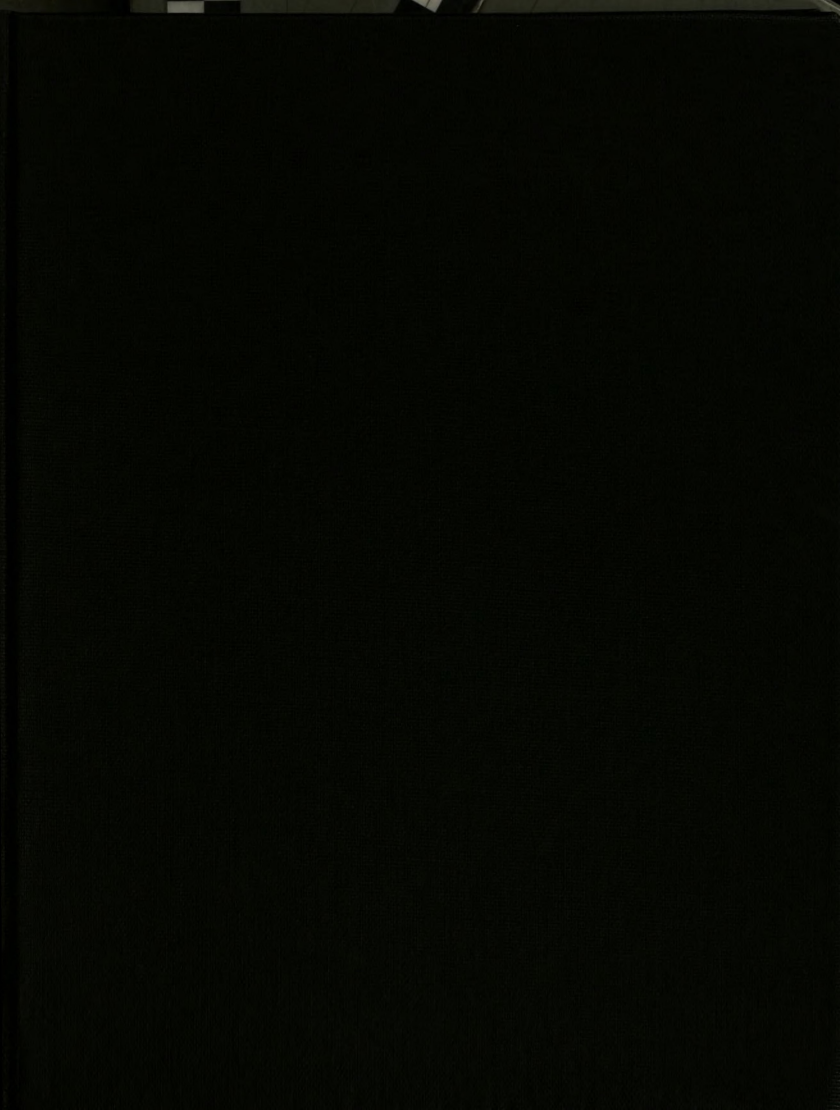






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AN ECONOMIC ANALYSIS OF FARM LEVEL
LIVESTOCK MARKETING IN
EASTERN UPPER VOLTA

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**AN ECONOMIC ANALYSIS OF FARM LEVEL
LIVESTOCK MARKETING IN
EASTERN UPPER VOLTA**

By

Fenton Bravid Sands

A DISSERTATION

**Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of**

DOCTOR OF PHILOSOPHY

Department of Agricultural Economics

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ABSTRACT

AN ECONOMIC ANALYSIS OF FARM LEVEL LIVESTOCK MARKETING IN EASTERN UPPER VOLTA

By

Fenton Bravid Sands

The important livestock subsector of Upper Volta, dominated by a pastoral, open-range mode of production, faces an uncertain future. Expanding crop acreage is likely to push livestock grazing in to areas with poorer pasture and less water thereby constraining the productivity of this subsector. Improved integration of crop and livestock production may be one means of raising livestock productivity. To assess the viability of intensive livestock production on mixed farms as well as develop appropriate programs to promote such a system, a thorough knowledge of existing Voltaic mixed farming systems is required.

In this study, an analysis is made of farm level determinants of livestock marketing in the mixed farming systems of eastern Upper Volta. Data gathered in a 1978-79 farm survey were used to describe the production, management and marketing practices of farm households. Multivariate Tobit analysis was utilized to estimate the relationship between household socioeconomic characteristics and livestock sales. These factors, which are outside the livestock enterprise, are important in household livestock marketing decision making. Tobit analysis allowed the

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incorporation of non-selling behavior which is as much a part of market behavior as is selling.

Factors such as household purchases of foodgrain, livestock production expenditures and average (deflated) prices of small ruminants were found to be important determinants of monthly household small ruminant sales. Since most of the sampled households were deficit grain producers, their use of livestock sales receipts to purchase grain is crucial to their survival. Monthly household cattle sales were found to be closely correlated with average (deflated) cattle prices, purchases of other cattle, income from commercial activities but not to purchases of foodgrain. Also, it was found that most of the adjustment resulting from a change in the major determinants of both small ruminant and cattle sales was attributed to the decision to sell or not sell an animal rather than the decision to market more animals during any given month.

To my parents, Fenton and Dorothy,
who instilled in me the will, desire and fortitude
to succeed at such a task,

and

to my wife, Cynthia
for her support through it all.

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I would also like to express my thanks to the other members of my Guidance and Thesis Committees. Dr. Harold Riley critically reviewed the thesis and offered many helpful comments. He graciously agreed to join the committee as a replacement for Dr. Eric Crawford who was my first Thesis Supervisor. Dr. Crawford helped me in the difficult early stages of the research effort before he had to leave for an overseas assignment. The constructive criticism of Dr. Tjaart Schillhorn van Veen was greatly appreciated. I also thank Dr. John Staatz for his valuable input.

A word of thanks also goes to Dr. Gregory Lassiter who kindly answered many questions about the data. Paul Wolberg assisted with the running of the Tobit regression package by solving the program and systems problems whenever they occurred.

My family deserves a lot of credit for my successful

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completion of the doctoral program because of their loving support and encouragement. I would like to especially thank my wife, Cynthia, who had to make many sacrifices "for the cause" and as the saying goes, "stuck with me through thick and thin". I would like to pay special tribute to my parents, Fenton and Dorothy Sands, for giving me a good start in life and for always being there when I needed them. I also owe much to my in-laws, Edward and (the late) Louise Mosely, for their assistance and understanding for which I am truly thankful.

Since I used a word processor to do this dissertation, I take full credit or blame for all aspects of the document.

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CHAPTER I

INTRODUCTION

1. Background

Throughout most of the developing world, livestock can be found in abundance. In much of West Africa, livestock production provides a major source of protein, employment and income. Yet, despite the significant role this subsector plays in the lives of a large part of the rural African population and the important contribution it has made to some countries' GNP (as much as 33 percent), it remains a greatly underdeveloped subsector. There are perhaps two main reasons why the development of animal protein production in West Africa has been neglected: (1) meat supplies in urban areas were generally adequate and low-cost until the end of the recent drought period (1968-74); and (2) there is a plethora of complex policy, institutional and technical constraints which requires that progress be made simultaneously in all areas (policy, institutional, technical) to unblock most constraints in any one area (Ferguson, 1979).

In Africa, the management, and often the ownership of most ruminant livestock is in the hands of nomadic or semi-nomadic groups. Due to their geographic isolation and transient lifestyle, it has been difficult to study this

form of livestock production. Livestock systems under more sedentary conditions are in turn, very complex and difficult to understand. Thus, compared to information on crop production, little economic data are available on livestock systems. As a result of this and many other factors, livestock has often been left out of the development planning process. But in the context of what the farming systems approach to development has revealed, there is ever increasing evidence that more attention should be put on balancing the emphasis on both animal and crop production if there is to be any hope of achieving goals of increasing food production and raising farmer incomes in developing countries. There is now little debate among development planners on the need to narrow the knowledge/application gap on how best to increase the production and availability of animal protein (Raun et al., 1981).

Upper Volta is one of four landlocked Sahelian countries in which livestock production contributes significantly to both GNP (over 10 percent) and foreign exchange earnings (almost 50 percent in some years). Livestock production is not only a vital component of the Voltaic economy but it is also an integral part of the socioeconomic structure of many rural households.

2. Research Problem

Given the importance of the livestock subsector, the Voltaic government is keenly interested in increasing livestock production, not only to augment foreign exchange ear-

nings, but also to achieve the country's development goals of improved rural incomes, nutritional levels and employment. The government and many donor organizations have concluded that the future of Voltaic livestock production may not lie with the extensive production system but may in no small measure depend upon a greater integration of livestock and crop production in agriculture (IBRD, 1982). The need for this is primarily related to the impact of population growth on the availability of arable land. As crop production expands over time to meet a rising demand for food, the traditional, extensive livestock production system is likely to be pushed on to marginal lands with less water and poorer pasture. Such a diminished livestock production resource base will undoubtedly make it difficult if not impossible for the livestock industry to continue or expand its role as a major economic subsector in the Voltaic economy. However, the further integration of crop and livestock production has been considered one of the few means of increasing livestock productivity in light of the potential demise of the extensive production system.

Recently (post drought), farmers in mixed farming zones have become more involved in raising livestock. These zones offer some of the greatest potential for short and intermediate term advances in the integration of crop and livestock production.¹ Most of the eastern region of Upper Volta (Eastern ORD or EORD)² lies within the Sudano-guinean climatic zone where agriculture predominates on

small semisubsistence mixed farms. The hoe is the major tool in agricultural production while family labor is a key input. Sorghum and millet are the main crops grown and practically everyone raises goats, sheep, fowl and sometimes cattle. In the past, most agricultural development programs aimed at crop/livestock farmers in Upper Volta (as in other developing countries) have focused almost exclusively on increasing crop production while livestock production has been ignored or considered not important. Recently, however, livestock production on mixed farm households in developing countries has received more attention. There is now evidence that animal production is in fact an important part of these households' productive process and resource base. Improving the productivity and marketing of livestock on these farms has the potential of having a significant impact on the welfare of rural households as well as the overall output of the livestock subsector.

3. Research Objectives

In order to formulate effect policies and programs in support of greater integration of crop and livestock production and to evaluate the impact this will have on both the welfare of mixed farming households and the supply of animals, it is imperative that as much as possible be known about the circumstances under which this form of production/marketing presently takes place. The Voltaic government, like many other West African governments with a substantial livestock resource base, has emphasized a production approach to improving livestock production and quality

without a complimentary emphasis on marketing. Studies of many economic systems have revealed that greater quantities of better quality agricultural produce can only be realized in a least-cost manner when both production and marketing receive proper attention in development policy formulation.³ This dissertation will address both issues of crop/livestock integration and livestock marketing by focusing on household marketing practices regarding cattle, sheep and goats in the mixed farming systems of eastern Upper Volta.⁴ Most of the data to support this study was collected during a 1978-79 Michigan State University-led farm level survey in the EORD⁵ (see Table 1.1 and Appendix A for details on the survey methodology). The survey was conducted as one phase of an AID/Government of Upper Volta integrated rural development project. The objectives of the survey were to provide basic socioeconomic information which could be used to: (1) evaluate the impact of animal traction; (2) provide data for regional planning and project design; and (3) provide base line information for future comparative studies and evaluations.⁶

It is widely believed that ruminant marketing decisions on mixed farms, particularly with respect to small ruminants, can be greatly influenced by factors external to the economics of herd management (ILCA, 1980). One major objective of this dissertation is to estimate empirically the relationship between household sales of cattle, sheep, and goats and socioeconomic characteristics of households

TABLE 1.1

Distribution of the 480 Farm Households Surveyed in 1978-79
by Agroclimatic Zone, Village and Subsample

Agroclimatic Zone	Village	Number of Households Surveyed in Each Village or Region	
		Traditional (Hoe)	Animal Traction
Bogande	Gbanlamba	18	-
	Komboassi	18	-
Mani	Lanyabidi	18 ^a	-
	Bonbonyenga	-	-
Piela	Dabesma	18	-
	Piela	-	18
Diabo	Monkontore	18	-
	Lantaogo	-	18
	Diabo I	-	17
	Diabo II	-	18
Logogou	Namponkore	18 ^a	-
	Kindikombou	18 ^a	-
	Logobou	-	18
Partiaga	Bomondi	18	-
	Dubcaali	18	-
Yonde	Ouobgo	17	-
	Kondogo	18 ^a	-
Diapangou	Tilonti	18	-
	Diapangou	-	18
Botou	Botou ^b	18 ^a	-
	Ougarou ^b	19 ^a	-
Kantchari	Mantchangou	17	-
	Moadagou	18	-
Ougarou	Poniokonli	18	-
	Ougarou	-	18
Pama	Tindangou	16	-
	Kpajali	16	-
Total		355	125

^aVillage chief included as a non-randomly selected household head.

^bNorth of Fada.

at the time of sale. Two key questions are of interest. Firstly, what additional insights can be gained by including, in an analysis of household livestock marketing, information on those households which did not sell their animals in a given time frame? Secondly, to what extent does livestock sales offset insufficient grain production (for home consumption) by EORD semisubsistence grain producers?

More specifically, the research objectives are:

- (1) To describe livestock raising in different crop/livestock production systems within the EORD;
- (2) To describe farm level marketing practices;
- (3) To develop an economic and statistical model which relates a household's situation and characteristics to its sale of cattle, sheep and goats. The emphasis will be on small ruminants and particularly the relationship between foodgrain purchases and sales of these animals;
- (4) To estimate empirically and comment on the relationship between the household's situation and characteristics and its sale (or non-sale) of ruminants; and
- (5) To discuss policy implications of the above findings plus comment on future research efforts and needs.

4. Organization of the Study

There are six chapters in this dissertation. Chapter II provides a discussion of livestock production and management in the crop/livestock farming systems found in eastern Upper Volta. The chapter also presents a short over-

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view of livestock production and marketing in Upper Volta.

Chapter III provides information on livestock marketing practices of mixed farming households included in the survey. The emphasis is on determining when, where and to whom cattle and small ruminants are sold, as well as the (gross) financial returns generated from these sales.

Since the unit of analysis is the rural farm household, the theoretical structure of such a unit (as it pertains to the problem at hand) is briefly discussed in Chapter IV. Also, both economic and analytical models of household level livestock sales are developed. A review of the unique problems created by including information on non-sellers and the appropriate model to deal with this situation, is also part of this chapter. Chapter V presents the analysis and results of the models dealing with small ruminant and cattle sales developed in the previous chapter.

Finally, a summary of major findings of the study and their policy implications are set forth in Chapter VI. In addition, some comments are made on future research needs.

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FOOTNOTES TO CHAPTER I

¹ A common misconception in an exclusively production oriented policy is that efficient changes in marketing will automatically spring up after production has been improved. This often cannot happen because of a host of constraints in the marketing system itself.

² Some of the reasons include: (1) many of these areas have had a long association with livestock production; (2) livestock are used for reinvesting profits from crop production; (3) the crop marketing system offers a convenient initial marketing channel for livestock; (4) some small scale animal fattening already exists, etc.

³ One of eleven Organismes Regionaux de Developpement (ORDs). These regional development organizations have been given many responsibilities, such as agricultural development, community development, building a transportation infrastructure, marketing, etc. Of all the ORDs, the least is known (in terms of economic, demographic, and social information) about this particular ORD (Eicher, et al., 1976; IBRD, 1982).

⁴ These animals are the most important ones to farm households as well as the market economy. Also, the data gathered on other livestock species, especially other small stock, was not considered as reliable.

⁵ Note: this author did not participate in this survey which was conducted by MSU as part of the EORD Integrated Rural Development Project. But the farm management survey consisted of weekly and monthly interviews of 473 farm households of which 348 were randomly selected hand-hoe farmers and 125 were purposively selected, relatively successful animal traction (ANTRAC) adopters.

⁶ Several studies and reports have been produced as a result of the Integrated Rural Development Project's farm survey. Among these have been Ph.D. dissertations: Tapsoba, 1981; Lassiter, 1982; Fotzo, 1983; Negash, 1983; Ouedraogo, 1983; and Baker (forthcoming).

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CHAPTER II

LIVESTOCK PRODUCTION AND MANAGEMENT IN EORD CROP/LIVESTOCK FARMING SYSTEMS

This chapter describes the national situation regarding livestock production and marketing and is followed by a discussion of production and management of livestock in the eastern region. Livestock marketing in the eastern region is reviewed in the next chapter.

1. Overview of National Livestock Production and Marketing¹

1.1 Production, Consumption and Exports

A census of the Voltaic herd size has never been taken, but estimates of the national livestock population place the national cattle herd size at approximately 2.65 million with sheep and goats numbering 4.38 million (IBRD, 1980). As mentioned earlier, the livestock subsector is one of the most important sectors of the economy, both at the national level as well as the local rural level. The drought years (1968-74) put severe stress on the productivity of the livestock subsector, especially in the northern portions of the country. One significant result of this particularly drought was a southern movement of cattle in reaction to both diminished pasture resources in the north and improved conditions in the south created by a retrac-

tion of the tsetse infestation limit (Ibid). Cattle ownership in the south increased as a result of this migration of northern pastoralists in search of better pastures, by enabling farmers, among others, to purchase animals at favorable prices. The recovery of Voltaic herds after the drought was commented on in the most recent World Bank livestock subsector review:

Since the drought, the country restocked, which is reflected in the low level of exports during this period. To some extent, these growth patterns probably reflect assumptions developed for planning and for estimating national accounts. What is unclear is why the growth rate has not been higher, especially during the period of restocking after the drought when offtake rates were presumably also low. The most sweeping hypothesis is that the more northern, tse-tse free areas are now saturated, limiting expansion to the rate at which the tse-tse challenge is reduced in the south by clearing land for crops (IBRD, 1982).

Also according to World Bank estimates, the growth rate of the national cattle herd is considered to be back to around the pre-drought level of 3 percent while that of sheep and goats may be around 4.6 percent. Market offtake rates (as a percent of herd size) have been variously quoted to be anywhere from 10.5 to 11.8 percent for cattle and 25-35 percent for small ruminants (IBRD, 1980; Herman, 1983; Holtzman, 1983).

In general terms, the productivity of Voltaic livestock is considered, by the World Bank, to be among the lowest in West Africa and very low when compared to some developed countries (IBRD, 1980). In addition to low productivity, the cattle found in most Voltaic markets are characterized by Herman to be "thin and of poor quality".

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As one might expect, most higher quality cattle go to higher priced export markets on the West African coast. Within the country, urban areas attract the next best animals with rural areas receiving animals in the poorest condition and of lowest carcass weight.

In rural villages and small markets, small stock (mainly small ruminants and fowl) predominate due to their divisibility and the lower purchasing power of rural consumers. Problems people have in storing meat outside of the only two places that have cold storage (the urban centers of Ouagadougou and Bobo-Dioulasso) creates a demand for only small quantities of meat. In much of West Africa, beef is seldom consumed outside of the urban areas and villagers usually do not consume mutton or goat meat except on special occasions--e.g. festivals and ceremonies (Josserand and Ariza-Nino, 1982). Although chicken and other fowl can be more expensive than small ruminant meat on a unit weight basis, they are the major sources of animal protein in the countryside. Additionally, the price of small ruminant meat has in recent years been rising relative to beef due to consumer preference for sheep and goat meat as well as the special socio-cultural importance of these animals (Ibid).

Only the major urban cities of Ouagadougou and Bobo-Dioulasso have modern abattoirs and slaughtering elsewhere is accomplished in a simple manner. Butchering under poor sanitary conditions are the rule rather than the exception almost everywhere in the country.

Consumption of beef in urban centers has been the major domestic market for livestock and livestock products. The general picture regarding consumption of meat in Upper Volta has been summarized by Herman:

First, urban consumption of commercialized butcher meat is three to five times that in rural areas on a per capita basis....the populations of Ouagadougou and Bobo-Dioulasso consume over 17 percent of the country's production of red meat while accounting for only roughly 5 percent of the population. Second, beef consumption is the dominant component of urban animal protein intake in Upper Volta, accounting for more than three-quarters of urban meat and meat by-product consumption. Conversely, rural populations rely predominantly on other sources of animal protein, most notably small ruminants and in some areas, milk. Finally, one might conclude that....domestic beef demand is likely to sustain high rates of growth in the future (Herman, 1983).

The most recent estimates of red meat consumption, presented in Table 2.1 show that in 1981, per capita beef consumption (rural and urban) was approximately 3.7 kilos and 1.9 kilos for mutton and goat.

