralists keep large herds only in order to achieve high social status in their society. This book intends to illustrate the economic aspects of having herds. The keeping of large herds is closely linked to the need to protect the household against the effects of drought or epidemics as well as for food requirements during a particularly dry period. A sufficient number of animals must survive a disaster in order that the household can exist while the herd is being rebuilt. An understanding of this central feature of traditional nomadic livestock economies, asserts the authors, is essential both for the comprehension of pastoral land use and for the planning of alternative land uses, such as ranching.

- G-30. DESHLER, W. "Cattle in Africa: Distribution, Types and Problems." Geographical Review, 1963, 53(1): 52-58.

There is significant difficulty involved in gathering data; underenumeration is common. Herds that reside in border areas are often erroneously ascribed. Furthermore, total count depends upon whether the cattle were counted in the wet or dry season. Beyond the problems of data gathering, cattle distribution depends upon the cultural values of those who keep the animals, by availability of food and water and by disease. The major cattle types probably represent infusions of stocks introduced at various times in the past. Sources of data by country are listed and several maps included.

- G-31. \_\_\_\_\_. "Native Cattle Keeping in Eastern Africa." In Man, Culture and Animals, 153-168 pp. Edited by Anthony Leeds and Andrew P. Vanda. Washington, D.C.: American Association for the Advancement of Science, 1965.

From author's introduction:

One of the dominant aspects of the cultural landscape of the semiarid zones of both eastern and western Africa is the large number of cattle kept by the tribes of these areas. In eastern Africa such tribes as the Masai, the Suk, the Karamajong, the Nuer, and others maintain herds of from four to ten cattle per person. These are spoken of as the "cattle complex" peoples. Cattle take on an extreme importance. They play a part in tribal ceremonies, they have aesthetic value, and their possession gives prestige. On the basis of field observation, this paper discusses the subsistence contribution of cattle and the problem of herd size among the Dodos, one of the northern Karamajong tribes of Uganda.

- G-32. DE VOS, Anton. "Wildlife Production in Africa." Paper presented at Third World Conference on Animal Production. Melbourne, Australia, 1973.

The author discusses various constraints to domestic animal production and the potential for sustained production of wild animals. The most suitable geographic areas and the advantages of mixed livestock-wildlife ranching are considered in some detail.

- G-33. DE YOUNG, Maurice. "Some Notes on the Economics of the Beef Industry in the West African Sub-Region." FAO/ECA Agricultural Economics Bulletin for Africa, 1968, 10: 49-60.

This report states that the present marketing system of the cattle industry is fundamentally uneconomic. It restricts producers to a very small "take-off" which will not permit the landlocked countries to satisfy increasing demand for beef. The cost of alternative systems has not been sufficiently explored. The author calls for further study of the economics of transport for this industry and the development of a marketing system which relates not only to direct costs, but also to the costs of misallocation of scarce resources.

- G-34. DILLON, John L. Analysis of Response in Crop and Livestock Production. Second Edition. Pergamon Press, 1977.

From author's preface:

The aim of this text is to provide an introductory outline of the analytical principles involved in appraising the efficiency of crop-fertilizer and livestock-feed response. Chapter 1 gives an outline of the theory of crop and livestock response and the purely physical implications of this theory. Chapter 2 presents the principles involved in ascertaining best operating conditions for response processes in which time and risk play no role or may be reasonably ignored. These principles are extended in Chapter 3 to cover time considerations in response efficiency, and in Chapter 4 to cover response efficiency under yield and price uncertainty. As an epilogue, Chapter 5 surveys some of the major difficulties involved in the implementation of a program of crop or livestock response research.

- G-35. DOUTRESSOULLE, G. L'Élevage au Soudan Français: Son Économie. Alger, 2<sup>ème</sup> édition, 1952(?), 374 pp.

This work provides us with an exhaustive study of the characteristics of the Sudanese cattle (numerical importance, variety, density and balanced distribution). All the domesticated species are thriving and well represented, which is proof of a healthy climate producing at the same time an open and diversified population. Its social (good food supply, prosperous handicraft) and economic (animal traction, exports, barter and increases of meat consumption) consequences are numerous. Finally, the expected improvements are developing: medical protection of the cattle, predator destruction, reduction of the water problem and the quality and rational use of livestock.

- G-36. DYSON-HUDSON, Neville. "The Study of Herds." Journal of Asian and African Studies, 1972, 7(1-2): 2-29.

This is a review of the literature on nomadism from the 19th century to the present and an introduction and commentary on the essays contained in the volume. The author criticizes the approaches of writers on nomads. He discusses methodology and the kinds of data needed for meaningful analysis.

- G-37. DYSON-HUDSON, Rada. "Pastoralism: Self Image and Behavioral Reality." Journal of Asian and African Studies, 1972, 7(1-2): 30-47.

The author considers misleading qualities of category labels such as nomadic vs. sedentary and pastoral vs. agricultural in reporting the results of a study in Uganda. She emphasizes that the range of variation in activities such as herding should be considered more seriously. Degrees of nomadism are defined as a response to factors such as the environment, political situations, herd and family management and the individual psychology of the herder.

- G-38. ECOLE PRATIQUE DES HAUTES ETUDES-SORBONNE. Etudes de Géographie  
Tropicale Offertes à Pierre Gourou. Paris: Ecole  
Pratique des Hautes Etudes - VI<sup>e</sup> Section, 1972, 595 pp.

This work presents a series of studies introducing various aspects of geography (physical, human, etymological, economic, social and political) organized into five sections: 1) Human Geography, 2) Monsoon Asia and Oceania, 3) Tropical Africa, 4) Tropical America and 5) Miscellaneous. Most of the countries analyzed by these authors are very weak agricultural economies. This is due to their former positions within a colonial system which was only interested in developing export crops in order to supply Europe while ignoring the specific cultural and social aspects of each civilization. Since their independence, those countries have gone from one economic system to another and have had to reorganize themselves on new bases more adapted to their ethnic, demographic and agricultural realities. This promises a better adjustment of technical innovation to economic and land tenure conditions.

- G-39. EDELSTEN, P.R. and Newton, J.E. "A Simulation Model of Intensive Lamb Production from Grass." Grassland Research Institute  
Technical Report, No 17. Hurley, Maidenhead, Berkshire:  
Grassland Research Institute, 1975.

From author's Introduction:  
This model is part of a combined experimental/modeling program to describe systems of lowland fat-lamb production. The overall objective of the program is to be able to specify an optimum fat-lamb production system for a given lowland farmer, given certain input parameters such as the topography and soil structure of his farm, historical climate data, the economic environment and the farmer's attitude to risk. The aim of building this model was to integrate information about sheep grazing systems into a mathematical model to obtain insight into the interactions between the components of the system.

- G-40. EDIAFRIC. L'Economie des pays d'Afrique noire de la zone franc.  
First edition, Paris, 1973, 330 pp.

This report presents a detailed and elaborate study specific to the economic and financial state of each one of the thirteen countries of French Africa. It successively offers a geographical outlook; the most recent economic accounts; the export, industrial and food crop outputs; livestock; industrial, manual and sea fishing; mining industry; energy and water; the manufacturing industries; transportation; the development of international marketing since independence; finances and effected investments as well as prospects concerning proposals and, finally, multilateral and bilateral public aid.

- G-41. FERGUSON, D.S. "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.

- G-42. FEUNTEUN, L.M. "L'Elevage en Afrique Occidentale Française: Son Importance Economique et Sociale," n.p., n.d.

The author presents information gathered while he was "Inspecteur Général de l'élevage des industries animales de l'A.O.P." A major problem with the study is that none of the figures are dated and one can merely guess from the text that they are from the early 1960's. The major emphasis of this report is on the effect of extension services, improvement of the environment and research. The author concludes that numbers of animals can be increased and their health improved if government financing is continued and the peasants are educated to appreciate the government's efforts.

- G-43. FISCHER, John L. "Development of the Beef Industry in Africa: A Paper on Improving Technical and Capital Assistance with Proposed AID Policy Guidelines." Paper prepared for AID. University of Arizona, 1969.

From introduction:

The purpose of this report is to provide background information on the potentials and problems of the African beef industry in order to develop a rational framework for advising agencies in Africa concerned with the beef industry and to aid in evaluating requests for technical and capital assistance. Physical and human resources availability is reviewed and the potential market question is discussed.

- G-44. FAO. "African Trade in Meat, 1959-63." Monthly Bulletin of Agricultural Economics and Statistics, 1966, 15: 1-10.

Since many African countries depend very heavily on a few cash crops as earners of foreign exchange, the problems of Africa's agricultural trade have tended to be considered in the past primarily from the point of view of these products. This has resulted in an inadequate appreciation of the potential contribution of some other, less developed, but perhaps basically more dynamic, sectors of agriculture. Livestock and livestock products are considered as a case in point, and the following topics are addressed: distribution of livestock, trade in live animals, exports of meat and meat products, major meat import markets in Africa, some problems of African meat trade with the developed countries, and development of intra-African meat trade.

- G-45. FAO (Organisation des Nations-Unies pour l'Alimentation et l'Agriculture). Etude prospective pour le Développement Agricole des Pays de la Zone Sahélienne, 1975-1990, Tome I: Rapport Principal et Tome II: Annexes Statistiques. Rome: O.N.U., 1976, 321 pp.

This study was carried out over two years by an interdisciplinary team. It presents five chapters, describing in great detail the present and future situations of the CILSS countries. Its purpose is to bring about an awareness of the tremendous effort that must be undertaken in order to achieve rural development in the Sahel. This development includes providing the inhabitants with a stable food supply and improving the precarious life conditions of the rural society. Finally, this study must be seen as a reflective document addressing all Sahelian politicians and technicians as well as other countries and organizations who are willing to help them.

- G-46. FAO. World Animal Review. Quarterly. Rome: FAO.

A quarterly journal reviewing developments in animal production, animal health and animal products and byproducts, with particular reference to these spheres in Asia, Africa and Latin America.

- G-47. FOREIGN ECONOMIC DEVELOPMENT SERVICE and USAID. The Marketing Challenge: Distributing Increased Production in Developing Nations. Proceedings of a Conference in Washington, D.C., June 18-19, 1970.

From preface and abstract:

This publication is based upon a seminar sponsored by the U.S. Agency for International Development and the U.S. Department of Agriculture, held in Washington D.C., June 18-19, 1970. The purpose of the seminar was to provide guidance for AID-USDA efforts to improve food marketing in developing countries. Major topics covered include key considerations in marketing policies, marketing enterprises and the flow of resources into marketing functions, nutrition and marketing food for the needy, efficiency in the marketing system, regional experiences in marketing problems and priorities and approaches to technical assistance. A number of specific areas of activity were given high priority: 1) better identification of technical assistance and research needs in marketing; 2) improvement of marketing management capability; and 3) providing more adequate marketing information for consumers, producers and distributors.

- G-48. FRANSEN, J.M.; Khouri, R.H. and Milford, R. "The Dynamics of Livestock Production in Subsahara Africa." IBRD Livestock Development Division, Sept. 1970.

This article discusses livestock distribution and density as they are effected by ecological factors in 6 major regions of Africa. The characteristics of each region as they apply to livestock are summarized. Herdsmen, production data and the potential for increased production are discussed. A systems approach is recommended for increasing production. The article includes statistical tables, a map and a bibliography relating to livestock production and range management.

- G-49. GARCIA, M. "La Structure du troupeau bovin sahélien au Niger et en Haute-Volta après la sécheresse." Revue Trimestrielle de la Communauté Economique du Bétail et de la Viande, April-Sept. 1974, 13 pp.

The purpose of this study was to attempt an evaluation of the losses due to the drought. It concerns herd structure, specifically the distribution of males and females according to age groups.

- G-50. GULLIVER, P.H. The Family Herds: A Study of Two Pastoral Tribes in East Africa -- the Jie and the Turkana. London: Routledge and Kegan Paul, Ltd., 1955.

This work is a result of field research among the Turkana of Kenya during 1948-1950 and among the Jie of Uganda during 1950-1951. It deals at length with the physical environment and social ecology of these people. The main topics dealt with are ecology and pastoralism, family and property, stock-associates and marriage and bride-wealth.

- G-51. HANCOCK, W.K. Survey of British Commonwealth Affairs, Volume II, Part 2: Problems of Economic Policy, 1918-1939. London: Oxford University Press, 1942.

The major topics addressed in this volume are evolution of the settlers' frontier in Southern Africa and evolution of the traders' frontier in West Africa. The final chapter contains a review of the major themes.

- G-52. HELMAN, Howard B. "Cattle Production in West Africa: No Easy Answers for the New Enthusiasts," n.p., November 1972, 42 pp.

This paper takes as a point of departure that the traditional patterns of cattle raising have been unaffected by donor investments and domestic government policies and services. The author concludes that urbanization and modernization in Africa are producing demand for meat which cannot be met in existing marketing structures. He recommends that donors seek to accomplish improvements by selected interventions; including improvement of forage resources utilization, expansion of livestock services, establishment of region- or continent-wide research centers, development of modern livestock sector (including financial investment) and development of a sector strategy. Regional cooperation is emphasized and priorities for improvement are listed.



- G-53. HILL, Polly, "Notes on Traditional Market Authority and Market Periodicity in West Africa." Journal of African History, 1966, 7(2).

These notes on traditional market authority and market periodicity in West Africa are intended to draw attention to the neglect of a fascinating historico-anthropological field. They are concerned merely with markets as places, not as mechanisms. Markets, far from being outmoded institutions, are bound to increase in importance during the next few decades, especially in the expanding cities of the south. The author specifically discusses market authorities, market periodicity and geography and market taxes.

- G-54. \_\_\_\_\_ . Rural Hausa: A Village and A Setting. Cambridge University Press, 1972, 368 pp.

This is a wide-ranging, multi-dimensional study which examines, in general, the way of life in rural Hausa, and in specific, the socio-economic life of a small Hausa village. The book contains an extensive glossary of terms, concepts, statistical data and reference materials.