The Sahelian region of Upper Volta provides more animal products than any other region of the country. This is both in terms of production and most importantly, in terms of surplus available for export. The EORD is one of the four other surplus regions. The major deficit area in the country is the southwest primarily because of the urban centers and high population density in that part of the country.

Exports of animal products are by all estimates, a large portion of total national production.² World Bank estimates indicate anywhere from 10-30 percent of annual

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TABLE 2.1

Red Meat and Poultry Consumption Estimates For Upper Volta
(Kilograms Per Capita)

	1967	1977	1978	1981
Beef	4.3	4.0	4.7 ^b	3.7 ^c
Mutton/Goat Meat	2.5	2.5	2.0 ^b	1.9 ^d
Offals	1.3	1.3	---	1.2 ^e
Sub-Total	8.1	7.8	6.7	6.5
Pork	0.5	---	0.5	0.5 ^f
Poultry	1.0	---	0.9	1.3 ^g
Other Meat	---	1.8 ^a	---	---
Total	9.7	9.6	8.1	8.3

Sources:

Holtzman, J., "Small Ruminant and Poultry Marketing in the Mossi Plateau of Upper Volta", AID/S&T/MD, Washington, D.C., May 1983.

1967 estimates - SCET, La production animale voltaïque-perspectives de développement, Tome II, "Note de Synthèse", Paris, 1972.

1977 estimates - Herman and Makinen, Livestock and Meat Production, Marketing, and Exports in Upper Volta, CRED, University of Michigan, 1980.

1978 estimates - World Bank, Upper Volta: Livestock Subsector Review, Report No. 3306-UV, November 1982.

1981 estimates - Holtzman's estimates using Statistiques du Service de l'Élevage 1981; poultry estimates from Gergely, FAO, Enquête sur les possibilités de production et de commercialisation de la volaille, Haute-Volta, 1980.

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Footnotes to Table 2.1

^aHerman and Makinen use this estimate for all remaining meat. It is unclear whether the estimate is for other red meat or for other red meat and poultry.

^bWorld Bank estimates of beef and small ruminant meat consumption include consumption of offals.

^cThe 1981 estimate of beef consumption assumes offtake of 11% from the national herd of 2,815,000 head, export of 81,000 head (recorded exports were 125,000) and domestic slaughter of 228,650 head (assumed offtake - exports). An average carcass weight of 100 kilograms per head assumed.

^dAssuming a 29% offtake rate and exports of 260,000 small ruminant equivalent, it is estimated that 1,125,000 small ruminants were slaughtered in 1981. An average carcass weight of 10 kilograms is assumed.

^eCattle offals are assumed to equal 25% of cattle carcass weights and 15% of small ruminant carcass weights.

^fAn offtake rate of 60% and an average carcass weight of 25 kilograms are assumed (see World Bank, Upper Volta: Livestock, Subsector Review, 1982).

^gThis estimate is taken from Gergely, FAO, Enquete sur les possibilites de production et de commercialisation de la volaille, Haute-Volta, 1980.

cattle production is exported, 90 percent or more as live animals. They also report that about 30 percent of small ruminant production is exported (IBRD, 1980). Even though sheep comprise less than one-third of national production, they account for close to two-thirds of small ruminant exports. Seasonality of cattle exports are more determined by Voltaic supply conditions than demand (felt-demand for exports in Upper Volta is usually strongest in December and January). Small ruminant exports are affected by similar factors but are also greatly influenced by the demand effect of the Muslim Tabaski holiday.³ Ivory Coast has historically attracted the majority of declared Voltaic livestock export with most animals being transported by rail and the remainder by truck. Pouytenga (just west of the EORD) and Diapago are the main export market outlets for the region. Until Ghana suffered severe financial and political distress, it was this region's major export market. Niamey (Niger), Cotonou (Benin), Lome (Togo) and urban centers in Nigeria also figure in the region's export picture.

Concerning the future balance between domestic consumption and exports, no clear picture emerges. A recent World Bank report stated "it is clear that relatively small increases in domestic consumption might possibly eliminate any surplus for export....However, under reasonable assumptions about herd and population growth and changes in consumption, the surplus available for export might actually increase...." The report adds that the critical deter-

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minant may be relative prices between Upper Volta and its export clientele on the West African coast. If consumer incomes in these export markets rise relative to those in Upper Volta, they might continue to draw livestock products away from domestic consumers despite growth in population, urbanization and income in Upper Volta. A recent development in the supply of meat to coastal markets (particularly Ivory Coast, but also Togo, Benin and Nigeria) will also affect Upper Volta's exports and Voltaic consumption. This development is the importation of frozen and chilled meat from South America which began in response to the rapid drop in supply and subsequent rise in meat prices of Sahelian beef during the drought period.

1.2 Livestock Marketing System

The Voltaic livestock marketing system can be generally characterized as decentralized, operating fairly independent of government interventions. A recent study of the system by Herman has uncovered little evidence of collusion among buyers to fix prices--primarily due to the relatively large number of intermediaries, buyers and sellers.

Herman's basic conclusion is that for the most part, the marketing system functions efficiently, with an ability to adapt quickly to significant changes in supply and market conditions while gross margins are fairly consistent with costs and reasonable returns to capital, risk and management.

A schematic representation of the Voltaic cattle

Fig: Flows of oil
Flows of ex.
and water

Traders (Collectors)
and Traditional
traders from Mali,
and Niger

Long Distant Traders
from Mali and Niger

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Source: Herman

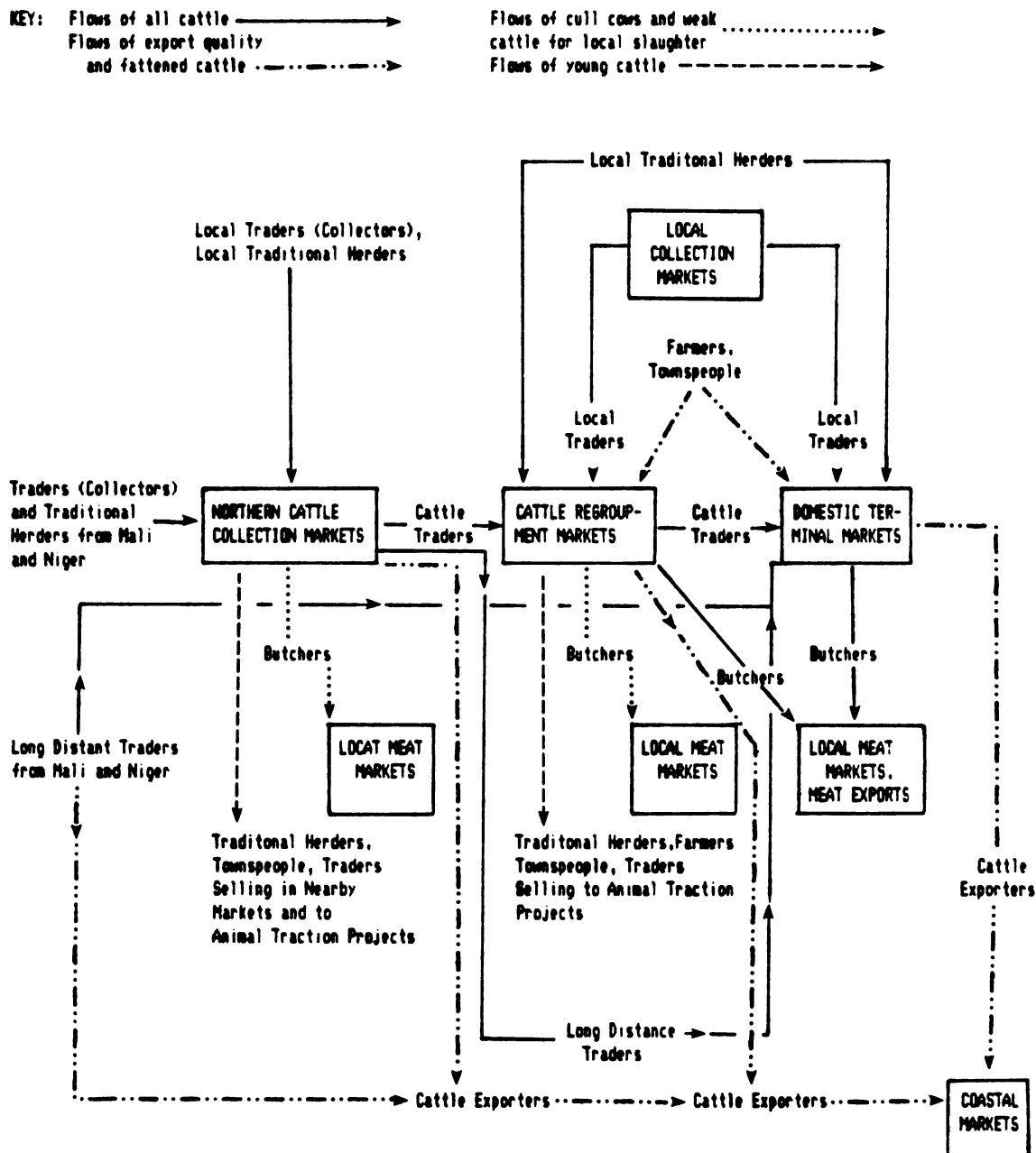


FIGURE 2.1

Organization of Cattle Marketing in Upper Volta

Source: Herman (1982).

UPPER VOLTA

* Major Cities Collection Marked

* MARKED
RECEIVED

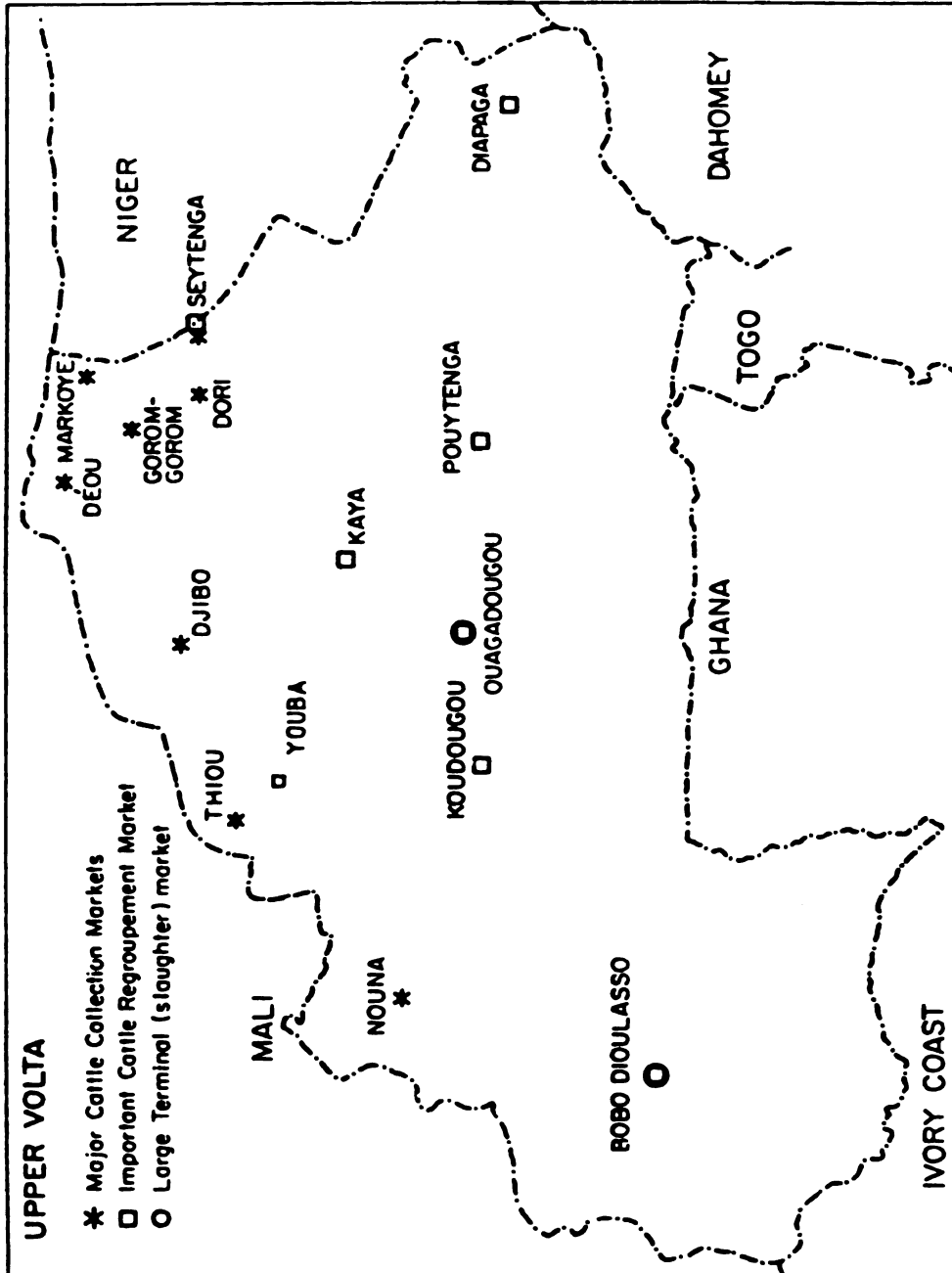


FIGURE 2.2
Major Cattle Markets in Upper Volta
 Source: Herman (1982).

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marketing network in Figure 2.1 depicts the origin and type of cattle frequently sold in different types of markets. Using Herman's terminology, markets can be divided into three major categories: (1) collection or primary markets; (2) regroupment or redistribution markets; and (3) terminal or slaughter markets.⁴ Figure 2.2 identifies the most important Voltaic markets. Two regroupment or redistribution cattle markets are of import to the EORD--Pouytenga (west of the region) and Diapaga (in the eastern part of the region). Although their size (number of cattle and small ruminants sold annually) relative to other Voltaic markets has changed over the years, Pouytenga was ranked second and Diapaga tenth in 1969 (SCET International, 1972; cited in Herman and Makinen, 1980). Most sellers in these markets are traders who buy cattle directly from herders and farmers in smaller markets and remote areas. Cattle sales by farmers in this EORD study took place mainly in bush markets (Herman's term for remote markets) or local markets. They (EORD surveyed farmers often sold to buyers who took some animals to redistribution markets. These same buyers sold to larger traders and merchants in these larger markets who in turn trekked the cattle to terminal markets. In comparison to terminal markets, redistribution centers generally attract greater numbers of butchers, coming from local areas or nearby urban centers. But buyers in redistribution centers can include those buying cattle for breeding and fattening - local herders, farmers and townspeople; local traders supplying nearby bush mar-

kets; and exporters, who buy the best quality and healthiest animals. Market channels for small stock are similar to that of cattle although their small size and value makes them more important in the rural areas in regards to market transactions and consumption.

2. Delineation of Crop/Livestock Farming Systems in the EORD

It is now widely recognized that one of the first steps that must be taken to improve the productivity and efficiency of the agricultural sector in any country is to understand and accurately describe the country's farming systems. Most Voltaics sustain themselves primarily by growing crops. Due to inadequate rainfall and high evaporation rates, average crops yields are low and the risk of crop failure is high in much of the country. Livestock production takes place in a predominantly extensive, pastoral setting. Herman (1983) provides a good description of this form of stock raising. Although livestock production varies by region and among different ethnic group, the Fulani, who own an estimated 70 percent of the national cattle herd dominate cattle production (IBRD, 1983). In the northern sahelian and sudano-sahelian zones, pastoralism is the standard mode of cattle raising. Cattle raising in the south is more sedentary where perhaps a third of all cattle are owned by farmers (IBRD, 1983). The EORD in particular, has a population who are mainly Gourmantche sedentary agriculturalists. This ORD has the

second highest (to the Sahel) number of cattle per capita (0.07) in the country (IBRD, 1982). The integration of livestock and agriculture is seen by many to be in the best long run interests of Voltaic livestock production. This means that both policy and more research needs to be aimed at helping the many farm level decision-making units who may in the future be important in determining the aggregate performance levels of the livestock sector.

Most of agriculture in the EORD can be characterized as taking place in a crop/livestock production system, dominated by grain production. Borrowing from Jahnke's definition of such a system, the focus in this study is on "the livestock sub-system of crop/livestock farming". Livestock husbandry and crop production are practiced in association with each other throughout the region with the cultivation of crops dominating the agriculture scene. The roots of this association lie in the traditional relationship that has existed for some time between herders and cultivators. Most Gourmantche farmers who owned cattle traditionally entrusted them to Fulani herders (Vengroff, 1980; Herman, 1983). Two main reasons for this arrangement was the recognized management expertise of Fulani herders and a labor constraint on the part of these agriculturalists. Delgado (1978) has stressed the latter based on his study in an area just west of the EORD. One important outcome of the 1968-74 drought was an increase in livestock ownership among farmers in the southern portions of the country. Many sahelian livestockmen moved further south

but were forced to sell much of their stock in order to limit their losses or buy food (IBRD, 1982). For several reasons, which will be touched on later (in Section 4.1), the practice of cattle entrustment may be on the decline. Increased livestock ownership among farmers and a greater involvement of farm households in livestock management has given impetus to the further integration of crop and livestock production. But except for a few instances, particularly among the limited number of animal traction farmers (who are only about 3 percent of the farm population), the degree of association between crops and livestock raising is not yet fully developed. The majority of the EORD agricultural farming system is really just beginning to move towards full mixed farming as Jahnke (1982) defines mixed farming:

The intensification of the output function of livestock within the farming system parallel to the development of the farm input function (work and manure) and the increased integration of livestock for the benefit of soil fertility and overall farm productivity, livestock development is viewed in the context of the farming system as a whole including the crop subsystem.

The output and input functions Jahnke refers to are two of the four functions he identifies as being the modes of action or activities by which livestock fulfill their purpose: (1) the output function (subsistence, income and nutrition) (2) the input function (crop inputs and farm integration), (3) the asset and security function, and (4) the social/cultural functions. We will see that livestock on most EORD farms fulfill the income, asset and security

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function more than any other. Considering the risk involved in crop production in this semi-arid region, animals help rural farm households counteract the risk in cultivation with a readily available form of liquid asset. All the criteria for livestock to fulfill this role, as postulated by Barth (1973) and Mc Cowen et al. (1979), are met here in the EORD. These criteria are:

- Arable land is communally owned or 'on loan' from the clan group; it is not a disposable asset;
- cropping is primarily undertaken for subsistence but periodically yields a saleable surplus;
- cropping is carried out on a low technological level; capital inputs are limited to seed and simple equipment;
- commercial banking institutions are not present or are not trusted (Jahnke, 1983).

There are four critical factors useful in distinguishing and characterizing livestock production in a crop/livestock farming system. Jahnke identifies these levels or gradients as:

1. Agroclimatic conditions, especially rainfall, which is associated with the cropping system;
2. The human population pressure as also expressed by the cultivation intensity;
3. The extent of tsetse infestation which affects the distribution of trypanotolerant animals; and
4. The overall importance of livestock as partly expressed by livestock densities and livestock species (Ibid).

This is an appropriate framework in which to discuss crop/livestock farming systems in the EORD. As already

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stated, the EORD survey divided the region into 12 zones to reflect the substantial differences in the agroclimatic and demographic characteristics of the area. The northern tip of the ORD protrudes into the sahelian climatic zone where we find the survey zones of Mani and Bogande. The rainfall in these zones averages between 610-690mm per year on a longterm basis.

Much of the ORD lies within the "north Sudanic" (Sahelian Margins) climatic zone while its southern tip extends into the wetter "Southern Sudanic" (Savanna Margin) where rainfall is as high as 1,000mm a year. Generally speaking, the region is characterized as a region of high temperatures with low, unreliable rainfall.⁵ Mehretu identifies three important factors with respect to precipitation in eastern Upper Volta:

First, the amount received is low....Second, the variability of precipitation is high and critical....[third,] not only is there an excessive level of potential evapotranspiration for the ER (eastern region) as a whole, but also there is quite a variation between the Sahelian margins in the north and the savanna margins in the south (Mehretu, 1982).