- G-55. HODDER, B.W. and Ukwu, N.I. Markets in West Africa: Studies of Markets and Trade Among the Yoruba and Ibo. Ibadan: University Press, 1969.

Both of the studies in this book were written by geographers and refer to market institutions in contiguous parts of West Africa. They illustrate widely differing approaches. While the Yoruba study is chiefly concerned with the analysis of markets as institutions, the Ibo study pays particular attention to markets as central places and analyzes the characteristics and processes of marketing and trade associated with these institutions.

- G-56. **INSTITUT D'ETUDE DU DEVELOPPEMENT ECONOMIQUE ET SOCIAL (INADES).**  
"Rapport d'Activité: Année 1974." Abidjan, 1974, 36 pp.

The Institute is trying to initiate a change in the agrarian habits of the population. This is done with the cooperation of a staff trained by INADES. Its staff is increasingly African (males and females) and their teaching mainly concerns the rural area. The training sessions are performed at three levels. The basic level offers farmers agricultural experimental classes as well as a further training class. The intermediate level, mainly concerns women (sensitization to their situation and role under pedagogical supervision) and, finally, the professionals (engineers, economists, sociologists), whose training offers development sensitization classes.

- G-57. **INADES (Université de Paris).** L'Approvisionnement des Villes dans les Etats Africains et Malgache (horizon 1985).  
Report prepared for le Secrétariat d'Etat aux Affaires Etrangères. Paris, 1973.

This work includes two studies (done from surveys carried out in the country concerned) presenting complementary characteristics. The purpose of the first study was to determine the daily caloric needs of Abidjan, Bamako, Lomé, Ouagadougou and Bouaké according to two approaches: 1) taking the structure and the activities of the population as well as the climatic incidence into account and 2) depending on quantitative and qualitative nutritious requirements as well as local habits. The objective of the second study was to analyze the food consumption according to two criteria: intertemporal and temporal.

- G-58. **JOANDET, G.E. and Cartwright, T.C.** "Modeling Beef Production Systems." Journal of Animal Science, 1975, 41(4): 1238-1246.

From author's summary:

Systems analysis techniques may be applied to modeling beef production at many different hierarchical levels: from the level of the cell to the level of a region or country. Choice of the proper level is critical to the attainment of objectives. A system may be described with a mathematical model that may be used to examine effects of alternative practices or inputs or a given objective function. Maximization techniques may be applied to simulate optimal breeding or management systems for a specific set of production, economic and social conditions. The modeling exercise is a systematic method of applying segmented knowledge to specific dynamic production situations.

- G-59. JOHNSON, Douglas L. The Nature of Nomadism: A Comparative Study of Pastoral Migrations in Southwestern Asia and Northern Africa, Research Paper No. 118. University of Chicago, Department of Geography, 1969.

From author's preface:

This study has a dual purpose. It reviews a portion of the vast literature dealing with nomads and it attempts to classify nomadic groups on the basis of the cartographic appearance of their migration patterns. An introductory statement about the nature and ecology of pastoral nomads is given. The individual case studies form the bulk of the work and were chosen to give the most representative selection possible within the regional limitations. Each tribal study is accompanied by a map of the tribe's migration pattern. The concluding chapter, together with its suggested classification, is the logical outgrowth of the maps and serves to draw together the collection of case studies.

- G-60. \_\_\_\_\_ . "The Response of Pastoral Nomads to Drought in the Absence of Outside Intervention." Paper presented for the UN Special Sahelian Office.

This paper is based on a review of more than 400 books and articles on nomadic studies dealing with the ecological organization and migration patterns of pastoral nomadism in North Africa and Southwest Asia. The author seeks to delineate the characteristics of nomadic life that condition a response to drought, to develop a generalized model of pastoral response to drought and to suggest in broad outline major developments likely to occur within the nomadic community in the absence of major external intervention, when adverse environmental conditions relax.

- G-61. KANE, Cheikh Tidjiane. "Une expérience de formation professionnelle rurale: le perfectionnement des éleveurs." Drought in Africa series, paper from CILSS rural development in Africa field trip/workshop, Feb. 1975, 15 pp.

The objective of the project reviewed in this paper was to set up a training structure designed for the rural community which would be a key for development. Five sections of the report cover history of the project, connections between this and other recovery projects, further training centers for stock-breeders, participation of foreign assistance and future prospects.

- G-62. KASSAS, M. "Desertification versus Potential for Recovery in Circum-Saharan Territories." In Arid Lands in Transition, 123-142 pp. Edited by Harold E. Dregne. Washington, D.C.: American Association for the Advancement of Science, 1970.

The topics dealt with in this work are: environmental shifts in steppelands; features of vegetation; land form and surface sediments; developmental versus retrogressional changes; change within the Gum Arabic Belt in Sudan; mechanism of recovery; experiments; water conservation by reservoirs; water redistribution systems; green belts and afforestation; and ecobiological recovery.

- G-63. KEULEN, H. Van; de Wit, C.T. and The Institute for Biological and Chemical Research on Field Crops and Herbage (I.B.S.). "Actual and Potential Herbage Production in Arid Regions. Annotated bibliography." Wageningen (Netherlands), August 1975.

This paper relates to a joint Dutch-Israeli research project which was conducted from 1972-1975. It summarizes the aims of the project and the results and also includes an annotated bibliography.

- G-64. LAGOIN, M.M.Y. and Salmon, G. "Etude technique et économique comparée de la distribution du poisson de mer dans les pays de l'ouest africain: étude régionale." Secrétariat d'Etat aux Affaires Etrangères, Chargé de la Coopération, (France), October 1967.

Data from 1960-1964 are used in a series of tables describing (among other things) fishing population, value of the catch, and imports and exports. The trade data are in terms of volume, value, change in composition over the period and customs duties paid. The consumption of fish and beef is compared and the problem of protein deficiency in the human diet of the area is noted. The authors conclude that an expansion of ocean fishing and domestic consumption of fish is the best remedy for this problem.

- G-65. GRIGORI, Lazarev. "Rural Development in the African Countries of the Sudano-Sahelian Africa." Report prepared for the UN Special Sahelian Office, July 1974, 16 pp.

The author reviews the situation of the rural population of the Sahel and brings up a variety of questions concerning rural development. He discusses geographic, economic, technical, social and institutional constraints which impede development. After a brief review of rural development action over the past 10 years, he shows that, because of a piecemeal approach, these efforts have to a large extent been limited to extension and improvement of exports, ignoring food crops, livestock raising and other activities. The author calls for new approaches to rural development - using political will and imagination to increase agricultural production, overcome technological constraints (energy, soil fertility, improvement of crops, breeding techniques, etc.), better organization of the domestic market and the development of rural employment.

- G-66. LE COEUR, Ch. "Le Commerce de la Noix de Kola en Afrique Occidentale." Annales de Géographie, No. 199, Paris: Librairie Armand Colin, Janvier 1927, 143-149 pp.

First, we are given a description of the conditions under which the kola tree must be grown, as well as the medical, religious, social and mystical virtues of its fruit. Two aspects of kola nut marketing are presented: native and European. Native marketing remains more important and is based on barter (for salt, textiles and cattle) from south to north. European marketing is still very low despite the extension of the French railway; Senegal and the Gambia thus remain the main coastal outlets.

- G-67. MCGINNIES, William G.; Goldman, Bram J. and Paylore, Patricia, editors. Food, Fiber and the Arid Lands. Tucson: University of Arizona Press, 1971, 437 pp.

This is a collection of articles by a variety of authors ranging in scope from general information for the lay reader to highly technical writing for the specialist. Main topics are: cultural and social problems, land and resource uses, water and agriculture, ecology of arid regions and information sources. The articles cover a wide geographical range - including the American Southwest, the Middle East, Mongolia and South America. Each article contains an abstract and an extensive list of references.



- G-68. MCLOUGHLIN, Peter F.M., ed. African Food Production Systems: Cases and Theory. Baltimore: Johns Hopkins Press, 1970.

The purpose of this collection of original articles by both anthropologists and economists is to focus on the food problem in an African environment. Based almost entirely on field work in rural communities, the case studies presented here describe in some detail the food production of seven African societies.

- G-69. MIU, Stephen J. and Longworth, John W. "Stochastic-Computerized-Activity-Budgeting for Sheep Enterprises." Australian Journal of Agricultural Economics, August 1975, 109-118 pp.

From author's introduction:

Stochastic-computerized-activity-budgeting (SCAB) facilitates and extends the traditional gross margins analysis for sheep activities. SCAB is one of the very few computerized management aids so far developed for Australian farm management situations. In the deterministic mode, SCAB calculates gross margins based on point estimates of all the relevant parameters. In stochastic mode, it generates a distribution of pay-offs (gross margins) based on the manager's subjective probability distribution for the relevant major uncertain parameters. The variance of this distribution of pay-offs represents a measure of the risk associated with the activity given the manager's subjective probability distribution for the relevant major uncertain parameters.

- G-70. MINER, Thomas H. and Associates, Inc. "Pre-Investment Study: Meat Packing Industry for Entente Guaranty Fund." Prepared for AID. Chicago, 1967.

The objectives of this study were to investigate factors pertinent to evaluating the opportunity for private American investment in Niger and Upper Volta. Specific data were gathered on the availability of livestock in those countries, types and structure of existing and potential consumer markets, recommendations on basic processing plants and transport needs, partnership potential with government and/or local private interests, local financial and legal arrangements including taxes, tariffs, import-export controls, limitations on capital movements and repatriation profits, etc. After a summary presentation, the study presents detailed analyses of potential markets, transportation, procurement and investment and income schedules.

- G-71. **MINISTERE DE LA COOPERATION, Direction de l'Aide au Développement (France).** "Compte Rendu de la Réunion d'Information et de Coordination sur l'Elevage dans les Pays du Sahel." FED, Paris, 1974, 80 pp.

This meeting gave the opportunity to hear countries' demands, to discover donors' positions and to record reactions on both sides to a study financed by FED analyzing the livestock situation at the end of 1973. The report of the meeting is in seven parts: agenda, list of participants, summary of the FED report, paper on Gambian livestock, Sahelian ecological problems, speech by M. Bailhache and conclusions.

- G-72. **MIRACLE, Marvin P.** "Comparative Market Structures in Developing Countries." LTC Reprint No. 75. Land Tenure Center, University of Wisconsin, 1970.

From author's introduction:

The purpose of this paper is to review some of the more important contributions to the literature on market structures in developing countries; to present theoretical arguments concerning the type of market structures we should expect during early phases of economic development and to report some relevant empirical evidence for the agricultural sector in some of the countries of Africa and Latin America.

- G-73. \_\_\_\_\_ . "Methodology for Research on West African Systems." Unpublished paper, University of Wisconsin, n.d.

Most economists analyze economic development in West Africa as suggested by the dual economy model. The author hypothesizes that many -- perhaps most -- rural West Africans commonly buy and sell a number of items, and that the marketing systems they are involved in are typically more complex, involving long distances and more middlemen, than is usually suggested. This hypothesis is tested and supported by eight months of field work in the Ivory Coast, with the main mode of data collection being the interview. The author presents an evaluation of this methodology.

- G-74. MITTENDORF, H.J.; Wilson, S.G. and the Centre (Fort Lamy, Chad). Livestock and Meat Marketing in Africa. Rome: FAO, March 1961, 123 pp.

This report is divided into two parts. The first is the survey of livestock and meat marketing in Africa based on information collected during a tour of Africa in 1960. The second part is a summary account of the Centre held at Fort Lamy, December 1960. The authors review the information on meat supply, consumption, prices and trade as well as livestock disease problems. There is a section on transportation and a discussion of markets and slaughterhouses. Marketing systems are reviewed and the authors conclude that the development of livestock and meat production and marketing should become a priority for many African countries. Many statistical tables and maps are included.

- G-75. MONOD, Theodore, ed. Pastoralism in Tropical Africa: Studies Presented and Discussed at the XIIIth International African Seminar, Niamey, December 1972. Published for the International African Institute. London: Oxford University Press, 1975.

From author's preface:

The seventeen studies published in this volume (some in French, some in English) were prepared for the discussions at the Thirteenth International African Seminar, held at Niamey in December 1972. The papers review African pastoralism (in both West and East Africa) in relation to ecology, economy, social and community organization, kinship, intergroup relations, modern administrative attitudes and policies and problems of development.

- G-76. MORGAN, W.T.W. East Africa: Its People and Resources. Nairobi: Oxford University Press, 1969.

From author's foreword:

This work is a descendant of the handbook on "The Natural Resources of East Africa," prepared for the Eighth Commonwealth Forestry Conference in 1969. This volume aims more consciously at a wider audience, especially to three kinds of people: the specialist in the subject who values a summary of the present position; the worker in another discipline who needs an introduction to other, perhaps neighboring fields and the relevant literature and to the student of East Africa in general. The major topics addressed are: history, demography, physical features, agriculture, forestry, fishing, industry, research and economics.



- G-77. MORRIS, C.A. and Wilton, J.W. "Influence of Mature Cow Weight on Economic Efficiency in Beef Cattle Production." Canadian Journal of Animal Science, 1975, 55: 223-250.

From author's introduction:

Linear programming has been used to investigate, with a farm level model, the influence of mature cow weight or economic efficiency in beef cattle production. Four other factors are considered: 1) farm size, 2) herd size, 3) beef and feed prices and 4) a marketing option (i.e. the facility to feed home-grown crops or to feed and sell home-grown crops). The model describes straightbred production, and is integrated in the sense that it includes a cow-calf operation with replacements bred on the farm, a beef feedlot for steers and surplus heifers, cropping and the labor and capital required for livestock and cropping.

- G-78. MORRIS, Wilford and Ottley, Rex A. "DAP Report - Livestock Sector - Entente." AID, November 1974.

From author's introduction:

This report is the product of one month spent in the Entente countries, primarily Upper Volta, Niger and Ivory Coast. Time in Ivory Coast was spent in meetings with REDSO, Entente officials and technicians who have prepared a request for AID from the Ivory Coast. The report also attempts to assess the current situation in Upper Volta and Niger - especially in relation to the present status of the livestock industry following several years of drought. It is not project specific, but identifies areas where AID intervention might be useful to compliment a very large input by other donors.