These characteristics have implications as to the land use potential and duration of plant growth, both of which are to some extent, determined by the moisture content of the soil. Hunter's (1977) summary of the region's climatic and soil characteristics is represented in Figure 2.3. The upper portion of the EORD falls within Hunter's classification of D'/B. Its southern limit is the line of annual rainfall level equal to 600mm with P=90 (probability of 90 percent). This northern part of the EORD contains the

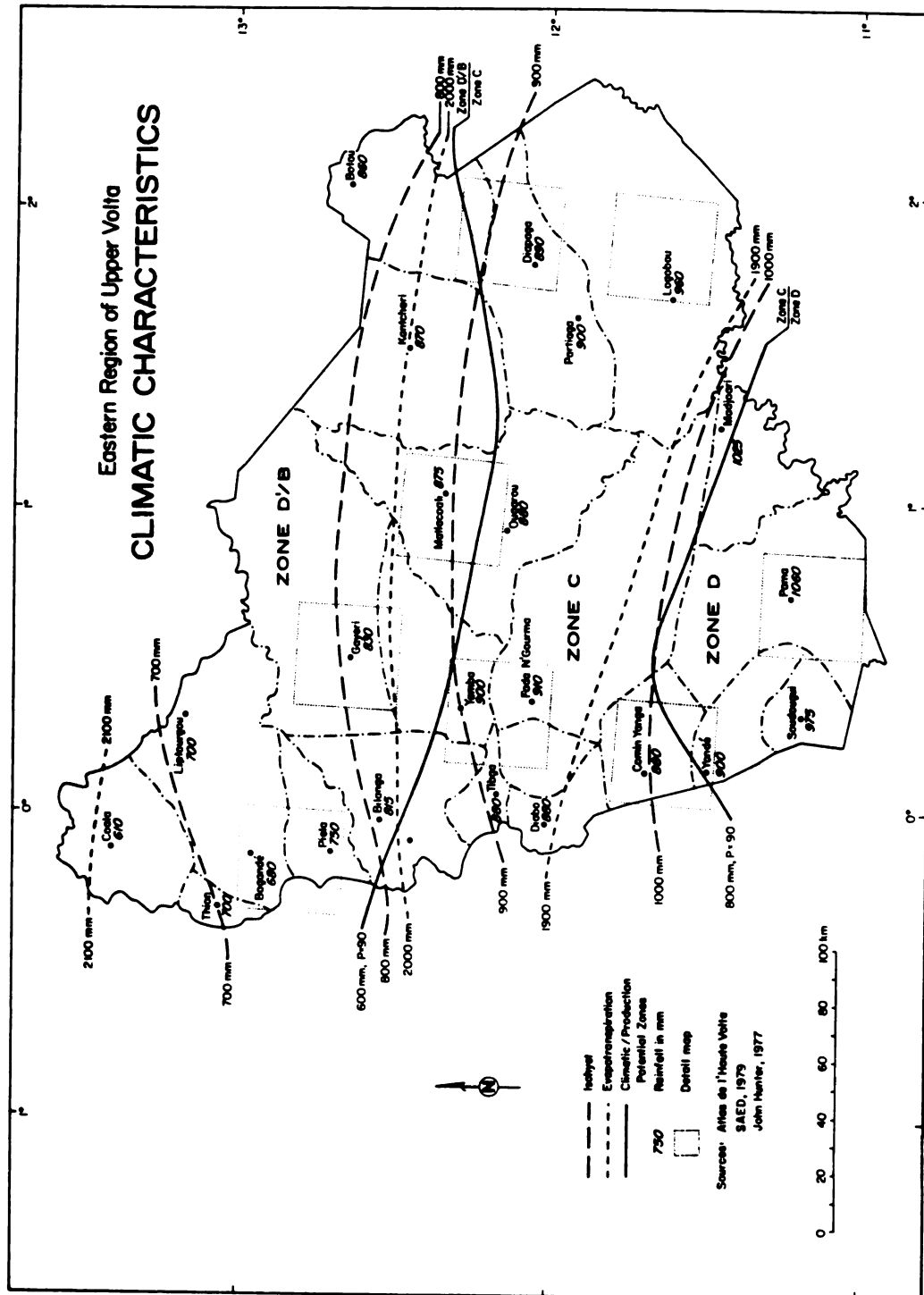


FIGURE 2.3

Eastern Region of Upper Volta: Climatic Characteristics

Source: A. Mehretu (1982).

surveyed zones of Bogande, Mani, Piela and Kantchari. Below this limit is Zone C, in the center of the EORD, bordered to the south by the rainfall limit of 800mm, P=90. The survey zones of Diabo, Logobou, Partiaga, Diapangou and Ougarou are found here. Below where the precipitation is more than 800mm with P=90, Zone D prevails, including the survey zones of Yonde and Pama.

Four seasons, based on temperature variations and two seasons of rainfall exist in this area. Figure 2.4 relates these seasons to calendar months and the survey periods. The hottest times of the year are March-April-May and September-October-November. June-July-August and December-January-February are the cool months. Rains come during the former months and taper off in September. During April and January, the highest and lowest temperatures of 39°C and 16°C respectively, can be expected (Renard, 1965; Remy, 1976).

Most of the EORD is open savanna. Trees scattered throughout the grasslands, become progressively fewer from south to north. Based on Benoit's analysis of the geography of pastoral areas in Upper Volta, three principle types of pasture can be identified in the EORD whose distribution is related to the climatic zones mentioned above. Above the 600mm, P=90 line in Zone D'/B, one finds pasture normally used only for green fodder. In the middle of the region, within Zone C, there is mainly pasture of four annual grasses. South of the 800mm, P=90 line there is quasi-permanent green pasture (Benoit, 1974). As a result

of tsetse fly infestation, livestock grazing in the southern part of the region has been substantially limited. The implications of this on the distribution of livestock breeds and livestock production in this area will be discussed later.

Soil types have not been accurately identified throughout the area but the poorest soils exist in the west and in the north. A summary of major soil types as well as other important aspects of each of the 12 survey agroclimatic zones is presented in Table 2.2.⁶ Most zones have lowlands which capture precious runoff water. Such areas have high levels of silt, clay and organic matter. As a result, their high fertility and moisture levels enable upland rice, sorghum, maize and occasionally tubers or garden crops to grow well there.

Most people in the EORD live in the west and southeast. Figure 2.5 illustrates this pattern and shows how the population density is low outside of this area. Diabo at the western edge of the region has the highest estimated density of 44.3 persons/km². Pama to the south has the lowest estimated density of 2.7 persons/km². The Gourmantche, who are the predominant ethnic group in this part of Upper Volta, occupy roughly 80 percent of the region east of the Mossi Plateau (which lies on the western fringe). The Mossi inhabit this plateau, characterized by high population density along with poor soils.

Sorghum and/or millet are the major crops, usually

TABLE 2.2

Agroclimatic Characteristics of Surveyed Zones

Zone	Approximate Population Density ^a (persons/km ²)	Dominant Ethnic Group	Major Soil Types	Estimated Longterm Average Rainfall ^c	----- Listed by Order of Importance ^d : -----	
					Major Crops	Livestock Types
1. Bogande	27.1 ^e	Gourma	leached sandy soil	690	millet + sorghum + sesame, groundnuts	cattle, sheep, goats
2. Mani	17.8 ^f	Gourma	leached sandy soil	610	sorghum + sesame, groundnuts	goats, sheep, cattle
3. Piela	32.1	Gourma	leached sandy soil	750	millet + sesame, groundnuts, rice	goats, sheep, cattle
4. Diabo	44.3	Mossi	poor lateritic soil	880	millet + cowpea, groundnuts, rice	cattle, goats, sheep
5. Logobou	40.0 ^g	Gourma	silty to sandy clay	960	sorghum + cowpea, sorghum + Niade ^h , groundnuts, rice, tubers	sheep, goats, cattle
6. Partinga	24.2	Gourma	hydromorphic black clay or sandy clay	900	millet + sorghum + cowpea, maize, rice, tubers, cotton	sheep, goats, cattle
7. Yonde	13.0	Mossi	black clay overlaying hydromorphic vertisols	900	millet + sorghum + cowpea, groundnuts	goats, sheep, cattle
8. Diapangou	14.7	Gourma	clay and sandy clay	910	sorghum + millet + cowpea	cattle, goats, sheep
9. Botou	14.9 ⁱ	Gourma	sandy clay and black clay	858	sorghum or millet + cowpea + sesame, groundnuts, cotton	cattle, goats, sheep
10. Kantchari	4.3	Gourma	sandy to sandy clay	870	sorghum + millet + cowpea, maize, manioc, cotton	goats, cattle, sheep
11. Ougarou	3.6 ^j	Gourma	clay	880	sorghum + cowpea, maize	sheep, goats, cattle
12. Pana	2.7	Gourma	hydromorphic black clay or sandy clay	1060	sorghum + cowpea ^m , sorghum + Niadi ^h , tubers, cotton, rice	sheep, goats, cattle

Source: Laseiter (1982), except column 7.

Footnotes to Table 2.2

^a1979 estimates taken from Mehretu and Wilcock (1979, Table 3, p. 20).

^bFrom Bureau de Production Agricole, "Determination des Zones Homogenes en Vue de l'Installation d'Un Reseau d'Essais Multicaux", ORD de l'Est, Fada N'Gourma, Upper Volta, August, 1977.

^cFrom J. Weldring, "Synthese sur les Amenagements Hydro-Agricoles dans l'ORD de l'Est: Fada N'Gourma", Direction du Fonds Developpement Rural, Ouagadougou, May 1979, pp. 5-6. Weldring took his figures from an uncited 1974 S.A.E.D. report and thus they probably represent 20 year rainfall estimates extrapolated from a few national rainfall stations from simialr latitudes. In cases where Weldring did not present an estimate for a survey village, regional averages were used: Bogande (Bogande + Thion), Mani (Coala), Botou (Bilanga + Yamba), and Diapangou (Fada N'Gourma).

^dBased on the information in Table 2.4.

^eDensity for Thion canton used.

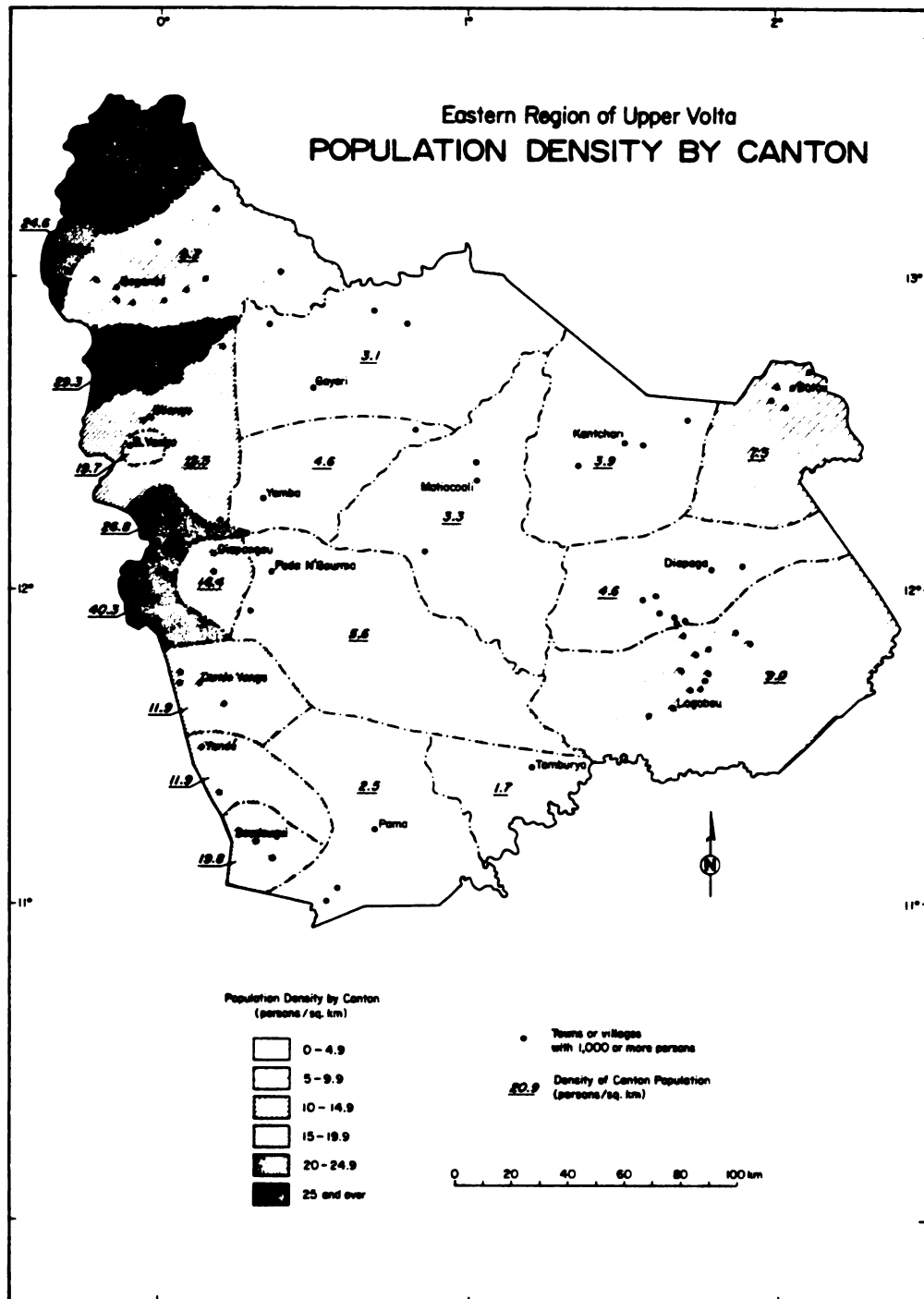
^fDensity for Coala and Bogande cantons used.

^gThis is a rough estimate of the effective population density in the survey area. The density of the Gobnangou canton is only 9.8, but the majority of the canton area is non-arable rock ridge or wildlife reserve.

^hNiadi is a short season, 60 day millet grown only in the wetter regions of the EORD.

ⁱDensity for Bilanga canton used.

^jDensity for Matiacoali canton used.



Source: A. Mehretu (1982). **FIGURE 2.5**

FIGURE 2.5

Population Density of the Eastern ORD

intercropped with cowpea or on occasion, sesame, depending on rainfall. Practically every household raises livestock--mostly fowl, sheep and/or goats (livestock types and production will be discussed in the next section). Household labor is certainly the major farm resource. Surveyed households were typically large with many dependent children. The animal traction (ANTRAC) subsample was comprised of significantly larger families (11.17 people) compared to the overall hoe subsample household size (7.27 persons).

Without much question, agriculture dominates the lives of the people in the EORD. Over 90 percent of the working age population is actively involved in agricultural field work. The dependency ratio (the number of dependents [young or old] per worker) ranges from 0.79 to 1.11 among hoe households and from 1.06 to 1.31 among ANTRAC households. These latter households appear to have a larger work force than hoe households in absolute terms, but proportionally fewer persons work, as the higher dependency ratio indicates. EORD households employ little technology in agricultural production and have only small amounts of material possessions. Since agricultural production occupies most household labor, basic hand tools and baskets (used to transport head loads of harvest) are owned by all households. Farmers rarely use crop production inputs such as fertilizer or insecticide.

Farms are generally small, averaging 4.2 cultivated hectares in 1978 among farms cultivated with just the hand

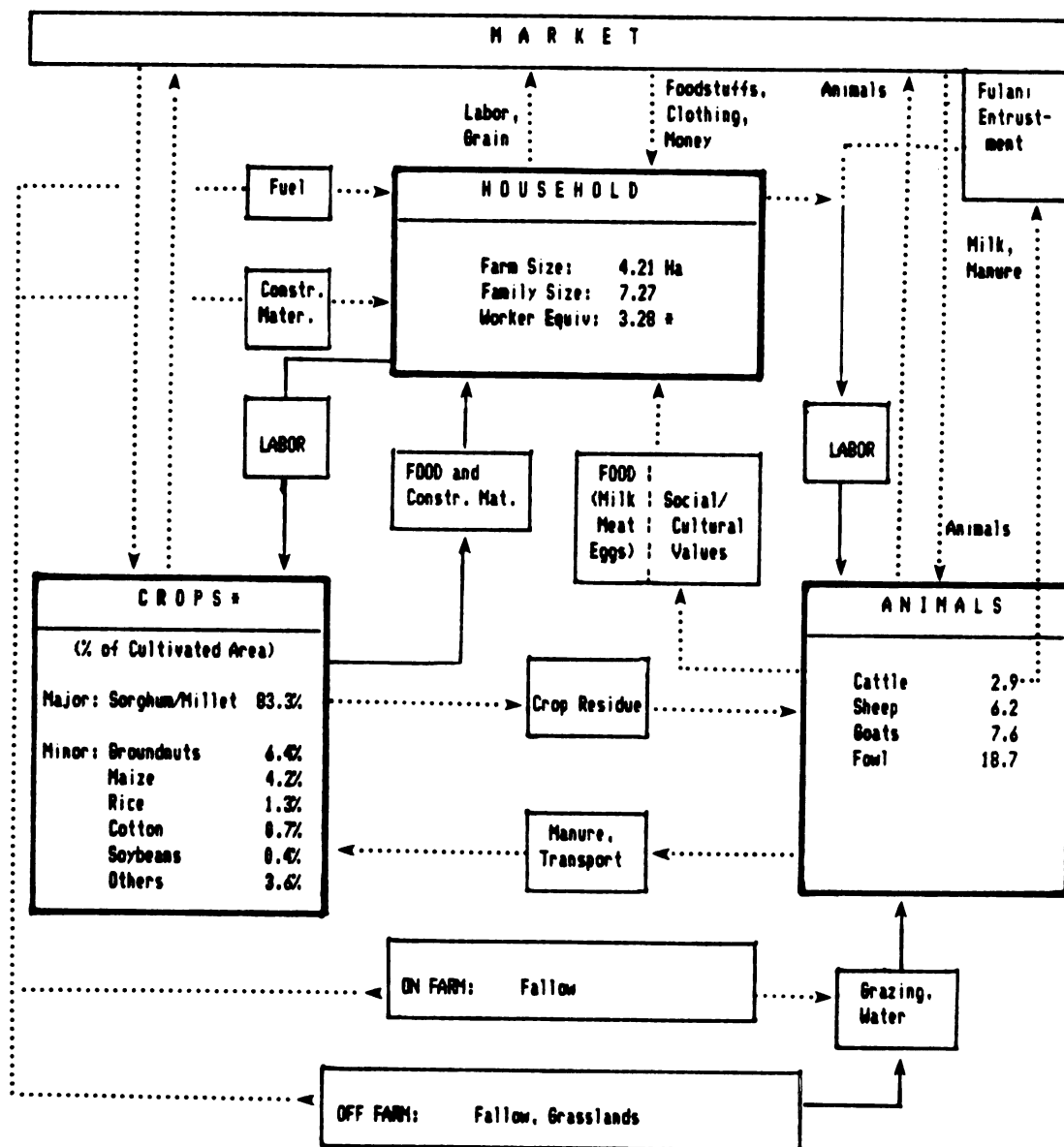


FIGURE 2.6

Rain-fed Hoe Agricultural Farming System of
Eastern Upper Volta

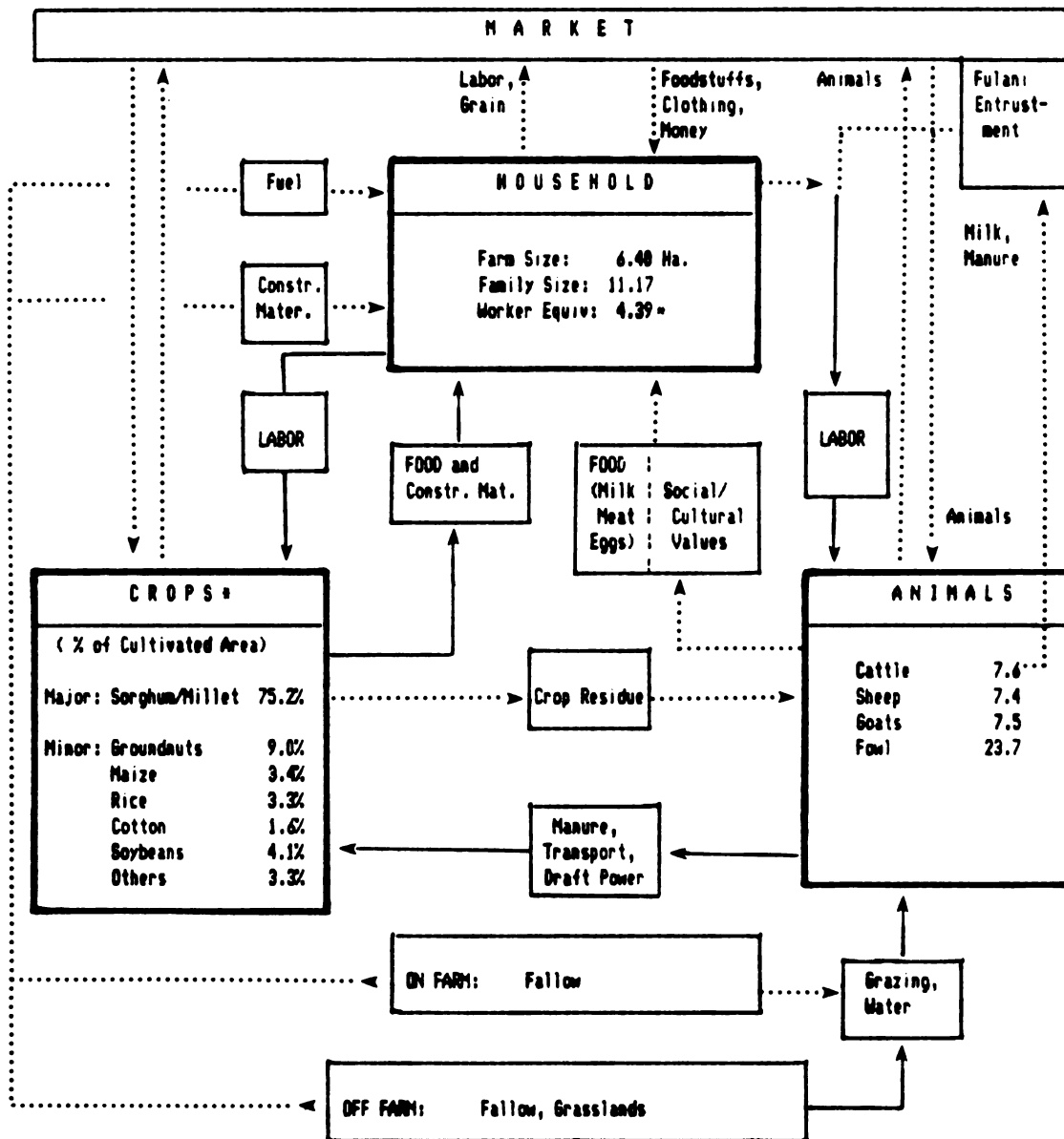


FIGURE 2.7

Rain-fed ANTRAC Agricultural Farming System of
 Eastern Upper Volta

hoe and 6.4 hectares among animal traction farms. This difference in acreage mainly reflects a difference in scale since ANTRAC households include more members.