- G-79. MOSGAARD, Christian. "Possibilities for Mid and Long Term Strategies for Development in the Sahelian Countries." Paper prepared for the UN Special Sahelian Office, April 1974, 13 pp.

This paper reviews the assistance which has been given to the Sahel countries for the drought and the effects of this aid. The author proposes various development projects concerning water, agriculture, transport, mining, fishing, medical care and training.

- G-80. MUFFITT, R.F.A. "Cattle Farming." West African Technical Review, February 1977, 96-101 pp.

This article discusses the various types of cattle in West Africa, their disease resistance, productivity and market movement. The author commends nomadism and criticizes the view that productivity is hindered by the conservatism of traditional stockmen. Maps, production tables and other statistics are included.

- G-81. NIWMAN, James L., ed. Drought, Famine and Population Movements in Africa. Maxwell School of Citizenship and Public Affairs, Syracuse University, 1975, 144 pp.

This book is a collection of papers which were presented at a symposium of the same title in 1974. The papers concern the activities of international assistance programs, for the Sahel drought, the meteorology of the drought, the resource poverty of the Sahel nations, the effects of drought and population pressures and the problems of settling the world's arid regions.

- G-82. NICOLAISEN, Johannes. Ecology and Culture of the Pastoral Tuareg. National Museum of Copenhagen, 1963, 548 pp.

The author uses a combination of historical and functional methods of anthropology to analyze the development of Tuareg culture with particular reference to food-producing activities. This study is a result of several years' study in Africa on pastoralism. It surveys the social organization, culture and environment of Tuaregs especially concentrating on cultural and economic aspects of agriculture and live-stock activities.

- G-83. OFFICER, R.R.; Halter, A.N. and Dillon, John L. "Risk, Utility and the Palatability of Extension Advice to Farmer Groups." Australian Journal of Agricultural Economics, December 1969, 171-183 pp.

From author's introduction:  
Using the results of an empirical study of farmers' utility functions, evidence is presented that risk plays a measurable role in farmer decision-making. The extension implications of such risk influences are discussed with particular emphasis on the possible efficacy of using group utility functions as a basis for group recommendations.

- G-84. OECD. Meat Balances in OECD Member Countries 1962-1975. April 1977.

This report presents: livestock numbers, gross indigenous production, meat production from slaughtered animals, consumption, consumption per head and country tables.

- G-85. OECD. Study of Trends in World Supply and Demand of Major Agricultural Commodities, Report by the Secretary-General. Paris, 1976.

From author's preface:

The object of this study was to elucidate the probable trends in world supply and demand for the major agricultural commodities (cereals, feedstuffs and livestock products) in the next ten to fifteen years. It is based on the assumption of the continuation of existing policies and on the analysis of the main factors which determine these trends, such as the level of production, trade, prices, stocks, problems of aid and their interrelationships. The study includes both a general assessment and regional analyses.

- G-86. PERETTI, M. Projet Mise en Place de l'ORD du Sahel, Tome 1: Situation Actuelle de l'ORD. Report prepared for the Ministère du Développement Rural, Direction des Services de l'Élevage et des Industries Animales, October 1976, 117 pp.

The Sahel ORD was created in 1975 for the following purposes: defining and programming actions to be undertaken, evaluating costs and calculating results. Indeed, according to its statutes, the ORD's main goal is to do everything possible to promote the social and economic development of populations located within its geographical reach. This report includes six parts: 1) population, 2) agriculture, 3) cattle raising, 4) goat and sheep raising, 5) the agro-climatological conditions in rain-water crops and 6) a study in view of the development of surface waters.

- G-87. RAE, Allan N. "Stochastic Programming, Utility and Sequential Decision Problems in Farm Management." American Journal of Agricultural Economics, 1971, 53: 448-460.

From author's introduction:

This paper presents a further development of discrete stochastic programming, viewed within the context of Bayesian decision theory. Some probability models and information structures (with and without additional information) are discussed, followed by an indication of how the stochastic programming matrix may be set up to reflect the various information structures. Some expected utility theories are then reviewed, and their usefulness in allowing the specification of a wide variety of objective functions for the stochastic programming model is illustrated. Finally, a method is presented for determining the money value of additional information, additional resources and the expected cost of uncertainty.

- G-88. RAEDER-ROITZSCH, J.E. "Institutional Forestry Problems in the Sahelian Region." Paper prepared for the UN Special Sahelian Office, December 1974.

The author believes that forestry policy could make a key contribution to the solution of the Sahelian drought problem. The paper reviews the setting for overall national forestry development. The present, passive policies are criticized and a concerted, dynamic development of the forestry sector as a whole is recommended. Facilities for training forestry personnel are discussed.

- G-89. REDETZKE, Keith Allen. "A Matrix Model of a Rangeland Grazing System." Ph.D. Dissertation, Colorado State University, 1973, 144 pp.

From author's abstract:

Data from long-term grazing intensity studies were used to develop a model capable of predicting the response of plant cover and animal production to variations in weather and grazing pressure for different soil types. The system was described by a set of matrix equations, with specific transition matrices for each combination of soil type, grazing intensity and weather category. Model verification and validation tests were done with data from a study having replicated grazing treatments.

- G-90. ROBINET, A.H. "Water and Livestock Development in the Sahel." Courrier de l'Association, 1974, 23: 29-35. Original in French, translation by U.S. State Department.

This article is concerned with problems of water as related to livestock development. It sets forth a few basic facts about grazing land water needs and policy. It gives physiological information on water needs for various livestock. Water policy is reviewed in terms of research, infrastructure, livestock watering economics, project management and modernization.

- G-91. RUSSELL, E. Walter. "Some Agricultural Problems of Semi-Arid Areas." In The Soil Resources of Tropical Africa: A Symposium of the African Studies Association of the United Kingdom, 121-135 pp. Edited by R.P. Moss. Cambridge: Cambridge University Press, 1968.

From author's summary:

These regions are characterized not only by experiencing drought as a normal agricultural hazard but often also by a very erratic rainfall regime in which runs of years occur when the rainfall is either well below or well above the long-term average. Water conservation is therefore essential during the drier years, and methods for achieving this are described.

- G-92. RUTENBERG, H. "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.

From author's introduction:

The production of more animal protein is one of the major objectives of agricultural development policy in West Africa. The use of natural grazing (ranching) in the Guinea and Derived Savanna is running into numerous difficulties. Artificial pastures may prove to be the more economic approach to beef production at high price levels for beef. This applies in particular to a combination of natural grazing in the rainy season and artificial pastures in the dry season.

- G-93. RYAN, James G. "Using Input Demand and Production Function Models to Assess the Net Benefits of Dairy Herd Improvement." Australian Journal of Agricultural Economics, April 1975, 23-38 pp.

From author's introduction:

Two methods of evaluating the net social benefits of the dairy herd improvement scheme operated by the New South Wales Department of Agriculture are described. The first involves derivation of an input demand function for the herd-recording aspect of the scheme and use of this function to estimate the economic surplus (net of both private and public costs) provided by the service. The second approach involves deriving a production function for milk from which it is possible to estimate the contribution herd-recording and artificial breeding have made to increasing milk yields per cow. Social benefits are shown to have been less than social costs for herd-recording, however, dairy farmers have made net private gains.

- G-94. SARNIGUET, J.; de Mieulle, J.E.; Blanc, P. and Tyc J. "Approvisionnement en Viandes de l'Afrique de l'Ouest." English translation by W.H.M. Morris. Paris: SEDES, 1973, 126 pp.

This document includes three parts: 1) current situation and projection for 1975-1985 for six states (Senegal, Mauritania, Mali, the Gambia, Sierra Leone and Liberia), 2) regional study (output, consumption and marketing) and 3) regional projection (proposals for development of production, improvements in marketing, equipment and infrastructure).

- G-95. SCHMIDT-NELSON, Knut. Desert Animals: Physiological Problems of Heat and Water. London: Oxford University Press, 1964, 277 pp.

The purpose of this book is to examine what is known about desert animals and how they manage to live in an environment of excessive temperatures and water shortage. To establish a basis for comparison, the author presents a discussion of man's physiological responses to this harsh environment. Moreover, before dealing with individual animals, the author also discusses body size, perhaps the most consequential single aspect of an animal's physical endowment.

- G-96. SCHNEIDER, Harold K. Economic Man: The Anthropology of Economics. New York: The Free Press, 1974, 278 pp.

From author's preface:

In this work, the author seeks to express two related themes. The first is the book's orientation to one aspect of man -- his economic perspective. This is broadly defined as a focus on how men relate their available resources to their desired ends, and explores human behavior cross-culturally from that stance, including within the focus the production, exchange and consumption not only of material means but also of more intangible values, such as honor and respect. Secondly, the author seeks to directly challenge the prejudice against the economic man. Economic man, asserts Schneider, is to be no more despised than, for example, religious man or political man. Rather, he is a part of all of us, but he is an abstraction from us and not the whole of any of us.

- G-97. SCHWAB, Gerald D. A Computerized Decision-Making Model for the Beef/Forage Enterprise. Ph.D. Dissertation, Purdue University, 1974.

The purpose of this study was to develop a model and methodology which would enable the exploration and evaluation of alternative beef/forage production systems. This decision-making model was designed with sufficient flexibility to allow analysis of a multitude of alternative farm situations. The solutions rendered by the model are sensitive to farm situations which often vary with respect to available resources, managerial abilities and price and production expectations.

- G-98. SECRETARIAT D'ETAT AUX AFFAIRES ETRANGERES, Direction de l'Aide au Développement (France). Exportations de viandes par les pays sahéliens francophones: statistiques 1970-1972. Paris: République Française, 1973, 28 pp.

This document presents statistical data concerning refrigerated meats distributed between exporting and importing countries.

- G-99. \_\_\_\_\_. "Participation du Fonds d'Aide et de Coopération à l'effort de développement de la production animale." Paris, October 1972, 18 pp.

The objective of this study was to find a way to satisfy the need for animal protein within a price compatible with low income consumers. The paper calls for planning and research in these areas of livestock and ocean fish; feeding and watering, sanitary protection, manufacturing and proper distribution.

- G-100. \_\_\_\_\_. "La Reconstitution du Cheptel et le Développement de la Production Animale en Zone Sahélienne et Soudano-Sahélienne: Esquisse d'une stratégie nationale et régionale." Août 1973, 46 pp.

This study concerns the analysis of different types of intervention to be done in order to rebuild cattle herds and to develop production. It also establishes the premises of the working schedule, which is more elaborate than the traditional catalog of interventions. This study concludes that, according to the countries and the volume of aid, a period of 2 to 3 years is necessary, so that urgent steps may be taken on the way. Subjects discussed include a herdsman's code, water and pasturage codes, export policies, investment and modernization and donor aid.

- G-101. \_\_\_\_\_, Département de l'Elevage (France). "Le développement de l'élevage: types d'intervention intégrées zonales ou régionales." Paris, 1972, 26 pp.

This report is divided into four files: 1) traditional production (animal health, guarding and improvement of pastures, water), 2) output intensification, 3) marketing, manufacturing and distribution and 4) agriculture-livestock association.

- G-102. \_\_\_\_\_. "Fond d'Aide et de Coopération: études et projets en cours." Paris, November 1972, 10 pp.

This is a review of various current projects concerning livestock in several countries of West Africa: Mauritania, Senegal, Mali, Upper Volta, Niger, Ivory Coast, Togo, Dahomey and Chad. It also presents financial aid statistics provided by national and international organizations.



- G-103. \_\_\_\_\_. "Note sur la politique du Fonds d'Aide et de Coopération en faveur du développement de la production animale." Paris, October 1972, 16 pp.

Given the problems raised by the increasing shortage of world-wide supply of animal proteins, this study attempts to provide a series of solutions centered around three main themes: planning of production development, sanitary protection and improvement of cattle, and transferring of livestock products to consumption centers using the most economic means.

- G-104. SHEETS, Hal and Morris, Roger. Disaster in the Desert: Failures of International Relief in the West African Drought. Special Report for the Carnegie Endowment for International Peace, Washington, D.C., 1974.

This report strongly criticizes the management of disaster relief during the period of the Sahel drought. It concentrates on the failure of USAID and UNFAO to recognize the developing problems, to coordinate information on the drought, and to deal effectively and quickly with a crisis situation due to "neglect, inertia, delays, red tape and institutional short-sightedness." The authors describe also the failure to organize and follow through its relief program - to monitor progress, to provide appropriate types and quality of food aid and to ensure equitable distribution. A long period of foreign aid policies which ignored the Sahel is blamed for the failure to stem the epidemic of hunger and disease. Barriers to gathering, retrieval and use of information are stressed. The authors suggest ways to monitor such aid programs and recommend the establishment of an international center for the training of experts in disaster relief.

- G-105. SHUMUAY, C.R.; Bentley, Ernest and Barrick, E.R. Economic Analysis of a Beef Production Innovation: Dairy-Beef Crossbreeding. Economic Report No. 26, Department of Economics, North Carolina State University, March 1974, 47 pp.

Research in North Carolina has demonstrated the potential of some crossbred calves to make very rapid growth. This economic study compares one crossbreeding system, Angus-Holstein cows bred to a Charolais Bull, with purebred Angus cattle. The issue is whether the faster rate of growth is sufficient to offset the economic cost of additional calving problems, required purchase of replacement heifers, and lower price received for calves sold. Linear programming and partial budgeting are used to analyze net returns to the farm from cow/calf, stocker and finishing activities under both breeding systems. Also investigated is the impact of alternative farm resources typical of central North Carolina and a wide range of beef prices on 1) crop and forage system, 2) herd size, 3) labor requirements and 4) the marginal value of inputs.

- G-106. SMITH, A.J., ed. Beef Cattle Production in Developing Countries: Proceedings of the Conference held in Edinburgh from the 1st to 6th September 1974 by the Centre for Tropical Veterinary Medicine. University of Edinburgh: Centre for Tropical Veterinary Medicine, 1976.