Based on such criteria as the resource base of these two groups, the ANTRAC subsample is representative of a distinct group of farm households. They are relatively successful ANTRAC farmers who not only own more livestock but also represent households that are relatively larger, wealthier, etc. The hoe household subsample exemplifies average EORD farm households.⁷ Figures 2.6 and 2.7 summarize the characteristics of the hoe farming system and that of the typical ANTRAC farming system found in this part of Upper Volta.

3. Livestock Ownership Patterns

3.1 Types of Animals Raised

In nearly every compound one will find livestock. Besides cattle, sheep and goats, nearly every household raises fowl (chickens, ducks and guineafowl), and some may have one or more donkeys, horses, pigs and even rabbits. But it is difficult to obtain accurate figures on household herd size in Upper Volta primarily because of the reluctance on the part of farmers to reveal their wealth (large and small ruminants in particular, are indicators of wealth). Cattle in particular can have social/cultural significance and the existence of a cattle head tax gives farmers a reason to underreport their holdings. This sensitivity of revealing one's wealth undoubtedly led to some underreport-

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ing in this survey.⁸ Estimates from 424 out of a possible sample of 470 farmers were used in the analysis of live-stock. About half of the farmers who were not included declined to answer questions while others who did respond were eliminated because their responses were considered inaccurate.⁹

The cattle breeds found in eastern Upper Volta may be classified under the general category of Zebu (Bos indicus) and to a more limited extent, Taurin (Bos taurus) (CID, 1980). Zebus inhabit areas which are hot and dry while Taurins are more often found in tsetse infested, hot and humid areas. A significant population of mixed breeds also can be found between and to some extent, within those areas dominated by Zebus and Taurins. The chief advantage Taurins have over Zebus is their greater tolerance of humidity and trypanosome infection which explains the prevalence of Taurins in the southern part of the region. The Zebu's lower tolerance to trypanosome infection keeps them out of this area. Zebus on the other hand, are much larger than Taurins. A male Zebu Maure for example, averages 350-450 kilos whereas a male Taurin N'Dama averages about 250-350 kilos. In the 1978-79 survey, there were more mixed breeds throughout the EORD. The central area had the highest concentration of Zebus while relatively more of the mixed breeds were found in the northern part of the region.

Sheep and goats are widely owned throughout the region with no less than 91 percent of the farms having at least one small ruminant. Three types of sheep are found--the

Peul (or Voltaic Fulani), Gourma, and Bariba breeds (CID, 1980). All the sheep are the hair type, not the wool type. Peul sheep are largest and Baribas are smallest. Goat breeds are either Peul (or Sahelian), Gourma, or Bariba (Ibid). Their relative weight and size is the same as that of the sheep types mentioned above.

Gourma sheep and goats were found to be more numerous during the EORD survey, occurring six times more often in farmers' herds than Baribas. Peuls were least common comprising less than 1 percent of the sampled small ruminant population.

Several authors who have studied livestock in arid and semi-arid Africa have pointed out the many advantages of raising small ruminants as opposed to larger ruminants such as cattle and camels. Small ruminants have a much wider dietary range, an earlier physiological maturity and more rapid reproduction rate (Dahl and Hjort, 1976; Fitzhugh, undated). As a result, they have the capacity to produce more rapid returns in terms of offtake for meat (Wilson, 1983). That is, major offtake for meat from small ruminants can occur three to five times earlier than from cattle. The divisibility and smaller quantity of meat obtained from these smaller animals is an asset in rural tropical Africa. The demand for meat is often for limited quantities at any given time while meat storage facilities are nonexistent or minimal at best. Also, it has been calculated (by ILCA) that the relative production of meat

(on an equivalent basis) is 5.0, 3.0, 1.5 and 1.0 for goats, sheep, cattle and camels respectively (Ibid). Not only can small ruminants produce more meat, they also can provide food (meat and milk) for human consumption at times of the year when cattle and camels are unable to do so. This is attributed to the different breeding seasons of each animal type (Ibid). Another extremely important characteristic of these small stock raised in a harsh arid and semi-arid environment is their demonstrated ability to withstand and rebound quickly from difficult conditions (Dahl and Hjort, 1976; Wilson, 1983). Small ruminant herds survived much better and recovered much faster than cattle from the 1968-74 sahelian drought (Wilson, 1983). Note that in practically every category mentioned above, goats have tended to perform better than sheep. Given these attributes, it is not surprising why so many rural households raise small ruminants and in some cases, prefer them to large ruminants (outside of the wealth/asset value of larger animals).

3.2 Herd Size, Structure and Changes

Table 2.3 and Table 2.4 show household livestock inventories and the pattern of herd size ownership during 1978-79. In the (ANTRAC zones) hoe subsample, the average household raised 3 cattle, about 6 sheep and 6 to 7 goats along with a few other animal types. But only one in three households actually owned cattle while approximately 92 percent owned a small ruminant. On the basis of the number

TABLE 2.3

Livestock Inventories

	----- Hoe Subsample -----		
	Entire Subsample	ANTRAC Zone Subsample	ANTRAC Subsample
<u>Number of Livestock per Household:</u>			
Cattle	2.9	2.1	7.4
Sheep	6.2	6.2	7.9
Goats	7.6	6.3	7.8
Chickens and Guinea Fowl	18.7	19.0	23.7
Donkeys	0.3	0.5	1.1
Horses	0	0	0.1
Pigs	0.6	0.8	0.5
Ducks	0.2	0.3	0.7
<u>Percent of Households Owning:</u>			
Cattle	29%	22%	64%
Sheep or Goats	92%	91%	93%
Fowl	97%	93%	93%
<u>Value of Herds per Household (in FCFA):</u>			
Cattle	104,655	71,301	289,765
Sheep and Goats	33,960	28,790	36,910
Fowl	4,805	4,505	5,745
All Large Livestock	108,825	77,585	305,450
All Small Stock	40,145	34,950	43,935
Total of All Livestock	148,965	112,530	349,385
<u>Household Sample Size:</u>			
For Cattle	313	101	118
For Small Stock	306	98	118

TABLE 2.4

**Livestock Holdings per Household by Animal,
Zone and Region**

Zone	Cattle		Sheep		Goats		Small Ruminants		TLU *	
	H	AT	H	AT	H	AT	H	AT	H	AT
Bogande	5.71	--	8.20	--	6.54	--	14.74	--	5.85	--
Mani	1.62	--	2.72	--	6.97	--	9.69	--	2.52	--
Piela	1.17	.72	4.00	4.44	5.35	5.72	9.35	10.20	2.18	2.43
Botou	5.68	--	4.67	--	8.14	--	12.81	--	5.79	--
Kantchari	3.30	--	6.61	--	10.40	--	17.81	--	4.80	--
.....North	3.62	--	5.49	--	7.65	--	13.15	--	4.39	--
.....Diabo	4.10	5.85	5.41	8.96	6.94	8.33	12.35	17.30	4.60	5.82
Logobou	.97	9.12	6.00	3.75	5.21	4.81	11.21	8.56	2.80	9.77
Partiaga	3.90	--	10.50	--	12.50	--	23.00	--	5.80	--
Diapangou	5.30	11.50	5.00	6.43	7.63	6.79	12.63	13.20	6.80	10.90
Ougarou	.53	13.40	10.30	13.30	7.39	12.10	17.70	25.40	3.10	13.20
.....Central	2.80	--	7.76	--	8.25	--	16.01	--	4.43	--
.....Yonde	1.80	--	3.11	--	6.07	--	9.19	--	2.10	--
Pama	2.10	--	6.53	--	6.37	--	12.90	--	3.20	--
.....South	1.58	--	4.91	--	6.23	--	11.14	--	2.71	--
All Zones	2.93	--	6.25	--	7.62	--	13.90	--	4.88	--
ANTRAC Zones **	2.60	7.57	5.99	7.43	6.46	7.48	12.40	14.90	3.80	8.15
Number of Households	306	98	313	118	313	118	313	118	306	98

Note: H = hoe and AT = ANTRAC household subsamples.

* TLU = Tropical Livestock Units, of all livestock owned.

** Based on weighted averages depending upon number of hoe or ANTRAC households in each zone.

of Tropical Livestock Units (TLU)¹⁰ raised (of all livestock), the average household raised 3.8 units. In comparison, the average ANTRAC household raised several more animals. An average household raised approximately 8 cattle, and an equal number of sheep and goats, about 7 to 8 of each. Among this group of households, two out of three households owned cattle, 93 percent owned a small ruminant and each household owned approximately 8.15 TLUs. These figures attest to the significantly greater ownership of livestock among ANTRAC households.

Ougarou zone ANTRAC farmers owned more cattle (13.4/household) than farmers in any other surveyed zone as can be seen in the table of animal ownership, Table 2.4. Among hoe households, those in Diabo and Diapangou own relatively larger herds of cattle. In contrast to Ougarou which has a low human population density, Diabo and Diapangou are in the highly populated Mossi Plateau. These latter two areas are more likely, as time goes on, to experience increased competition over land use for crop or livestock production. On the other hand, one advantage of raising livestock in these areas is their closer proximity to the centers of demand for livestock products.

In the northern sector of the EORD, one finds the highest average level of hoe household cattle ownership. This corresponds with the fact that greater numbers of livestock are generally found in the dryer sahelian zone of Upper Volta. Because of this area's limited crop producing ability and the greater risk involved in growing crops (due

to low, unreliable rainfall), the income generating potential of livestock production is more important to the survival of these households than to those further south.

Small ruminant ownership is somewhat more evenly distributed according to the information in Table 2.4. Larger sheep herds are found in the center of the region, especially in Partiaga and Ougarou which are thinly populated areas. Goat herds also tend to be larger in this central area and in these two particular zones. Relatively large goat herds are also found in Botou and Kantchari, both located in the north.

Voltaic farmers let their small stock roam freely, except in the cultivation season when they are tethered to limit their damage to crops. Households in less populated zones are able to keep more small stock because these animals have a larger area within which to browse for food. In this respect, the largest small ruminant herds were found to be in such sparsely populated zones with Partiaga hoe households possessing the most, an average of 23 per household. ANTRAC households raised an average of 3 more small ruminants per household than hoe households (in the same zones). Ougarou zone ANTRAC families owned the most of this class of farmers, an average of 25.4 per household.

In terms of the number of TLUs owned (all livestock), hoe subsample households in the central and northern parts of the region raised approximately the same number, 4.4 units. Three zones in the western half of the EORD,

Bogande, Botou and Diapangou recorded the greatest number of TLUs per family, primarily because of relatively larger cattle herds in these zones. The southern portion of the region clearly has a lower livestock density, largely due to a high level of tsetse fly infestation and the limitations on grazing caused by the presence of the game park in Pama.

This difference in livestock ownership between these two groups of farmers leads to an equally significant disparity in the value of their herds. Within the same zones, the total value of the average ANTRAC household's livestock inventory was three times that of the average hoe subsample household. Animal traction household cattle holdings were estimated to be four times the value of the average hoe household.

Both hoe and ANTRAC subsample farmers had similar proportions of males and females in their cattle herds. They kept a relatively large proportion of females (61-66.5 percent), particularly reproductive females (31.5-33.9 percent) which would contribute to a rather favorable herd growth pattern. Hoe households maintained roughly the same proportion of each male age category but this pattern is different in ANTRAC herds. Almost 30 percent of their cattle herds were sterile reproductive age males which is of course, due to their use of oxen for animal power.

Both groups of farmers basically maintained the same structure in their small ruminants herds. Evidently, they retain a high percentage of females (57-66 percent), especial-

ly from weaning (approximately 7 months) to reproductive age females (i.e. 34.6-40.1 percent) and a low percentage of actual reproductive females (2.12-4.23 percent).¹¹

3.3 Animal Purchases

ANTRAC farmers purchased many more cattle compared to hoe farmers. Most farmers, (regardless of type) according to Table 2.5, purchased animals with an expressed intent of starting or building up their herds. Only about 4 percent of the cattle were purchased on any kind of credit basis. ANTRAC farmers quite naturally bought a greater number, 16.2 percent, to use on their farms whereas only 2.7 percent of the cattle bought by hoe farmers were destined for on-farm use.¹² Only a select group of hoe households have the capacity to buy cattle. Thus, cattle purchases among the hoe subsample was dominated by purchases for resale (45.2 percent) by the few cattle trading households in this sample. Compare this to the relatively fewer purchases for resale in the ANTRAC subsample (29.7 percent). Roughly 76 percent of all the cattle purchased were males, correlating closely with the intent of many buyers to resell or use the animals on their farms. Males are preferred for fattening operations and are better suited for providing draft power on a farm.

In addition to small ruminants being purchased to increase family herds, many were bought for social/cultural purposes. The larger ANTRAC households purchased relatively more for festive consumption. They also bought

TABLE 2.5
Reasons for Purchasing Animals
(Percent of All Purchases)

ANTHAC Subsample

Animal	Home Consumption	Invitation Consumption	Festive Consumption	Sell	Sacrifice	Give As Gift	Use On Farm	Start/Incr. Herd	Other
Cattle	0	0	0	45.2	2.7	1.4	2.7	46.6	1.4
Sheep	1.9	0	1.9	23.1	16.2	4.4	7.5	41.3	3.7
Goats	2.4	1.4	5.7	38.6	8.1	1.4	5.3	44.5	.5

Hoe Subsample

Cattle	0	1.8	0	29.7	0	0	16.2	51.4	.9
Sheep	2.0	1.0	15.2	19.2	7.1	2.0	4.0	47.5	2.0
Goats	1.3	1.3	11.7	18.2	10.4	0	9.1	45.5	2.6

proportionally fewer sheep for sacrifice and relatively more goats for sacrifice. Few animals were purchased for home consumption irregardless of household farm type. In general, more reproductive age sheep and goats were purchased and relatively more males were bought.

4. Livestock Production and Management Practices

4.1 Resource Use and Management Practices

Land and natural pasture are primary inputs to livestock production. Under the prevailing land tenure system there is no limit to the use of public rangeland. Individual household use of land is thus difficult to assess. The vastness of the land base in the EORD will allow perhaps a greater expansion of livestock production compared to that of other regions in Upper Volta. The use of rangeland by Voltaic farmers is documented in Vengroff (1980):

Very little is known by local livestockmen about the broad general concept of range management. Most livestockmen have an excellent knowledge of the grasses and bushes which are preferred by their cattle (this is substantiated by Swift, 1979). Similarly they are aware of the process whereby pasture is regenerated or degraded by overgrazing and/or burning. Problems do not result from a lack of knowledge of the environment and the interrelationships which govern it. Instead, they result from the inability of the individual livestockmen to manage these resources....Most livestockmen say that they leave their cattle in a pasture area until they have consumed all, or almost all the available grasses and leaves. The key factor is water. If water is available all the forage in the area will be used.... There is no real conception of a system of pasture rotation....

But crop production has traditionally been given priority in access to the best land. For generations in many parts of Upper Volta, there have been conflicts between

agriculturalists and livestockmen (usually Fulani). Problems have arisen out of agriculturalists' assumed first-use rights to land and the damage Fulani herds have done by trampling crops. During the dry season however, animals can graze on crop stubble to the mutual benefit of both the crop and livestock enterprises (animals deposit manure while grazing which is quite valuable to future crop production). Dry season irrigated fields are an exception and for cattle, access to this vital lowland is getting progressively more difficult (Delgado, 1979).

Several studies have recounted the nature of the conflict over land use for crop and livestock production in West Africa (CID, 1980; Delgado, 1979; Eddy, 1979; Herman, 1983; Riddell, 1980; Vengroff, 1980; etc.). This conflict is not only between pastoralists and agriculturalists but it can also be between sedentary farmers who have been increasing their livestock holdings over time. The EORD has not experienced as much of this problem as other regions in the country because of a lower population density.

Labor is a critical factor of production as far as each individual household is concerned.¹³ Little labor and management goes into small ruminant production. Women and children are more involved in raising small ruminants than cattle. These animals are usually allowed to roam freely to scavenge nearby in the village and bush during the dry season. When crop production starts, they are often tethered or watched closely to prevent them from eating and

damaging crops. Therefore, their diet and general condition is considered better during the dryer months when they are able to roam about and eat more. Rarely do farmers attempt to control breeding. Many people believe farmers practice a sort of negative selection of breeding stock. Farmers tend to market the largest, most attractive animals (to the detriment of herd improvement) in their effort to meet consumers' preference for the best looking animals to slaughter at special social or cultural affairs (Holtzman, 1983; Staatz, 1981).

Cattle require considerably more labor input than any other animal species.¹⁴ Herein lies the greatest point of conflict over the use of the most valuable household resource, labor. As other studies of livestock production in West Africa have reported, the young are the ones who tend to a family's animals in the EORD as shown in the table depicting livestock raising duties, Table 2.6. In the hoe household subsample, 63 percent of family labor devoted to livestock production was provided by youths not older than 14 years. In ANTRAC households, this figure is even greater where 73 percent of all labor was provided by this age group. Proportional amounts of labor devoted to duties performed by each age group is also presented in Table 2.6. Guarding cattle, sheep and goats accounted for over 90 percent of all (recorded) livestock raising labor input.

But it is difficult to determine the exact amount of labor that was allocated to each animal species. Yet, given the importance and management requirements of cattle,

this part of the livestock enterprise is expected to demand the bulk of labor allocation. Although during survey data collection the labor allocated to cattle was often comingled with raising other animals, 41 percent of all livestock related labor use in the hoe subsample was recorded to have been associated just with cattle production.¹⁵ Not surprising, this figure was much higher in the ANTRAC subsample where 61 percent was recorded as labor employed only in cattle production. ANTRAC households have more dependents which may account for the much greater share of labor provided by under 14 year old children and the absence of any input from those older than 55.

The distribution of labor input over time follows a pronounced seasonal pattern which is depicted in Table 2.7. The seasonal pattern is heavily influenced by transhumance and the need to keep animals away from field crops during the growing and harvest seasons (both reasons are interrelated). In this part of Upper Volta, the most common time for departure on transhumance is said to be just before and during the harvest season, although there is considerable local variation in this pattern (Vengroff, 1980). This corresponds closely with the rise and fall in labor use observed in the hoe subsample. Tables 2.8 and 2.9 show both livestock labor use and cropping labor use in relation to the agricultural calendar. The profile of their livestock labor use begins a substantial increase in the beginning of the cultivation period, peaking noticeably in

TABLE 2.6

**Livestock Raising Duties Performed by
Different Age Groups**

Age	<u>Hoe Subsample</u>										Total
	Guard	Herd	Enclose	Water	Search For	Feed	Milk	Train	Carting	Harness- ing	
0-14 Years	66	72	0	32	10	0	38	100	100	-	63
15-55 Years	30	28	73	41	77	87	59	0	0	-	32
55+ Years	4	0	27	27	13	0	2	0	0	-	6
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	-	100%
Percent of All Labor	90	2	0	6	1	1	1	0	0	-	100%
Age	<u>ANTRAC Subsample</u>										Total
	Guard	Herd	Enclose	Water	Search For	Feed	Milk	Train	Carting	Harness- ing	
0-14 Years	74	72	0	45	24	0	30	0	40	58	73
15-55 Years	25	26	0	43	68	0	65	100	40	40	26
55+ Years	1	0	0	12	9	0	5	0	0	0	1
Total	100%	100%	100%*	100%	100%	100%*	100%	100%	100%	100%	100%
Percent of All Labor	92	5	0	2	0	0	1	0	0	0	100%

* Small, but a positive amount of labor allocation.