From author's preface:

Cattle in developing countries have many different uses; they act as one of the main sources of power in agriculture and provide fuel (dung) for domestic use; they supply milk and meat; act as a repository of wealth and fulfill numerous social and religious functions in various parts of the world. Therefore, it is not surprising that the output of meat from cattle in the developing world is not very high and beef production per head of cattle population ranges from one-third to one-twentieth of that in the United States. The relative importance of these various constraints to production vary from one region of the world to another. The objectives of this conference were to discuss the effect of these constraints on beef production and to outline if and how the output of beef can be increased from cattle in the developing world.

G-107. SEDES. Approvisionnement en Viandes de l'Afrique Centre Ouest, Tome I: Analyse de la Situation Actuelle et Projections, Tome II: Propositions de Développement et d'Améliorations. Prepared for Secrétariat d'Etat aux Affaires Etrangères (France). Paris, 1969. Also available in English translation.

Volume I concerns the countries of the "Entente" and their two English-speaking neighbors: Nigeria and Ghana. It is devoted to the analysis of the current situation and to prospects for 1980 concerning output, marketing modalities and economic circuits for each of the seven countries. Means for developing output, marketing improvements and current equipment are discussed. Annexes discuss import markets for beef and African breeding ranches. Volume II is divided into three main parts: 1) output development, 2) improvements of cattle and meat marketing and 3) improvement of network equipment. These development proposals arise from the numerical increase in cattle and the age decrease in exploitation of males.

G-108. SEDES. L'Approvisionnement des villes dans les pays Francophone d'Afrique - Enquêtes et Perspectives, Tome I: Rapport de Synthèse - Enquête Economique auprès des Familles, Tome II: Abidjan et Bouaké, Tome III: Lomé, Tome IV: Ouagadougou, Tome V: Bamako. Report prepared for the French Secretary of State for Foreign Affairs. Paris, December 1972.

The purpose of this study is to determine to what extent urban supply could be improved (quality and quantity) concerning food and import products (wheat, sugar and milk) as well as butchery meats and fish. Volume I includes two parts: 1) synthesis report which lists goals, the methods used, the main results achieved and the lessons that one can draw from this kind of study and 2) the family economic survey, which gives methods and results per town. Volume II offers results and expectations for the consumption of some food products in Abidjan and Bouaké. Volume III, IV and V give the same data about Lomé, Ouagadougou and Bamako.

- G-109. SEDES. Introduction aux Comptes Economiques de la Production Animale: Application aux Pays Sahéliens, Tome I: Etude Methodologique. Paris: Ministère de la Coopération, 1974, 182 pp.

To avoid uninformed projections of social models of developed countries on underdeveloped economies and to describe an economic system without neglecting its social aspects, a new methodological approach is necessary. It presents itself in several steps: 1) a phase of detailed analysis of systems of activities (description of products as well as economic agents); 2) a phase of synthesis and of establishment of a scheme of model accounts and 3) a further phase where procedures of compilation and of treatment of basic statistical information as well as methods of aggregate estimates will be specified.

- G-110. SEDES. Recueil Statistique de la Production Animale. Paris: République Française, Ministère de la Coopération, 1975.

This document presents statistical data and principal information related to animal production in 24 African countries up to June 1975. However, for some tables, it was impossible to obtain an identical reference year after 1970 for all countries. These data are presented in an identical way for each country: physical, demographic and economic characteristics, animal production data, administrative, financial and technical resources, resources and uses of byproducts, evolution of trade, animal production unit price and value, legislation and fiscal policy and perspectives on development.

- G-111. SOME, Bozi Bernard. "Quelques Composantes de la Personne Humaine Chez Deux Populations de Souche Dagomba: Les Mossi et les Dagara," n.p., n.d., typewritten.

This document is a linguistic study of some terms and concepts in the languages of the Mossi and the Dagara. The author explains their significance in religious and superstitious beliefs about the relationship between man's body and its spirit. The effects of these beliefs on daily life are then discussed.

- G-112. SZCZEPANIK, Edward F. "Recent Changes in World Livestock/Feed Price Ratios." Monthly Bulletin of Agricultural Economics and Statistics, Dec. 1976, 25: 1-16.

From author's introduction:

The purpose of this article is to describe the changes in livestock/feed price ratios from 1970 to 1976, and to analyze the effects of these changes on production and consumption of livestock products and feed in developed and developing countries. Coverage is limited to selected commodities. The main attention is given to cattle, pigs, poultry and their products on the one hand, and to concentrate feedstuffs such as cereals, oilcakes, fishmeal and compound feeds on the other.

- G-113. THATCHER, L.P. and Lloyd, A.G. "Least-Cost Feed Reserve Using Drought Probabilities Derived from a Grazing Model." Review of Marketing and Agricultural Economics, September, 1975, 43: 113-125.

From author's introduction:

An inventory model is used to determine least-cost fodder reserves for sheep in the Hamilton area of Victoria. Unlike earlier studies a grazing model is used to generate funding requirements and thus allows for the gradual onset of drought and the associated rise in feed prices. Compared with studies based on probabilities of effective rainfall, the approach used measures more accurately the way in which drought incidence is affected by the seasonal pattern of pasture production in relation to animal requirements. The grazing model facilitates a study of the relative severity of drought at a range of stocking rates and a number of probability distributions are identified. The refinements achieved by using a grazing model also allow a more realistic treatment of penalty costs than the usual prescription of a constant drought price for fodder. Furthermore it allows for the determination of least-cost fodder reserves for a range of stocking rates.

- G-114. TURBOW, Gigi. "Nomadic Pastoralists in the Sahel: A Review of the Fulani." Unpublished paper, Ann Arbor, Michigan, January 1976.

From author's introduction:

Persistent attempts by the various Sahelian governments to institute economic development have been stymied by the reluctance of the nomadic pastoralists, who own the majority of the cattle in these countries, to market their animals. The purpose of this paper is to review and synthesize some of the literature pertaining to the Fulani, with the objective of presenting the social and ecological constraints they face and the economic rationale behind their reluctance to market their cattle.

- G-115. UNCTAD, Research Division. "Selected Statistical Tables on the Six Drought-Affected African Countries: Chad, Mali, Mauritania, Niger, Senegal and Upper Volta." Mimeographed, June 1975.

This collection contains tables on selected economic indicators (GNP, growth, agricultural data, imports and exports, aid and financial data), tables on the structure of exports and imports for the six countries and a short note on the impact of the drought on the foreign exchange sector of each country.

- G-116. UNITED NATIONS ECONOMIC AND SOCIAL COOPERATIVE ORGANIZATION (UNESCO). Arid Zone Research, Vol. XVIII: The Problems of the Arid Zone. Paris: UNESCO, 1962.

This work will be interest to those looking for a general overview of problems of aridity. It is a collection of articles organized under several headings: the state of scientific knowledge, nomadism in relation to grazing resources, alternative uses of limited water supplies and public awareness and the educational problem. Key articles include: R. Capot-Rey, "The Present State of Nomadism in the Sahara"; O. Brémaud and J. Pagot, "Grazing Lands, Nomadism and Transhumance in the Sahel"; Fredrik Barth, "Nomadism in the Mountain and Plateau Regions of South West Asia" and Gilbert F. White, "Alternate Uses of Limited Water Supplies."

- G-117. UNITED NATIONS SAHELIAN OFFICE. "An Approach to Recovery and Rehabilitation of the Sudano-Sahelian Region." November 1974.

This document summarizes and analyzes the facts concerning needs arising from the Sahelian drought. It provides a review of developmental and ecological problems of the region and offers some basic considerations that the governments of the affected countries and foreign donors should consider in formulating recovery programs. There are four major sections: 1) description of the setting of the drought and chronology of relief measures taken by the UN; 2) examination of the economic conditions of the region, including capabilities and constraints for recovery; 3) survey of national development plans and measures proposed by CILSS and 4) presentation of principal objectives of recovery and policy issues raised for the Sahel countries.



- G-118. \_\_\_\_\_. "Human Resources: Outline Analysis of Human Resources Development Problems - Sudano-Sahelian Zone." UN Secrétariat, ST/SSO/21, February 1974, 66 pp.

This paper emphasizes the need to place people in the forefront of development planning and to develop medium and long term policies for a coherent human resources development strategy based on employment creation, skills management and institutional support. The strategy should be geared towards economic and social rehabilitation to combat the causes and effects of the Sahel drought and should go beyond simply restoring the pre-drought situation. Education models and various projects are considered. Statistical tables are included.

- G-119. UNITED STATES DEPARTMENT OF AGRICULTURE, Economic Research Service, "Improving Marketing Systems in Developing Countries: An Approach to Identifying Problems and Strengthening Technical Assistance." Foreign Agricultural Economic Report No. 93, February 1972, 85 pp.

From author's abstract:

This report provides a systematic approach to the analysis of marketing in developing countries and points out where research and technical assistance would be useful. It focuses particularly on means of measuring marketing efficiency and on identifying problems that need to be dealt with in improving efficiency. The report discusses the implication of alternative marketing policies, including socio-economic issues and the problems of organizing marketing reforms.

- G-120. VANSINA, J. "Long-Distance Trade-Routes In Central Africa." Journal of African History, 1962, 3(3): 375-390.

This article is devoted to one of three major types of trade in Central Africa -- direct trade over long distances. This trade was conducted by caravans, with currencies, standards of value and means of payment for services used extensively. Before it died out around 1900, long distance trade provided a web of regional trade systems, mostly for European goods but also for raw materials and staple foods. The author describes the evolution of the major elements of this web and discusses the influence on the culture and political development of the area.

- G-121. WALLEN, C.C. " Zone Meteorology." In Arid Lands: A Geographical Appraisal, 31-51 pp. Edited by E.S. Hills. London: Methuen and Co. Ltd. and UNESCO, 1966.

From author's introduction:

There are three main regions in the world where climatic circumstances are dominant in limiting the activity of man: the polar regions, the tropical rain forests and the arid and semi-arid zones. The author asserts that for the proper development of these regions it is essential that the basic factors affecting living conditions should be thoroughly known, and the study of weather phenomena and climate is fundamental for this. The two main areas addressed are: climatic causes of arid zones and the effects of human interference.

- G-122. WALTON, Kenneth. The Arid Zones. Chicago: Aldine Press, 1969, 175 pp.

This book discusses the nature and causes of aridity, including a technical discussion of the definition of aridity. Topics include: variations in character of the world's dry lands, hot and temperate deserts, hot coastal and steppe lands, climatic changes over milleniums, soils, lithology and erosion of desert landscapes, biogeography in relation to vegetation and animal life and water resources. The future of drylands is projected with Israel and southern California as examples of high standards.

- G-123. WARE, Helen. "The Sahelian Drought: Some Thoughts on the Future." Paper prepared for the UN Special Sahelian Office. University of Ibadan, March 1975.

The author discusses desertification in terms of climatic change, human and animal population pressures and defoliation. She claims the desertification of marginal areas should not be a major point of concern. Alternate sources of fuel, pasture, etc. should be found. This paper reviews the present demographic position of the Sahel and predicts a trebling of the total population within the next 50 years. The author predicts that there will be no appreciable decline in fertility in the next quarter century and discusses population pressures on lands and agricultural resources, especially as they affect relations between agriculturalists and pastoralists.



- G-124. WILKS, Ivor. "A Medieval Trade-Route from the Niger to the Gulf of Guinea." Journal of African History, 1962, 3(2): 339-341.

European demand for gold in the late 14th century was felt in North African ports and then, via Saharan trade routes, in the Western Sudan. This added stimulus to Mande speaking traders to rationalize the structure of trade of the gold producing lands in the South. They moved from the area of the Upper Niger, southward, extending south to the coast. The trade route provided a major outlet for the products of the south (gold, kola, slaves, etc.) from 1400 to 1800 to the North for the products of the Western Sudan and North Africa (cloth and brassware) to the South.

- G-125. WILTON, J.W. et al. "A Linear Programming Model for Beef Cattle Production." Canadian Journal of Animal Science, December 1974, 54: 693-707.

From author's introduction:

A linear programming model is defined in detail to describe an on-farm integrated beef production enterprise. The model includes cropping, feeding and breeding activities with their requirements for land, labor animal housing and crop storage facilities. Net energy and digestible protein equations are used prior to the model construction to determine the nutrient requirement for cows, replacement heifers, feedlot heifers and steers, given weights and growth rates in young animals proportional to mature cow weights. A method for identifying the distribution of animals across different age groups is also described. Three enterprises with pure-bred cows of different mature size are analyzed and interpreted.

- G-126. WRIGHT, A. and Dent, J.B. "The Application of Simulation Techniques to the Study of Grazing Systems." Australian Journal of Agricultural Economics, December 1969, 144-153 pp.

From author's abstract:

This paper discusses some methodological aspects of simulation with specific reference to grazing systems. Problems arising in the development and use of simulation models are discussed and the need for interdisciplinary cooperation to data problems is indicated. One approach to experimentation is illustrated by reference to a model of a sheep grazing system and the problem of cropping for winter grazing. It is concluded that simulation is a potentially useful technique for management-oriented systems research in agriculture.

- G-127. YOUNG, E. "Technological Aspects of Game Management and Utilization in Africa." Paper presented at Third World Conference on Animal Production, Melbourne, Australia, 1973.

This paper discusses growth rates, productivity, adaptability and resistance to disease of much of the game of African savanna lands. The author stresses that these factors must be taken into account in game management and utilization techniques. A bibliography is included.

- G-128. ZULBERTI, Carlos A. and Caster, George L. "The Economic Evaluation of Beef Cattle Production on Pasture Using Animal Equivalent Cash Flows." Cornell University, January 1973.

This article discusses production techniques which will maximize profits to the producer. In the past there were two main techniques: employment of a low stocking rate, which results in a high output per animal, or employment of a high stocking rate, which results in a high output per unit of surface. Neither of these two techniques, asserts the authors, will result in a maximization of profits per unit of surface and unit of time. When this is the goal, they suggest use of the annual equivalent cash flow technique.