TABLE 2.7

Labor Input to Livestock Production

HOE SUBSAMPLE				
Survey Period	Agric. Calender*	Hours	!	Bar Graph of Hours
1	P/H	26	!	*****
2	C	65	!	*****
3	C	118	!	*****
4	C	140	!	*****
5	C	145	!	*****
6	H	153	!	*****
7	H	124	!	*****
8	H	85	!	*****
9	H	61	!	*****
10	P/H	45	!	*****
11	P/H	44	!	*****
12	P/H	35	!	*****
13	P/H	40	!	*****
.....!				

ANTRAC SUBSAMPLE

Survey Period	Agric. Calender*	Hours	!	Bar Graph of Hours
1	P/H	66	!	*****
2	C	147	!	*****
3	C	188	!	*****
4	C	217	!	*****
5	C	187	!	*****
6	H	144	!	*****
7	H	128	!	*****
8	H	70	!	*****
9	H	53	!	*****
10	P/H	37	!	*****
11	P/H	42	!	*****
12	P/H	32	!	*****
13	P/H	36	!	*****
.....!				

Note: Hours is an average/household (from a subsample of each farm group). Hours does not include those involved in ANTRAC.

* P/H = post harvest period, C = cultivation period,
H = harvest period.

TABLE 2.8

Enterprise Labor Input per Survey Period: Hoe Subsample

MONTH	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March	April	
SURVEY PERIOD	1	2	3	4	5	6	7	8	9	10	11	12	13
CLIMATE	Dry	Dry	Wet	Wet	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
AGRICULTURAL CALENDAR	Post	Post	Cultivation	Cultivation	Cultivation	Cultivation	Cultivation	Cultivation	Cultivation	Cultivation	Cultivation	Cultivation	Cultivation
Harvest	Harvest	Harvest	Harvest	Harvest	Harvest	Harvest	Harvest	Harvest	Harvest	Harvest	Harvest	Harvest	Harvest
ENTERPRISE ACTIVITY													
Crops #	5	18	20	18	10	6	11	9	1				
Livestock #	2	6	11	13	13	14	12	8	6	4	4	3	4

* Labor use per hectare on all crops, including animal traction.

** Labor use only in livestock raising.

TABLE 2.9
Enterprise Labor Input per Survey Period: ANTRAC Subsample

MONTH	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March	April	
SURVEY PERIOD	1	2	3	4	5	6	7	8	9	10	11	12	13
CLIMATE	Dry	Dry	Wet	Wet	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
AGRICULTURAL CALENDAR	Post	Post	Cultivation	Cultivation	Cultivation	Harvest Season	Harvest Season	Harvest Season	Post Harvest Period	Post Harvest Period	Post Harvest Period	Post Harvest Period	Post Harvest Period
ENTERPRISE ACTIVITY													
Crops *	6	14	18	18	10	7	13	10	2				
Livestock **	5	11	14	16	14	11	9	5	4	3	3	2	3

* Labor use per hectare on all crops, including animal traction.

** Labor use only in livestock raising.

TABLE 2.10

Proportion of Labor Input to Cattle Production
Performed Each Period by Different Age Groups

Period	Agric. Calendar*	<u>Hoe Subsample</u>			<u>ANTRAC Subsample</u>		
		Age			Age		
		0-14 Yrs	15-54 Yrs	55+ Yrs	0-14 Yrs	15-54 Yrs	55+ Yrs
1	P/H	47	53	0	68	32	0
2	C	45	53	2	73	27	0
3	C	54	42	3	77	23	0
4	C	58	34	8	75	25	0
5	C	60	34	6	75	25	0
6	H	43	46	10	76	21	3
7	H	45	48	8	65	35	0
8	H	51	42	6	58	42	0
9	H	44	45	11	49	51	0
10	P/H	32	59	8	45	55	0
11	P/H	46	42	12	50	50	0
12	P/H	32	55	12	67	33	0
13	P/H	37	45	18	60	40	0

* P/H = post harvest; C = cultivation period; H = harvest period.

period 6 (September/October)--the start of the harvest season. The competition between crops and livestock over labor is apparently most severe during these times of the year. Labor use by ANTRAC farmers is also greatest during the growing season and harvest seasons. Labor use in livestock production mentioned here is not that involved in animal traction which is accounted for in crop production.

During August in the ANTRAC subsample, the relative proportions of labor allocated to crops and livestock both reached their maximum--pointing to this time. Therefore, August is the most likely month in which a labor bottleneck may occur.

Table 2.10 illustrates the sharing of work between age groups throughout the year. Quite noticeably, younger members of animal traction households contribute over 75 percent of all labor (primarily for guarding cattle) during the busy crop production season. The heavy reliance on younger members of a household shows that the opportunity cost of labor (in relation to crop production) employed in livestock production is kept to a minimum. Delgado (1981) has argued that this cost can be prohibitive to livestock raising on West African farms. Using more accurate labor data from the EORD survey, Lassiter (1982) concluded that much lower labor input levels are required for the maintenance of draft oxen than that suggested by Delgado. Thus he concludes:

The maintenance labor requirements of draft oxen differ greatly from those of range cattle herding in terms of absolute levels, timing and quality. While

by no means negligible, the labor requirements for draft animal maintenance do not appear to be prohibitive (Lassiter, 1982).

Farmers in much of Upper Volta have traditionally entrusted their cattle to more experienced Fulani herders who specialize in cattle production. Delgado reported that all the (Mossi and Bisa) farmers in his Tenkodogo area sample entrusted their animals to local Fulani herders. Herman, on the other hand, did not find that every household in his (Mossi) Pouytenga subsample entrusted their cattle to others. Gourmantche farmers have tended to do so far less than many other Voltaic ethnic groups. Vengroff (1980) reports that only 11.8 percent of the Gourmantche cattlemen in the Village Livestock Project (an AID sponsored project) marketing study entrusted their cattle to others.

Although the question of entrustment was not pursued in depth in the EORD survey, 72 percent of all households indicated they took care of their own animals. Furthermore, roughly two-thirds of the oxen were recorded as being kept in the homestead or compound (Barrett et al., 1982). Among many sedentary farmers throughout Upper Volta there is increasing evidence of a general movement away from entrustment. Many problems (e.g. distrust) have arisen with this traditional arrangement.¹⁸ One important point is that those who keep the entrusted animals are able to capture one of the major advantages of raising animals in association with crops--manure, which is a vital organic fertilizer. This is a loss to the original owner. The extent of self sufficiency in livestock production on

Gourmantche farms is further demonstrated by the fact that two-thirds of these farmers use family members and/or relatives rather than the Fulani when sending their cattle on a transhumance (Vengroff, 1980). Transhumance enables cattle to take advantage of seasonal regional variations in the availability of grasses as environmental conditions change (Ibid).

Insufficient nutrition continues to be a major problem in cattle production in Upper Volta as it is in much of arid and semi-arid Africa. Dry season feeding presents a particularly difficult problem. The limited availability of feed and labor requirements to overcome this problem is one of the most important limiting factors to expanded production on small farms. As stated by Vengroff, "[s]upplementary feeding is a very complex issue which has been the subject of much discussion, debate, research and experimentation" (Vengroff, 1980). This dissertation provides some information on this subject but will not discuss it in any depth.¹⁶ Much as the Village Livestock Project's (VLP) marketing study reported, this survey revealed that farmers in the EORD do provide some supplemental feed on a seasonal basis. This feed is most important during the dry season, especially for draft animals.

Typically, this (limited) supplemental feed is millet and/or sorghum grain, millet stalks/bran and peanut hay. These would be in the form of agricultural processing by-products. Ouedraogo's (1983) grain flow analysis in se-

lected EORD zones revealed that 68 percent of on-farm use of grain went to feeding animals in the ANTRAC subsample (most of which was for traction animals). For hoe households, this figure was 46 percent. Most feed originated from on the farms themselves. Planting forage crops for animal feed is not practiced in the EORD nor is it given much consideration by these and other Voltaic farmers (CID, 1980). Throughout West Africa, labor constraints as well as the lack of sufficient productive land are the two main reasons for the reluctance on the part of many farmers to consider such an effort.¹⁷

All the major livestock producing sahelian countries are trying to come to grips with the problems caused by the conflict between the need to increase production and the potential destruction (through overgrazing) of the fragile resource base upon which production is based. As in many of these countries, this has led to consideration of a livestock development strategy in Upper Volta based upon the stratification of cattle production.¹⁹ In this strategy, most of the EORD would be included in the "strata" or zone for growing out and/or fattening animals by bringing about a greater integration of crop cultivation and livestock raising (mainly on mixed farms). Upper Volta has not fully implemented the stratification of cattle production (as a governmental development policy). Experiences with some of the elements of such a strategy (especially small farmer animal fattening) both in Upper Volta and other West African countries have produced mixed results but show that perhaps

it has the potential to succeed under certain conditions (IBRD, 1981; Ariza-Nino et al., 1980; CID, 1980; Holtzman, 1982; Thomas, 1982).

4.2 Health and Disease Problems

Significant animal losses during 1978-79 among sampled herds could be attributed mainly to disease. Reported occurrences of sick animals during the EORD survey corresponds closely with the reported disease and health problems analyzed among Ougarou area cattlemen by the VLP. The most frequently recorded causes of sickness among cattle in this survey were trypanosomiasis, malnutrition (hunger and thirst) and Blackleg. Small ruminants appeared to have suffered most from pneumonia. Throughout the country, most sick and weak cattle are commonly disposed of in the village and before the full force of the hot, dry season takes affect which could lead to a total loss of the animal. This was observed in the sales pattern of unhealthy cattle in the EORD survey. The greatest number of emergency sales took place in a seller's village (70 percent of all animals sold in poor health) and in period 7 (October/November), two months into the dry season. Prices received in October were also lowest for the year. No such pattern emerged in the pattern of small ruminants sold in poor health.

Disease, leading to mortality and sub-optimal (reproductive) performance rather than nutrition seems to be a much greater constraint to small ruminant production within this region as it is in similar environments around West

Africa (CID, 1980; IEMVT, 1980; IBRD, 1982; Wilson, 1983). There is however, considerable room for improvement in small ruminant nutrition and experimental fattening schemes in Upper Volta and elsewhere (in Africa) have shown that significant advances in weight gain are possible (ILCA, 1980; IEMVT, 1981; Wilson, 1983). Improvements in the management of small stock has also been mentioned as another area of potential gains in production.

Livestock marketing by EORD farm households is the subject of the next chapter.

FOOTNOTES TO CHAPTER II

¹ Much of the following is drawn from Herman, 1983; Herman and Makinen, 1980; Holtzman, 1983; and IBRD, 1982.

² Except for pigs which appear, for the most part, to be all consumed locally.

³ Tabaski is a religious holiday to celebrate the willingness of Abraham to sacrifice his son to God, with the last-minute intervention from heaven substituting a sheep for his son Isaac. This explains the Moslim community's desire to celebrate Tabaski by the slaughter of sheep--preferably a white ram.

⁴ Collection markets are characterized as mainly northern markets in the cattle-producing or surplus zone where animals usually first enter the market chain. Redistribution markets can be distinguished from these collection markets not so much by them being located in the south, but by the dominate presence of traders as sellers. No true terminal markets exist in Upper Volta (where all sales would be to butchers for final use) but Herman defines the Ouagadougou and Bobo-Dioulasso cattle markets as terminal markets for two reasons-- "butchers' purchases of cattle are of so much greater importance in these two cities than in other redistribution centers; and secondly, practically all of the remaining sales are to exporters, making these two cities major embarkment points for exports".

⁵ The next few paragraphs draw heavily from Mehretu, 1982.

⁶ Much of the next few paragraphs are taken from Lassiter, 1982.

⁷ Lassiter (1982) provides a thorough description of EORD farming, especially the use of animal traction.

⁸ In an effort to overcome this problem, estimates of household holdings were gathered only after trust and understanding was built up over a year of communication with farmers before asking them to reveal the size of their livestock holdings. Thus, this survey team believes these estimates are as good as any other research effort in similar areas has collected.

⁹ Lassiter (1982), who was a member of the survey team points out that underestimation of herd sizes may well have occurred using this selection process because cattle owned by large herders are more likely to be underreported. He also adds that although estimates from the survey are higher than those reported by other authors, underestimation may be as much as 30 to 40 percent. For instance, if

the 9.8 percent attrition was comprised of farmers with cattle holdings as large as those of the top 10 percent of reporting farmers, underenumeration of cattle numbers could amount to 36 percent.

¹⁰ TLUs are a means of converting animals of different size and of different species into reference units. The TLU or "Unite de Betail Tropicale" (UBT) is generally considered to be an animal of 250 kilos liveweight. A small ruminant is commonly taken to be 25 kilos of liveweight. As Jahnke points out, differences between zones, breeds, and management systems makes these conversion factors most useful in gross aggregate calculations. His TLU conversion factors which are a compromise between many different common practices are employed in this study:

Camels	1.0
Cattle	0.7
Sheep	0.1
Goats	0.1
Horses	0.8
Pigs	0.2
Chickens	0.01

¹¹ This survey did not have well defined age guidelines. Farmers were asked about the number of animals they had in each age category by referring to general age-type terms. Thus, the age profile can only be considered general. Both CID (1980) and Wilson (1976) consider female sheep and goats older than 10-11 months as breeding females which is basically the age cut-off employed here.

¹² About 3 percent of the hoe subsample did in fact include farmers who employed animal draft power in agricultural production.

¹³ Weekly labor data were collected from a random subset of 125 households.

¹⁴ A detailed analysis of cattle used in animal traction in eastern Upper Volta can be found in Barrett et al. (1982) and Lassiter (1982).

¹⁵ Labor allocated to raising cattle was also recording with raising other animals.

¹⁶ For details on feeding draft animals in the EORD, see Barrett et al. (1982).

¹⁷ Barrett et al. (1982) discuss forage production for dry season feeding which is important in utilizing animal traction.

¹⁸ Where entrustment is practiced, the owner maintains

control over the disposal/marketing and offspring of any animals entrusted. The nature of the entrustment "contract" varies. Vengroff (1980) reports that in more than two-thirds of the cases surveyed in the VLP study, the compensation given was milk plus an occasional gift of grain, clothing or cash. The other cases mentioned only milk as payment.

19 The concept of stratified livestock production has been formulated for West Africa to include planning and arranging all land use and management systems according to vegetative and/or climatic zones: extensive grazing, extensive or intensive crop production, mixed farming (including animal traction), conservation and forestry (Ferguson, 1979; Sleeper, 1979). These activities would be sited and planned to make the best use of all scarce resources, land-use potentials, existing infrastructure, population density, product demand and other physical, social and economic factors (Ibid). Stratification in Upper Volta would mean, in the first instance, regional specialization in production: using the sahelian ecological zone for breeding and producing calves, and using the sudanian and guinean zones for growing out and/or fattening animals (IBRD, 1982). In the second instance, this regional stratification would lead to specialization by type of producer. Pastoralists residing in the sahelian zone would be expected to produce and sell off "immature" stock (calves around 18 months old) rather than range-mature animals. This would hopefully reduce both their herd size and lead to less grazing intensity and eventually to a better ecological balance between resource availability and use. A spectrum of intermediate or final stage production units, ranging from (possibly) parastatal ranches and feedlots to sedentary mixed farm units in the sudano-guinean area in the south would then purchase these immatures and grow them out to larger sizes suitable for slaughter or even further fattening (Ibid).

CHAPTER III

FARM LEVEL MARKETING PRACTICES

1. Introduction

Animal resources in Upper Volta are important at all levels of economic stratification: the farm, regional and national levels. In this study, the farm level is the main stratum of analysis which in turn has important implications for the other levels. In many West African livestock producing countries, livestock policy has, until recently, been directed towards production rather than marketing (Herman, 1983). But evidence of late has shown that a narrow production orientation in policy may not lead to more and better quality animals in the market place. Marketing interventions are now being recognized as equally important in improving production and efficiency.

In the future, a greater share of livestock production may originate from crop/livestock farming systems, making this sector a more important component of the livestock economy. Thus, before effective policies and interventions can be developed, the marketing activities and behavior of present crop/livestock farm households should be analysed. Based mainly on the results of the 1978-79 EORD survey, this chapter will describe the marketing patterns of crop/livestock farm households in eastern Upper Volta. The

next chapter will focus more on household market behavior.

The original objective of this EORD survey was aimed primarily at gathering information on animal traction households while using a random sample of traditional, hand-hoe farm households as a control group. Therefore, there were two strata of farmers in the EORD survey, a purpositively selected sample of animal traction farmers in 5 "ANTRAC" zones and a random sample of hoe farmers (in all 12 agroclimatic zones, including these 5 ANTRAC zones). Hoe and ANTRAC households offer an interesting contrast since they each represent two distinct groups of farm households found in the EORD. Therefore, when appropriate, comparisons in this study between hoe and ANTRAC households will be done only within the 5 ANTRAC zones.

A review of one year's livestock marketing levels should be related to the weather conditions during the year. Unfortunately, there is little reliable historical rainfall data available for the EORD. What data was recorded for 1978-79 is considered too inaccurate for use in any technical analysis (Lassiter, 1982). Given that crop yields are a reasonable barometer of overall weather conditions, the next best alternative, employed by other researchers, for arriving at an assessment of 1978-79 in a historical perspective was an evaluation of the 1978 harvest compared to the average harvest of 1973-77 as well as farmers' subjective evaluation of the harvest. The general conclusion was that yields in 1978 were higher than the

previous four years when the region suffered the effects of the Sahelian drought (Ibid).

2. Profile of Marketed Animals

It is clear from Table 3.1, that more small ruminants than cattle were sold during the survey period. Of these small ruminants, goats were more numerous, comprising 50 percent of all livestock sold by farmers in the survey. But 82 percent of the revenue generated from livestock was derived from cattle which numbered just 21 percent of all animal sales. A significantly greater proportion of all the animals sold were males which were roughly 86, 78, and 60 percent of cattle, sheep, and goat sales respectively. Male cattle sales grossed the most income, generating 75 percent of all livestock revenue yet they added up to only 18 percent of the total number of live animals sold. This is due in part to male animals being generally heavier and, as Table 3.2 indicates, their average (on the hoof) price was anywhere from 45 to 69 percent higher than the overall average price of cattle and 49 to 78 percent higher than the average price of small ruminants (depending upon age). Other factors do of course, affect livestock prices. Among sheep, rams receive a premium because they are usually preferred for festive, religious and/or social occasions. Females, for example, have additional value beyond providing meat--they have reproductive and milk producing capabilities. These findings on the profile of marketed live-

stock correspond closely to what the Village Livestock Project (VLP) marketing study found in their survey of livestock marketing in the soudanian zone of Upper Volta, as well as what Herman found for the southern-most sub-sample in his Voltaic marketing study.

From Table 3.2 it is apparent that there were certainly more animals of reproductive age marketed in the EORD. This age profile of marketed animals was more true among males than females except for goats where almost the same proportion of males and females were sold. The fact that a proportionately larger number of female goats were sold (compared to other animals and based on age and sex) may reflect either a demand for reproductive females or a desire on the part of farmers to keep their breeding stock for as long as the females are reproductive (Coulomb, 1982 cited in Holtzman, 1983). The number of females, being 40 percent of all goat sales, corresponds closely to the 43 percent proportion that females were of goat sales in Niger reported by Josserand and Ariza-Nino (1982).¹ In Niger markets, however, female goats were traded for reproductive purposes rather than for slaughter. This may be related to the fact that these data were collected only a year or two after the 1978-74 drought when farmers were trying to build up their goat herds. But average prices received by farmers in the EORD survey do not reflect the same premium received for young females in Niger. The relatively large proportion of females sold (a high percentage of them being in poor health) coupled with a high

TABLE 3.1

Composition of Livestock Sales

=====					
	I	CATTLE: (Percent of Total)			
Age	I				
	I	Cattle	All Livestock	Cattle	All Livestock
	I	Sales	Sales	Revenue	Revenue
=====					
O-Reproductive	I				
	I				
Age Males	I	18	4	12	12
Reproductive Age	I				
	I				
Males	I	68	14	76	62
Total Males	I	---	---	---	---
	I	86%	18%	91%	75%
O-Reproductive	I				
	I				
Age Females	I	7	1	5	4
Reproductive Age	I				
	I				
Females	I	8	2	4	3
Total Females	I	---	---	---	---
	I	15	3	9	7
Total Cattle	I	---	---	---	---
	I	100%	21%	100%	82%
=====					
	I	SMALL RUMINANTS: (Percent of Total)			
Animal	I				
	I	Small Rum.	All Livestock	Small Rum.	All Livestock
	I	Sales	Sales	Revenue	Revenue
=====					
Sheep	I	40	28	45	8
Goats	I				
	I	60	50	55	10
Total Small Rum.'s	I	---	---	---	---
	I	100%	78%	100%	18%
=====					

TABLE 3.2
Average Prices Received for Animals by Sex and Age
(in FCFA)

Age	Cattle		Sheep		Goats	
	Male	Female	Male	Female	Male	Female
O-Wean	14,590 N=3	26,250 N=2	500 N=1	2,000 N=1	1,940 N=5	---
Wean to Reproductive	27,575 N=33	29,430 N=11	2,470 N=31	1,980 N=25	1,805 N=66	1,410 N=53
Reproductive	45,220 N=135	21,760 N=16	4,020 N=173	2,335 N=31	3,420 N=208	1,985 N=135
Average	39,595 N=171	24,890 N=29	3,725 N=205	2,175 N=58	2,940 N=280	1,810 N=189

Note: Includes only healthy animals. N = number of animals sold.

TABLE 3.3
Average Prices Received for Healthy and Unhealthy Animals
(in FCFA)

Health	Cattle		Sheep		Goats	
	Male	Female	Male	Female	Male	Female
Good	39,595 (26,215) N=171	24,890 (1,442) N=29	3,725 (1,925) N=205	2,175 (1,295) N=58	2,940 (1,720) N=280	1,810 (880) N=189
Not Good	19,040 (13,785) N=13	17,500 (23,235) N=9	2,365 (515) N=6	1,480 (775) N=16	2,320 (1,025) N=13	1,505 (830) N=28
Average Price	34,575 (26,060) N=187	20,480 (17,960) N=38	3,640 (1,925) N=211	2,060 (1,255) N=74	2,895 (1,695) N=295	1,755 (880) N=219
Trimmed Average Price *	35,440 (7,175)	24,450 (6,965)	3,470 (680)	1,950 (325)	2,530 (635)	1,700 (250)

Note: Prices are based on the number of animals for which there was complete data on health and age.
N = number of animals sold and the values in parentheses are the standard deviations.

* All observations below the first quartile and above the third were removed and the average was calculated from the remaining 50% of the observations.

percentage of wean to reproductive age females in farmers' herds (35 percent) all indicate that perhaps female goats in the EORD are being retained in the herds for as long as they continue to reproduce.

More Zebu cattle were sold than any other cattle breed (although they were only 30 percent of the sampled cattle population) and they generated the most revenue. Based on an average of prices recieved, a Zebu male (on the hoof) sold for approximately 165 percent more than a male Taurin and about 60 percent more than a crossbreed (cross was not identified). Among small ruminants, substantially more crossbred animals were sold (84 percent and 88 percent of sheep and goat sales respectively). These animals were also 85 percent of the surveyed small ruminant population. But male Baribas brought the highest price of all small ruminants.

Although most animals were marketed in good health, proportionately more females than males of each animal type were sold in poor health. This pattern reflects the fact that females are usually sold only when a seller is forced to sell (e.g. the animal is sick). There was a substantial price margin between animals sold in good versus poor health which was also documented to be true in other West African countries such as Nigeria (Schillhorn van Veen and Buntjer, 1983). The older age and poor health of many female small ruminants sold in the EORD is reflected in the relatively low price received for the average female goat. Based on the health and disease profile of

EORD herds, cattle sold in poor health were probably suffering most from trypanosomiasis, Blackleg and hunger and/or thirst but their exact condition was not recorded in the survey. For small ruminants, most animals may have had pneumonia and were plagued by parasites. As one might expect, most cattle sold in poor health were sold in the early stages of the dry season when farmers evaluate whether or not the animal would survive the stressful dry season. There is no clear seasonal pattern as to the sale of small ruminants in poor health.

Table 3.3 presents by sex, the average price received for each animal type. There was considerable variation in prices received by farmers (especially for cattle) which is reflected in the large standard deviations of simple average prices. It is interesting that trimmed average prices² are greater than the simple average prices for cattle and are less than the simple average prices for small ruminants. This shows that relatively more of the outlying cattle prices were lower rather than higher than the arithmetic average price. Perhaps this is related to under-reporting of prices received due to the reluctance on the part of most farmers to reveal the full extent of monetary transactions. There is not much difference between the simple and trimmed average prices regardless of animal type which, coupled with small standard deviations of the trimmed prices illustrates the tighter distribution of prices once the high and low outlying prices are removed

from the distribution.

3. Cattle Marketing Practices

3.1 When Cattle are Sold

Cattle marketing in Upper Volta follows a definite seasonal pattern. The climatic cycles in arid and semi-arid Africa are important to cattle raising since the availability of good feed is greatly affected by seasonal climatic changes. Upper Volta has a short wet period (see Figure 2.2), which is a time when cattle are in their best condition and at maximum weight. They lose weight during the long dry season and marginally healthy animals may not survive. A few households provide some dry season supplemental feed. But this is not a common practice and for the most part, is limited to traction animals. Over a quarter of all cattle sold in poor health were put on the market in the 7th survey period (October/November), the early part of the dry season. Farmers often decide at this time to sell off their marginal animals if they are uncertain whether these animals will make it through the stressful dry season. Supply and demand factors at this time combine to result in some of the lowest prices of the year.

Most Voltaic farmers believe the best time to market cattle is any time between August and December (CID, 1980; Vengroff, 1980). This is during and just after the wet season, when, as was stated before, cattle are in their best condition. Predictably then, the data from the EORD survey (Table 3.4), shows that most cattle (57 percent) were sold between survey periods 5 and 9 (August/September

and December), especially during period 8 (November/December) when both demand and cattle prices are reasonably high and grain prices are low. But it is interesting that almost one in five farmers in the Village Livestock Project survey of Voltaic cattlemen said there is no best time to sell cattle other than when money is needed (Ibid). Generally, however, the number of animals sold during these four months of year was higher than in most months and average prices received were fairly high. The variation in market entries and slaughter at major cattle markets exhibit this same seasonal pattern (Herman, 1983).

August through December is also regarded by buyers as a good time to purchase cattle (Vengroff, 1980). Buyers know that animals bought at this time are the heaviest they will be during the year and will lose the least amount of weight when trekked from villages or rural markets to larger markets. Demand in Upper Volta for exportable cattle is also strongest at this time. Therefore, on a per head basis, buyers are willing to pay more for cattle at this time of year. The EORD survey did reveal that a large share of distant marketing took place during these months. For instance, over 82 percent of the reproductive age males taken at least 100 kilometers from a seller's village were sold during this period. Moreover, since this was the dry season, farmers were not preoccupied all the time with crop production and they had more time to engage in cattle trading.

TABLE 3.4

Cattle and Small Ruminants Sold per Survey Period

		CATTLE		SMALL RUMINANTS				Total	
Survey Period	Months	No. of		No. of		No. of		No. of	
		Number	Households	Number	Households	Number	Households	Number	Households
1	May	12	10	13	13	51	26	64	37
2	June	16	11	21	18	61	33	82	47
3	July	27	14	16	15	79	50	95	61
4	J/Aug	11	11	19	12	38	27	57	39
5	A/Sept	24	11	29	22	35	25	64	43
6	S/Oct	30	15	28	20	48	25	76	41
7	Oct/Nov	18	14	59	21	29	28	88	38
8	Nov/D	44	9	14	11	20	16	34	24
9	Dec	29	10	17	8	25	21	42	29
10	Jan	13	8	26	12	30	17	56	25
11	Feb	8	7	13	10	30	26	43	34
12	March	7	6	10	10	43	29	53	36
13	April	17	6	22	18	32	21	54	38
Total		256	85**	287	134**	521	145**	808	199**

Note: Entire sample included 348 randomly selected hoe farmers and 125 purposively selected animal traction farmers.

* Survey periods and months overlapped--see Figure 2.4.

** This is the total number of households that sold at least one animal during the year. A household often sold an animal in more than one period while many households did not sell an animal at all during the year.

TABLE 3.5

Average Prices Received per Survey Period
for All Cattle, Sheep and Goats^a
(in FCFA)

Survey Period	Month ^b	Cattle	Sheep	Goats
1	May	22,062	2,288	2,050
2	June	31,125	2,474	2,545
3	July	28,780	2,633	2,330
4	J/Aug	25,625	2,290	1,889
5	A/Sept	29,768	3,059	2,129
6	S/Oct	45,698	3,084	1,978
7	Oct/Nov	16,186	4,592	2,501
8	Nov/D	46,854	3,546	2,044
9	Dec	38,606	3,375	2,238
10	Jan	32,500	3,374	3,636
11	Feb	21,300	2,660	2,842
12	March	31,500	4,385	2,500
13	April	47,750	3,194	2,982
		=====	=====	=====
	Average:	32,775	3,152	2,396
	Dry Season ^c :	34,660	3,440	2,494
	Wet Season ^d :	28,865	2,648	2,255

^aOnly animals in good health.

^bSurvey periods and months overlapped,
see Figure 2.4.

^cPeriods 1, 6 - 13.

^dPeriods 2 - 5.

CATTLE SALES AND PRICES

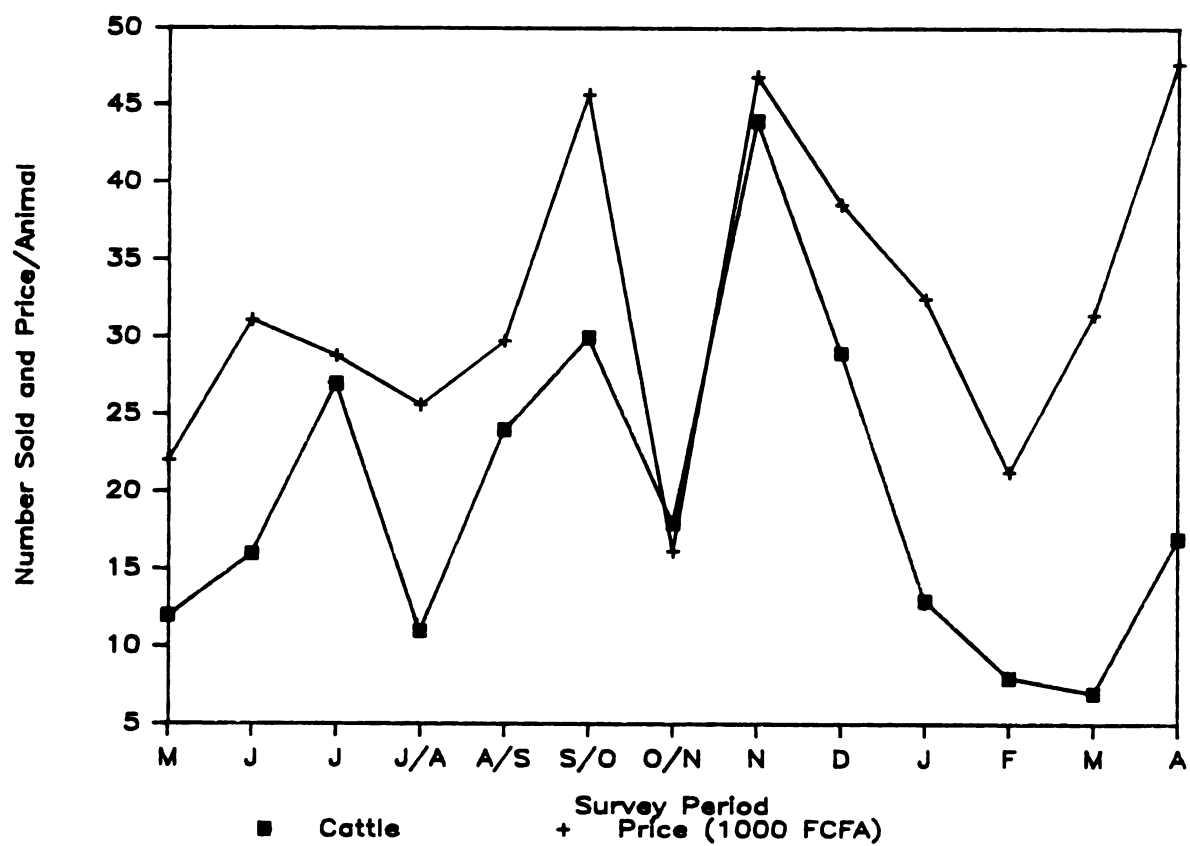


FIGURE 3.1

Monthly Cattle Sales and Prices

Prices received for cattle, depicted in Table 3.5 and Figure 3.1, were lowest between periods 1 through 5 (May to September), during period 7 (October/November), as well as periods 11 and 12 (February and March). But interestingly, not during period 13 (April). The wet season's average price reflects the prices of periods 2 - 5 when cattle are gaining weight. During periods 13 and 1 (April and May) animals are under severe environmental stress. This is the hottest, driest period of the year when little grass is available and animals are in their worst condition. They are often weak (limiting the opportunity to trek them) and must confine their eating to evenings or early morning (Vengroff, 1980). Cattle do not begin to gain weight until the end of period 2 (June), some weeks into the rainy season when grasses have begun to regenerate. The higher average dry season price was the result of good prices received for cattle after they had been fattened during the wet season.

Figure 3.1 demonstrates how cattle sales declined steadily from period 9 to 12 (December to March) as the hot season progressed. Then there was a sudden surge in the number of animals marketed as well as the overall price level starting in period 13 (April). The sales pattern over periods 11-12 (February to March) and between 13 and 3 (April and July) are the most interesting. As one can see from Figure 3.1 very few cattle were sold in periods 11 and 12 (January and March). This was not likely due only to animals being in poor condition. Weight loss was not at

its worst. Primarily during the cool season, January to February, as well as towards the end of the dry season (when cattle are weak and undernourished) does the impact of disease become an important factor (CID,1980; Vengroff,1980). Factors external to the cattle subsector may exert an overriding influence on the cattle marketing behavior of smallholder farmers. The important factor at this time of year was the nature of the relationship between livestock prices and grain prices (this topic will be addressed more fully later when an economic model of smallholder livestock sales behavior is discussed in Chapter 4). But suffice it to say at this point, that the seasonal pattern of increasing grain prices after period 8 (November/December) causes the exchange value of cattle to begin to decline. By periods 11 and 12 this exchange value is so low that some sellers may figure it is not the most profitable time to sell. One of the main reasons why some farmers sell cattle is to purchase grain for home consumption. The low exchange value of cattle for grain at this time may help explain the limited number of sales during this period. Another factor to consider is the limited buying power of many rural inhabitants during this same period, much as increased buying power (from grain sales) in period 8 (November/December) enables people to afford meat (and desire it, as for social needs at that time of year). Many households have little grain left in this post harvest period to sell and thus do not have much money

available with which to buy cattle.

There was a slight upswing in cattle sales starting in period 13 (April). This is during the late post harvest period when many households typically begin to react to their diminishing grainary levels by buying grain. ANTRAC households in particular, begin to purchase some farming inputs.³ These factors may influence farmers to sell some cattle. Also, over a quarter of all females past weaning (sold during the 12 month survey period) were marketed in this period. This may reflect an interest on the part of buyers to restock during the wet season. Prices received for cattle were good in period 13, perhaps because the overall level of supply was down the previous two periods. Prices may then have reflected the shortfall in supply verses demand (which was down due to the deteriorated condition of most cattle). Those who decided to sell obtained some of the highest prices of the year.

Both Herman and the VLP found (through regression analysis) that to a large extent, weight is the most important determinant of cattle prices and that in turn, age is a good proxy for weight--moreso for males than females (Herman, 1983; CID, 1980). Productivity is another important factor regarding females (CID, 1980). Their studies also revealed that price is strongly associated with season. The price data from the EORD survey corroborates this fact (see Table 3.5). Concerning the market conditions faced by cattle owners, Herman concluded that they face relatively competitive buying conditions. In addition, the

market system operates well enough to rather efficiently transmit price signals to sellers, both over time (seasonally) and distance (market location).

3.2 Where and To Whom Cattle are Sold

Table 3.6 is very helpful in providing insights into where EORD farmers market their cattle and to whom they tend to sell. The marketing pattern of all farmers can only be generalized up to a point because significant differences can be identified according to the level of agricultural technology they use. One of the most consistent facts concerning all surveyed farmers is that they sold most of their cattle to "others from outside a household's village". Traditional farmers sold 58 percent of their cattle to these buyers and among ANTRAC farmers, the corresponding figure was 92 percent. These "other" buyers were likely to have been butchers, other farmers, local livestockmen or businessmen (CID, 1980; Vengroff, 1980). If one looks at the column entitled "Average Price" (offered by each category of buyer) in Table 3.6 it appears as though one major reason why farmers preferred to sell to them was the higher average price they received. At the same time, these buyers bought most of the heavier, older males for which higher prices are normally paid.

Almost a third of all cattle were sold (by all sellers) in or near a seller's village. Close to 46 percent of all cattle were sold within 10 kilometers of every

TABLE 3.6

Cattle Buyers and Location of Sales Transactions
(in Percent of All Sales)

Buyers	Distance From Seller's Home to Location of Transaction														Average Price Paid (FCFA)
	In Vlg.		1-10 Kms		11-20 Kms		21-40 Kms		41-100 Kms		100+ Kms		Portion of All Sales		
H	AT	H	AT	H	AT	H	AT	H	AT	H	AT	H	AT		
Member of Concession					1								1	30000	
Large Merchant in Village	2												2	16750	
Small Merchant o/s Village	4	1					1						4	1	24200
Large Merchant o/s Village	2		15		1		2		1				22		27555
Other in Village	12	5	1	1									14	6	17400
Other o/s Village	20	18	19	5	2	9	14		2	7	1	53	58	92	35330
% of Total Number Sold	41	24	35	6	4	10	16	1	4	7	1	53	100%	100%	
Number Sold	33	35	28	9	3	15	13	1	3	10	1	78	81	148	
Average Price Received (FCFA)	26185		22167		36750		24840		37660		55580				31010

Note: H = Hoe households and AT = animal traction households.

Sample size: 68 hoe and 53 animal traction households.

* Due to missing data, one cattle sale was not included in the Hoe subsample while 6 cattle sales were not included in the ANTRAC subsample.

seller's village. Again, these sales were likely to have been to other farmers, local livestockmen, local businessmen or butchers who often go directly to the home of potential sellers (Vengroff, 1980). Such visiting buyers are the ones who would take on the responsibility of trekking animals to larger markets which could even be international markets (Ibid). This can be a lucrative activity for those who are willing to get involved (Ibid; Herman, 1983).

Hoe farmers exhibited a tendency to sell their cattle, within only 10 kilometers of their home village and very few animals were taken any distance to a market--only 5 percent were taken more than 40 kilometers to be sold. It was different for ANTRAC farmers. They sold 60 percent of their cattle at least 40 kilometers from home while 53 percent of all their cattle were trekked as far as 100 kilometers or more to a larger market. Again, most of this longer distance marketing took place during the early dry season which also corresponded with the crop harvest period. There appears to have been a considerable financial incentive for them to market these animals at that distance inasmuch as these animals were mainly older males, for which the prices they received were much higher than average prices. Since animal traction households sold more cattle, more frequently than traditional households, it was more economical for them (by capturing certain economies of scale) to attempt longer distance marketing. The costs and risks involved in trekking animals to larger markets can be prohibitive for the average hoe household who sells only

one or two animals a year. There are labor cost (for the herders) to be considered as well as the risks of weight loss, accident or disease that may be encountered along the way (Vengroff, 1980).

These findings for the hoe subsample are consistent with that of the VLP marketing study, where only 7.6 percent of those they interviewed (all of whom were strictly cattle owners) sold their cattle in one of the larger, or even middle size cattle markets (CID, 1980). However, the figures for the ANTRAC subsample are more consistent with Herman's findings regarding the location of cattle sales transactions in his Pouytenga sample (Pouytenga is close to the western limits of the EORD).⁴ About 92 percent of the sellers in his sample (cattle owners only) sold in large regional cattle markets (Herman, 1983).

4. Small Ruminant Marketing Practices

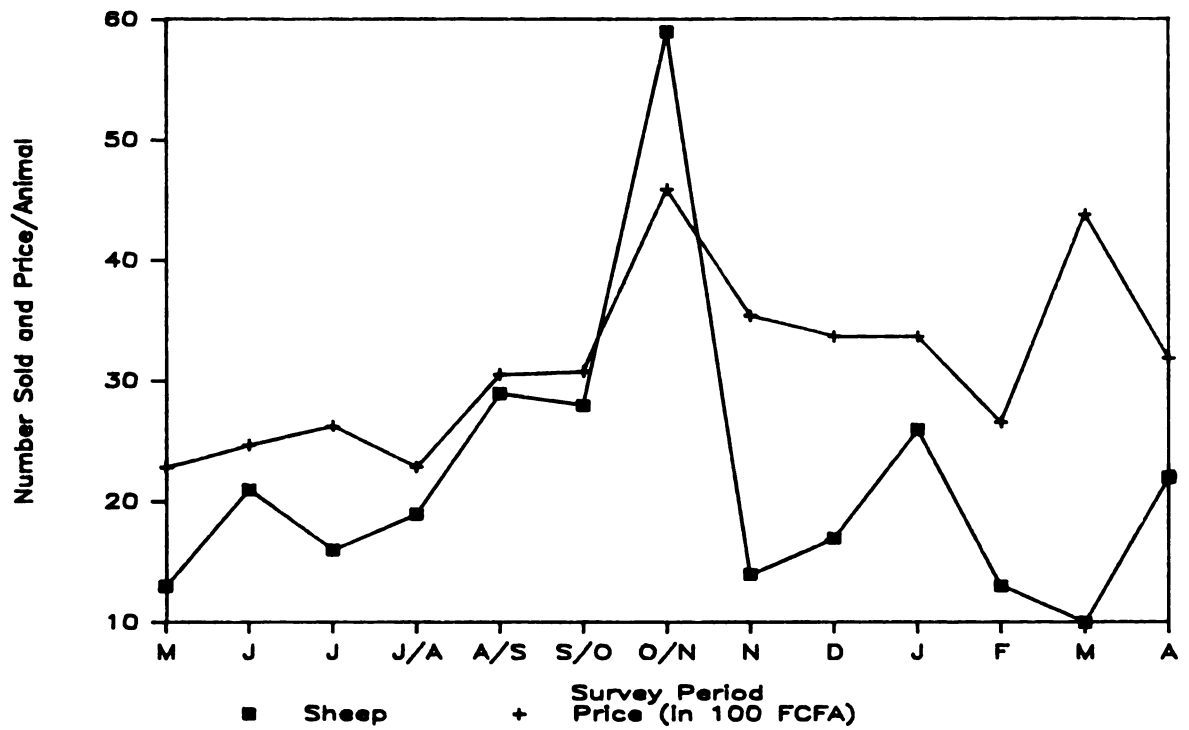
4.1 When Small Ruminants Are Sold

According to Table 3.4 and as illustrated in Figure 3.2, most sheep were sold during periods 5 through 7 (August/September to October/November) with by far the greatest proportion of them (20.5 percent) being marketed during period 7 (October/November). No doubt the heavy demand for male sheep which are preferred for the Moslim Tabaski holiday celebration explains this significant trend in sales. This important holiday was preceded and its date determined by the Ramadan fast which began August 5, 1978. Therefore, Tabaski was in November. Farmers, small-scale

merchants and even a few urban households in many parts of the country fatten rams for such occasions. They tether the rams close to home and feed them household wastes, agricultural by-products freshly cut or stored grasses and, when available, grain and agro-industrial by-products (such as cottenseed cake and peanut cake) (Ariza-Nino et al., 1980; Holtzman, 1983). That is why 40 percent of all sheep sales were recorded between August and November, particularly in November when over 20 percent of all sheep were sold. The smooth rise in prices received shown in Figure 3.2 from May to a peak in October/November and their subsequent sharp decline thereafter clearly illustrates this seasonal cycle.

For goats, sales were heaviest during periods 1-3 (May-June) when a third of all sales took place (see Figure 3.2). This is just prior to and including the beginning of the cultivation period for millet and sorghum. These two crops accounted for 83.3 to 75.2 percent of hoe and ANTRAC farmers' cultivated area.⁵ (Lassiter, 1981). Food needs for some families are greatest at this time because large amounts of energy are expended in the fields and most family grain reserves are at their lowest level. Many expenses for crop production (especially among the larger ANTRAC farmers) are also incurred at this time. Thus, there is frequently the need on the part of a household to make small cash purchases of food grain, labor assistance and crop inputs. Selling a goat is a convenient means of

SHEEP SALES AND PRICES



GOAT SALES AND PRICES

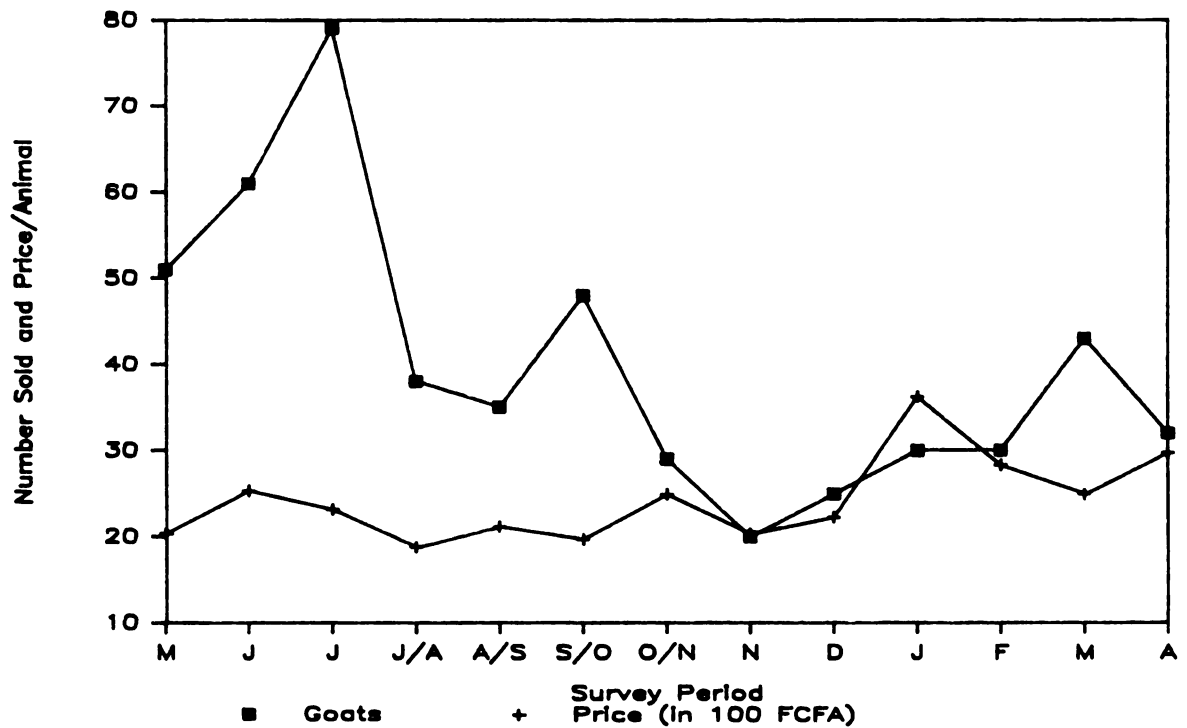


FIGURE 3.2

Monthly Small Ruminant Sales and Prices

CATTLE AND SMALL RUMINANT SALES

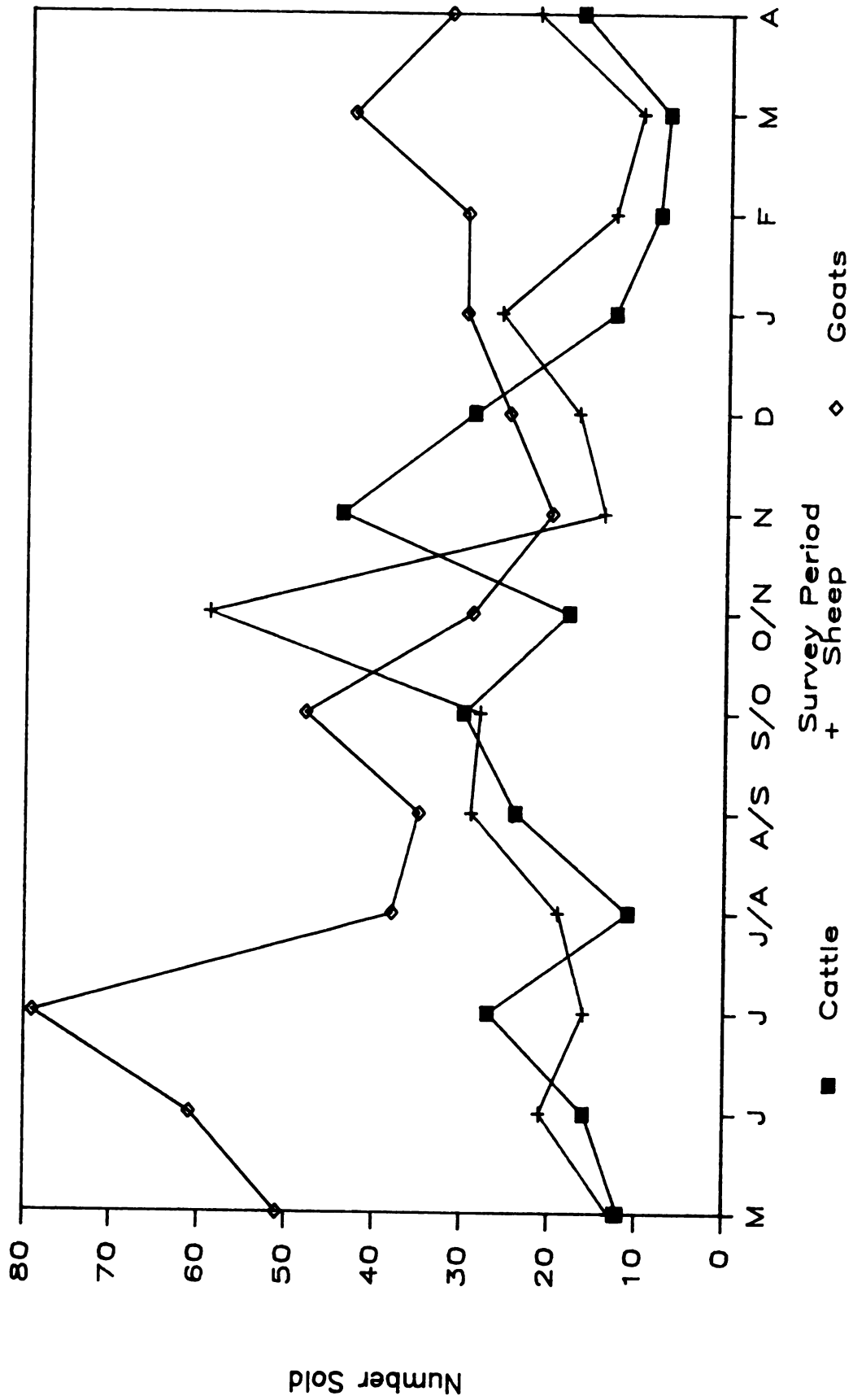


FIGURE 3.3

Monthly Cattle and Small Ruminant Sales

meeting this need. The marketing levels depicted in Table 3.4 illustrate the extent to which this did occur in the EORD. Average goat sales of both hoe and ANTRAC households were up during this time of the year. Plus, the number of households selling during each of these periods was also up, especially in period 3 (July) when the later figure peaked. Goat sales fell off steadily after period 3, reaching their lowest level in period 8 (November/December)--when incidentally, cattle sales were up substantially. Prices (shown in Table 3.5) showed a trend in the opposite direction, moving up gradually, after period 3 and reaching their highest level in period 10 (January).

Except for the specific occurrences mentioned above, the sales pattern of each small ruminant was generally variable throughout the year. When sheep and goats sales are combined (Table 3.4) a more pronounced seasonal pattern emerges. Periods 1-3 (May-June) (in the ANTRAC zones) accounted for most sales (almost 30 percent). Traditional households sold an average of 1.2 small ruminants throughout this period. Animal traction households averaged almost 2.0. It was the higher than average number of goat sales and the increase in number of sellers which explains this overall high level of sales.

Average household small ruminant marketing levels dipped in period 4 (August) but climbed steadily thereafter until period 7 (October/November), reflecting the rising demand in sheep for the Tabaski Moslim holiday celebration. Sales fell off again in period 8 (late November).

Many farmers have said the best time to sell small ruminants is over the dry season, when these farmers feel sheep and goats are in their best condition. (Vengroff, 1980). However, the data in this survey reveals sales during the dry season were at their lowest level of the year. Just as the data in the Village Livestock Project (the source of Vengroff's reference) and in this survey show, most sales other than rams are during the rainy season. This difference in farmers' opinion and action will be discussed later (Chapter 4). However, pressing household financial needs are a driving force behind much of small ruminant sales behavior which often precludes households from selling when they might otherwise do so.

There is some evidence of a countercyclical movement in the general sales level of cattle versus that of small ruminants. During the survey year, high periodic levels of cattle sales were quite often met with low levels of small ruminant marketings (and vice versa)--see Figure 3.3. Both supply and demand factors for these animals are forces behind this relationship. Cattle marketing follows a more distinct seasonal pattern throughout the country, more determined by supply than demand factors. But there is a different seasonal demand pattern for cattle and small ruminants which also helps explain some of the countercyclical pattern. In the major consuming areas (urban centers throughout West Africa), mutton and goat meat is typically substituted for beef at different times of the

year (Delgado, 1980). The historical profile of monthly meat consumption over several years in Maradi, Niger also clearly shows this relationship (Makinen and Ariza-Nino, 1982). Besides the influence of seasonal demand for sheep and goats, most households who own both cattle and small ruminants may base their annual household marketing strategy on the more dominant cattle market cycle. Cattle are clearly a larger, more valuable asset and it is certainly rational for such households to be more attentive to maximizing household utility from cattle sales first. If a family has both cattle and small ruminants (as many ANTRAC households do), they would logically try to meet as many small financial needs by selling off their smaller stock. We have already seen for example, how the high market level of small ruminants in period 7 was met with the lowest level of annual cattle sales. The best evidence of this marketing strategy is within the ANTRAC subsample. High cattle sales levels during periods 3, 4, 5, and 8 corresponded with low small ruminant sales in periods 4, 5, 8 and 10 - 11.

4.2 Where and To Whom Small Ruminants Are Sold

Traditional households did not go far to market their sheep. Table 3.7 shows that they sold 84 percent of their sheep within a radius of 10 kilometers, most to buyers (non-merchants) from outside the sellers' village. These buyers purchased over 60 percent of all the sheep marketed by these farmers. Nearly all sheep in poor health were

also disposed of locally. Very few sheep (only 2 percent) were taken to a distant market (40-100 kilometers away) where the highest average prices were received for these exclusively older, male sheep..

Animal traction households on the other hand, took 43 percent of their sheep (again, only larger males) to distant markets--mainly during the harvest season. But a good portion of their sheep sales did take place in a seller's village--34 percent, which was the same proportion among hoe households. The key contrast between these two groups is the fact that animal traction households sold many more of their sheep in markets that were over 40 kilometers from their villages.

When these ANTRAC households marketed goats, they behaved quite differently. They sold 80 percent of their goats right in their own villages. Only one goat was sold further than 20 kilometers away. But Table 3.8 also reveals that the prices received for such local sales were reasonably good compared to the overall average for all goats. The selling practice of traditional households did not appear to differ much from the way in which they sold sheep (see Table 3.8). They sold a quarter of all their goats in their villages as well as over 80 percent of their animals within 10 kilometers. Only 4 percent of their marketed goats (all except one being male) were sold over 40 kilometers from the seller's home village. These later sales occurred only during the dry season.

A high proportion of all the sheep sold by the

TABLE 3.7

**Sheep Buyers and Location of Sales Transactions
(in Percent of All Sales)**

Buyers	Distance From Seller's Home to Location of Transaction												Average Price Paid (FCFA)		
	In Vlg.		1-10 Kms		11-20 Kms		21-40 Kms		41-100 Kms		100+ Kms			Portion of All Sales	
	H	AT	H	AT	H	AT	H	AT	H	AT	H	AT		H	AT
Member of Concession	0	1											0	1	2290
Small Merchant in Village	1		0	1	0								2	1	4100
Large Merchant in Village	0		1				4						1	4	4440
Small Merchant o/s Village	3		11	1	3								17	1	2790
Large Merchant o/s Village	1		2		1								5	--	4695
Other in Village	11	20	2	6									13	26	2785
Other o/s Village	17	13	33	9	9	1			2	43			61	66	3085
.....															
% of Total Number Sold	34	34	50	17	14	1	--	4	2	43	--	--	100%	100%	

Number Sold	72	24	105	12	29	1	0	3	4	30	0	0	210	70	
.....															
Average Price Recieved (FCFA)	3110		2950		3500		4750		5670						3135

Notes: H = hoe subsample and AT = animal traction subsample.

Sample size: 158 hoe and 39 animal traction households.

Because the figures are rounded, zero represents less than 0.5%, except for the number sold.

* Due to missing data, 7 sheep sales were not included in the hoe subsample.

TABLE 3.8

**Goat Buyers and Location of Sales Transactions
(in Percent of All Sales)**

Buyers	Distance From Seller's Home to Location of Transaction												Average Price Paid (FCFA)		
	In Vlg.		1-10 Kms		11-20 Kms		21-40 Kms		41-100 Kms		100+ Kms			Portion of All Sales	
	H	AT	H	AT	H	AT	H	AT	H	AT	H	AT		H	AT
Member of Concession	1	2	0										1	2	1345
Small Merchant in Village	0	1	1	1									1	2	2075
Large Merchant in Village	0	5	2	2									3	7	3490
Small Merchant o/s Village	2		5		1								7	--	1880
Large Merchant o/s Village	1	6	5		3		0				2		11	6	3575
Other in Village	10	36	5	5	0		0						16	40	2115
Other o/s Village	12	31	37	5	9	6	1			1	2		61	43	2395
.....															
% of Total Number Sold	26	80	54	13	13	6	2	--	--	1	4	--	100%	100%	

Number Sold	110	70	230	11	56	5	8	0	0	1	18	0	422	87	
.....															
Average Price Received (FCFA)	2350		2365		2540		2165		1100		4675				2385

Note: H = hoe subsample and AT = animal traction subsample.

Sample size: 311 hoe and 60 animal traction households.

Because the figures are rounded, zero represents less than 0.5%, except for number sold.

* Due to missing data, 7 goat sales were not included in the hoe subsample while 4 goat sales were not included in the ANTRAC subsample.

participants in the EORD survey were sold to the buyer category of "others" who were from outside a seller's village. These buyers bought over two-thirds of all sheep (see Table 3.7). Traditional households spread their sales to different buyers much more than did animal traction households. Average prices paid by each type of buyer did not fluctuate very much. Members of a seller's concession understandably paid the least while large merchants, especially those from outside a seller's village paid the most and at the same time, they bought the largest animals.

As with sheep, most goats were bought by non-merchants regardless of the type of seller. Again, as with sheep, traditional household goat sales were to many more different types of buyers. But a substantial proportion of these sales were to others (non-merchants) who were not from the seller's village. The pattern among ANTRAC households differed mainly in the fact that 36 and 31 percent of their animals were purchased by others who were from the same village as the seller or outside the seller's village. These figures can be compared to the subsample of hoe households--10 and 12 percent. There was not much variability in the prices received for goats by sellers from different categories of buyers. Large merchants in general paid the highest prices compared to the overall average price paid--in part because most of the animals they bought were the oldest and heaviest.

Taking small ruminants as a whole, the close proximity of market transactions to a seller's village was an over-

whelming fact. Only ANTRAC households made an effort to market sheep any significant distance from their village. As would be expected, these household received relatively higher prices for these animals, approximately 80 percent more than the overall average price. These animals were taken such distances during the dry season and tended to be reproductive age males which usually bring the best prices.

Throughout West Africa, there are very few markets just for small ruminants and prices generally do not vary much among markets or buyers (Josserand and Ariza-Nino, 1982). Therefore, it is not surprising that individual farmers do not often find it profitable to market a small ruminant beyond local markets. Animal traction households, who tend to be more active in (general) trading, frequent somewhat distant markets more often, usually during the harvest season and may have other business reasons for going to market.⁶ Thus, they may find it economical to bring along a sheep or goat to sell while they trade and buy other commodities. Sheep comprise close to two-thirds of all Voltaic small ruminant exports and are higher valued than goats which helps explains much of the longer distant marketing of sheep versus goats. In the same sense, the localized, mixed-product market setting that prevails in rural Upper Volta does no doubt, influence the selling pattern of most small ruminants. That is, sheep and goats are often brought by farmers to these general markets (usually near their home), where they buy or sell many

other goods (Ibid).

5. Sales Per Household

5.1 Annual Sales Levels

Approximately 61 percent and 80 percent of all hoe and traction households respectively, sold either cattle, sheep or goats during 1978-79. Table 3.9 shows the composition of their sales. Most notably, 17 percent of the traction household subsample sold only cattle compared to just 4 percent of the hoe subsample.⁷ Half of the hoe subsample sold only small ruminants whereas just over a third of the traction subsample sold only small ruminants. The greater extent to which hoe farmers rely on small ruminants is clear from this sales-composition breakdown. In comparison, there appears to be a greater flow of cattle from ANTRAC households.

By examining the level of sales activity at the household level, one can get some feel for the degree to which there are spatial differences in EORD farm level marketing patterns as well as the extent to which these farmers are involved in livestock marketing. The information from the EORD survey, as seen in Table 3.10 indicates that a household using traditional, hoe farming techniques sold an average of 0.10 cattle, 0.59 sheep and 1.10 goats during the year (ANTRAC zone figures). Households using draft power sold an average of 1.1 cattle, 0.79 sheep and 0.76 goats.

ANTRAC farmers were evidently more involved in cattle

TABLE 3.9
Annual Household Sales Pattern
(Percent in Each Category)

	At Least One Sale	Sold Cattle Only	Sold Sheep Only	Sold Goats Only	Sold Sheep and Goats Only	Sold Cattle and Small Ruminants	Sample Size
All Hoe Households	71	4	7	24	50	7	315
.....							
Hoe Households	71	4	8	28	54	3	102
ANTRAC Households	70	17	7	16	37	17	84

* In the 5 ANTRAC zones.

TABLE 3.10

Average Number of Animals Sold per Household
by Animal, Zone and Region

Zone	I	Cattle		:	Sheep		:	Goats		:	TLU ¹	
		H	AT		H	AT		H	AT		H	AT
Bogande	I	.20	--	:	.74	--	:	1.11	--	:	.33	--
Mani	I	.56	--	:	.72	--	:	3.06	--	:	.77	--
Piela	I	0	.11	:	.11	.22	:	.78	.50	:	.09	.15
Botou	I	.38	--	:	.52	--	:	1.81	--	:	.50	--
Kantchari	I	.12	--	:	.18	--	:	.55	--	:	.16	--
.....North	I	.27	--	:	.49	--	:	1.49	--	:	.38	--
Diabo	I	0	1.41	:	.35	.53	:	.82	.94	:	.12	1.14
Logobou	I	.27	.12	:	1.33	2.18	:	1.82	1.00	:	.51	.40
Partiaga	I	.26	--	:	.60	--	:	1.66	--	:	.41	--
Diapangou	I	.19	4.64	:	.44	.57	:	1.13	.57	:	.29	3.36
Ougarou	I	.11	2.28	:	.50	.56	:	.56	.56	:	.18	1.84
.....Central	I	.19	1.41	:	.73	.65	:	1.35	.77	:	.34	1.13
Yonde	I	.07	--	:	.30	--	:	.41	--	:	.12	--
Pama	I	0	--	:	.40	--	:	.43	--	:	.08	--
.....South	I	.04	--	:	.35	--	:	.42	--	:	.10	--
All Zones	I	.20	--	:	.56	--	:	1.24	--	:	.32	--
ANTRAC Zones ²	I	.10	1.10	:	.59	.79	:	1.10	.76	:	.24	.91
Number of Animals Sold	I	82	154	:	217	70	:	429	91	:	--	--

Note: H = hoe household subsample of 315 households in the entire subsample, 102 households in the 5 ANTRAC zones. AT = ANTRAC subsample of 119 households.

¹ TLU = Tropical Livestock Units, of all livestock owned.

² Based on weighted averages depending upon number of hoe or ANTRAC households in each zone.

trading and their sales activity was quite variable too. Several of these households bought cattle for resale which is one indication that some of them are cattle traders.⁸ If these cattle bought for resale were taken out of the sample, the average sale level among ANTRAC households drops precipitously to an average of 1.7 cattle, almost half the overall average level for this group of farmers. Twenty three out of 53 ANTRAC households sold animals they had bought for resale. Far fewer traditional farmers did this.

Abercrombie among other authors, reports that in much of Africa, normal marketed offtake for cattle under pastoral production is only 5-8 percent while under improved management, a marketed offtake of 12-15 percent is possible. This rate differs from the typical 20-25 percent in western countries for several reasons. The rate in the U.S. is achieved through a cow-calf operation where calves are sold as feeders at 9-10 months of age. The maximum obtainable under African production conditions for Zebu breeds is limited by their slower rates of maturity (than say, European breeds when placed on a higher plane of nutrition), and when a high percentage of the herd is made up of immature males, 1 to 3 1/2 years of age, before the animals reach desired market size.

An examination of the marketing levels of only those households who traded animals (ruminants) during the survey period, reveals that average sales levels quite naturally change. Considering cattle sales, the average hoe house-

hold in the ANTRAC zones sold an average of 2.2 for the year. Those who sold only sheep or goats sold on the average, 2.8 sheep and 2.4 goats annually. Among the group of households that sold small ruminants as a whole, their average yearly sales level was 3.4 small ruminants.⁹ As already stated, animal traction farmers generally own several cattle. On an annual basis, about 4.5 cattle were sold per household. Their average household sheep sales were 2.3 for the year, with goat sales being 2.2 and small ruminants as a whole, 3.1 animals.

These marketing figures can be compared to those reported by two other recent Voltaic marketing studies, the Village Livestock Project (VLP) livestock marketing assessment and Herman's marketing study. The VLP's sample was drawn within the soudanian climatic zone (like part of this study's sample was), where they found the average cattle owner sold 2.3 cattle, 1.0 sheep and 0.60 goats in a one year period (CID, 1980). Herman on the other hand, sampled livestockmen in Djibo which is located within the sahelian zone. His figures are 3.5, 1.3, and 2.5 sales in one year (Herman, 1983). Both Vengroff and the VLP report point to the difference in ethnicity of the livestockmen as an underlying reason for the differences between their figures and Herman's. Herman's sample in Djibo was almost entirely Fulani who compare more closely to the VLP's Fulani subsample.

The difference between the level of household sales

quoted in this study and that of the VLP and Herman studies may in part be due to several factors such as the ethnic differences in the samples, the difference in when the samples were collected, and also the type of sellers sampled. The VLP study assessed the marketing practices of only cattle owners in four sites who were of four ethnic groups. Herman also surveyed just cattle owners in 1976 who in addition, lived close to a major cattle market. The EORD survey (1978-79) on the other hand, included farm households throughout the EORD who may or may not have owned cattle. The vast majority of this sample were members of the Gourmantche ethnic group.

A more direct comparison can be made between the VLP Gourmantche subsample and the ANTRAC subsample in this study (most of whom owned cattle). Most of Gourmantche in the VLP study were from the Ougarou area. Ougarou was also included in the EORD survey. In Table 3.10 the marketing levels of the average animal traction farmer in Ougarou, who more closely resembles the VLP's sample of cattle owning Gourmantche livestockmen, sold the same number of cattle per household but a different average number of small ruminants than that reported in the VLP study--2.3 cattle, 0.56 sheep and 1.9 goats.

5.2 Marketing Levels Throughout the EORD

Table 3.10 provides information on the (survey) zonal and regional breakdown of sales within the EORD. Concerning cattle, the average hoe household in the northern part

of the region had more sales than those in any other area with Mani showing the highest average for the entire hoe subsample. Animal traction households in the center (Ougarou) and the western part of the region (Diapangou) sold many more cattle, 2.3 and 4.6 respectively, on average than any other group of households. (Remember, the ANTRAC subsample covered only 5 of the 12 survey zones--all except one, in the central part of the region). The high level of household sales in Diapangou may be partly attributed to their close proximity to the largest urban center in the EORD, Fada-N'Gourma, and to the major transportation axis between this city and Ouagadougou. In fact, the relatively high population density of the western half of the EORD, including West-Mossi, and most of the northern area (which in this survey was west of the center of the ORD) creates a substantial base of demand for livestock, especially cattle. The large cattle market in Pouytenga, the second largest Voltaic livestock market (Herman, 1983) is just to the west of these two EORD regions. Costs and risks (to buyers and sellers) involved in trekking animals to market are much lower from these areas. Livestock ownership levels are also high in these two areas. Thus, due to these factors (demand, lower risks and marketing costs and relatively large cattle population), it is not surprising that the eastern portion of the EORD shows the highest overall level of cattle sales per household.

For the same reason--proximity to a major market, Partiaga and Logobou show a slightly higher than average

regional cattle sales level in the hoe subsample. Partiaga is not far from Diapaga, a large far-eastern redistribution market.

There does not appear to be as strong a spatial pattern of small ruminant household marketing. The highest household sheep marketing levels among traditional and ANTRAC farmers were in the south-central area (in Logobou--a highly populated area). Hoe farmers also had the largest sheep herds. Concerning goats, hoe farming residents in the north, particularly in Mani, marketed more than hoe households in other areas. Farmers in that area do not have exceptionally large goat herds. But goats do better in a dry Sahelian climate, leading in some cases, to more frequently commercialized goat herds (Vengroff, 1980). ANTRAC farmers in Ougarou sold the most goats in the ANTRAC subsample.

6. Animal Sales In Relation To Herd Size¹⁰

What difference does herd size and composition make in the level of livestock commercialization by smallholder farmers? Do those who own the most simply sell more and/or more frequently? To address this issue, the number of animals sold was correlated with various herd sizes and the results are presented in Table 3.11. In general, ANTRAC households marketed more cattle for any given cattle herd size. This average figure, it should be noted, was somewhat inflated by the sales activity of a few households

TABLE 3.11

Annual Livestock Sales in Relation to Herd Size

Number of Animals Owned	Percent in Each Category		Cattle		Sheep		Goats		Small Ruminants	
	H	AT	H	AT	H	AT	H	AT	H	AT
Cattle:										
None	75	28	.03	.07	.50	1.03	1.33	.72	1.91	1.76
1-2	4	15	.50	.20	1.00	.60	0	1.73	1.00	2.33
3-5	8	12	.38	.75	.63	.33	1.00	.33	1.63	.67
6-15	9	13	.56	.77	.89	1.33	.56	1.70	1.44	3.00
16-30	3	9	.67	2.33	1.33	.44	0	.67	1.33	1.11
31+	1	6	0	14.83	2.00	.50	1.00	.83	3.00	1.33
Sheep:										
None	25	25			.16	.19	.76	.43		
1-10	55	51			.80	.04	1.45	.98		
11-15	10	11			.40	1.22	.70	1.67		
16-30	10	11			1.40	1.67	.80	1.22		
31+	1	2			1.00	1.00	1.00	3.50		
Goats:										
None	18	21			1.00	1.28	.61	.28		
1-10	63	54			.61	.69	1.23	.60		
11-15	17	6			.21	.60	.57	.80		
16-30	14	17			1.33	.50	3.00	1.77		
31+	*	2			*	2.00	*	11.50		
Small Ruminants:										
None	11	10	.18	1.13					.91	.38
1-10	46	35	0	.76					2.11	1.38
11-15	13	17	.88	3.36					1.31	1.14
16-30	25	29	.35	2.13					1.73	1.88
31+	5	11	.40	.56					2.60	5.33
Average	1(N=102) (N=84)		.14	1.68	.67	.81	1.14	1.00	1.00	1.81

Note: Herd size is as of the end of the survey year, May 1979. Therefore, it was possible for some households to have sold off all their animals some time during the survey year. The subsamples are from the 5 ANTRAC zones.

H = hoe subsample and AT = animal traction subsample.

* No owners in this category.

involved in cattle trading. But ANTRAC households as we saw earlier, do have larger cattle herds than traditional households. Thus, even when controlling for herd size, the former group appeared to be more commercially oriented.

This pattern continues when cattle sales are correlated with the number of small ruminant holdings. ANTRAC households again sold significantly more cattle than their traditional farmer counterparts no matter how many small ruminants a household possessed. But it is interesting that ANTRAC households with 30 or more small ruminants sold fewer cattle than those with smaller flocks. This was not true in the hoe household subsample. This may be related to other circumstances which will be touched on a later in this section.

A look at the proportion of cattle transactions in relation to particular herd size indicates that the most commercially active hoe households during this one year were those with 6-30 head of cattle and 11-30 small ruminants. Among animal traction households, it was those with over 16 head of cattle and 16-30 small ruminants who appeared to be most active in trading cattle.

Regarding the relationship between herd size and small ruminant sales, some patterns also emerge. Concerning the association between the size of a household's cattle herd and small ruminant sales, the most striking pattern is the large percentage of sheep and goat sales among traditional households originating from those owning no cattle. They sold more animals per household than every herd size

category except those owning 30-plus cattle. In addition, 68 percent of all small ruminant transactions involved these families. ANTRAC households on the other hand, exhibited a somewhat different sales strategy. Those with 6-15 cattle were involved in more small ruminant sales transactions and averaged more animals per family than any other category of ANTRAC herd owners.¹¹

All households with large flocks of sheep (30-plus) sold only a few animals during the year while a large share of all transactions came from among those who owned only 1-10 sheep. At the same time, all households with 1-10 goats were more active in the market place although they may have sold fewer goats per family. Gefu observed a similar pattern of goat sales in a semi-arid part of Nigeria. As the size of a Nigerian family's goat herd increased, the proportion of increased sales from those with 10 or more goats increased (Gefu, 1982).

Animal traction farmers always averaged more sheep sales (for any given herd size) than hoe households. This was not so true for goat marketing where hoe households with the same size goat herds generally marketed more goats than ANTRAC households, except those ANTRAC households with a large number of goats.

Another aspect of these relationships that should be mentioned was that in the ANTRAC subsample, there was an increase in small ruminants sales accompanied with a reduction in cattle sales (among those owning 11 or more small

ruminants) as the size of small ruminant holdings increased. It may be that families with many smaller animals limit their cattle sales and depend more heavily on income from small ruminant sales to meet as many cash needs as possible. This may be related to the expressed desire on the part of many households to increase their cattle holdings. If they can limit their cattle sales by selling small ruminants when large funds are not needed, their cattle herd will be allowed to grow faster than it would otherwise. On the other hand, these average figures may point to some degree of specialization in small ruminant trading.

In summary, smallholder EORD farmers tended to market only one animal at any given time during the survey year. Proximity to markets and larger populations increased marketing activity but the limited radius of animal sales was quite apparent. The number of animals owned by a household (of the same type traded or of other animal types), did have a bearing on the frequency and amount of trading by each household. There is a certain amount of substitutability between these animals in question--this is more so among small ruminants than between small ruminants and cattle. Households in this particular milieu with large holdings of small ruminants did not necessarily sell animals more often than households with small holdings, as Josserand and Ariza-Nino maintain is true for most of West Africa. Only households with 16-30 small ruminants entered the market more frequently than others with larger or

smaller herds. In some instances, these other households (with smaller herds) also sold more animals per family during the year than those with 16-30 small ruminants.

One interesting observation to be made following the above discussion is that the market offtake rate from households with smaller livestock holdings was substantially greater than among households with larger holdings. Such a higher market offtake from farmers with smaller herds has also been documented in other African countries (Little, forthcoming; Low, Kemp and Doran, 1980a). A differential in cash needs and cash income alternatives (smaller households having the least of both) is a possible explanation for this observation. For example, the offtake rate of small ruminants among hoe households in this survey with 1-10 small ruminants was roughly 19 percent while the rate among those with 16-30 was about 6 percent. Such an occurrence may be an indication of the extent to which those with larger herds have more general wealth and other sources of income.¹² Another generalization is that hoe households with the same size herds as ANTRAC households tended to have higher cattle offtake rates. The fact that roughly half the ANTRAC farmers owned and used their own oxen for draft power may partially explain the lower cattle market offtake in the animal traction household subsample. Nevertheless, it appears that smaller and relatively poorer (in relation to value of livestock holdings) farm households marketed a greater proportion of their

assets during the year of this survey.

7. Earnings From Livestock Sales

Annual household earnings from livestock and livestock products amounted to an average of 12,651 FCFA for hoe households while ANTRAC households earned an average of 74,207 FCFA (see Table 3.12). Live cattle, sheep and goat sales accounted for roughly 85 and 95 percent of the recorded hoe and ANTRAC subsample household earnings (income from commercial livestock trading activities are included). The annual cash flow and annual income statements (Tables 3.13 and 3.14) tell us something about the relative contribution of livestock revenue to household income which was respectively, 2.0 and 2.5 percent in the hoe and ANTRAC subsamples. One basic fact about EORD households is their low level of monetization and general semisubsistence nature. Both Barrett, et al. (1982) and Lassiter (1981, 1982) provide detailed assessments of farm household income. In the traditional household subsample (using ANTRAC zone figures), livestock did not appear to contribute very much to total household income on an annual, net revenue basis. One could come to the same conclusion for ANTRAC households, although they were more commercially active in the livestock market. Yet ANTRAC farmers benefited greatly from the appreciation of oxen, estimated to be 10,000 FCFA annually per oxen which more than covered all animal traction related costs in 1978 (Barrett et al., 1982). Especially for these farmers, livestock raising and crop

TABLE 3.12

Purchases and Sales of Livestock

Transaction	Purchases		Sales	
	Hoe	ANTRAC	Hoe	ANTRAC
Total Value (in FCFA) ^a of which:	8,733	58,240	12,651	74,207 ^b
Cattle	4,695	50,187	5,594	65,764
Donkeys	166	1,720	106	1,001
Horses	275	0	279	0
Sheep	1,450	3,945	2,019	2,436
Goats	1,428	1,588	2,991	1,610
Pigs	351	191	502	312
Chickens	269	471	146	95
Guinea Fowl	73	129	184	7
Ducks	26	8	3	14
Milk, Eggs, and Hides	NA ^c	NA	42 ^d	1,103 ^d
Meat (raw or cooked)	NA	NA	768 ^d	1,856 ^d

Source: EORD Survey and Lassiter (1982)

Note: Includes commercial livestock trading activities as well as transactions directly related to livestock production.

^aValue of livestock products included for sales but not purchases.

^bThese values are exaggerated by a few households that include large livestock traders.

^cData not available.

^dThese values are probably underestimated by 20 to 30% due to underenumeration.

TABLE 3.13

**Annual Cash Flow Statement for the Average Hoe
and ANTRAC Farmer in the ANTRAC Zones**

Cash Flow Item	Hoe	ANTRAC
		(FCFA)
<u>Crop Production</u>		
Value of Sales	8,115	11,739
Non-ANTRAC Inputs	-2,316	-2,652
ANTRAC Related Current Cash Expenses	5	-3,456
ANTRAC Related Revenues	0	1,183
Net Cropping Cash Revenue	5,795	6,815
Major Food Purchases	-7,236	-16,200
Net Cropping Cash Surplus	-1,384	-9,385
<u>Livestock Production</u>		
Revenues	11,509	33,544
Expenditures	-9,585	-30,279
<u>Agricultural Trading</u>		
Revenues	4,731	10,395
Expenditures	-4,020	-11,404
<u>Agricultural Processing</u>		
Revenues ^a	2,277	7,483
Expenditures	-1,662	-6,604
<u>Other Sources of Income</u>		
Revenues	22,123	33,581
Expenditures	-3,138	-16,200
<u>Capital Expenditures</u>		
Non-ANTRAC Equipment Purchased	-344	-201
ANTRAC Equipment Purchases	-167	-1,520
<u>Credit</u>		
Inflows	2,005	8,011
Outflows	-2,504	-13,481
NET ANNUAL CASH FLOW	19,784	3,941

Source: 1978-79 EORD Farm Survey and Barrett, et al. (1981).

^aNon-agricultural trading, artistic activities, salaries, etc.

TABLE 3.14

**Summary of Sources of Household Income and
Efficiency Measures in the ANTRAC Zones**

Cash Flow Item	Hoe	ANTRAC
<u>Value of Major Sources of Income</u>	(FCFA)	
I. Crop Production	77,097	108,660
II. Livestock Raising	1,924	3,266
III. Crop Trading	559	1,426
IV. Agricultural Processing	615	879
V. Other Sources	18,435	16,293
NET FARM INCOME^a	80,191	114,230
NET HOUSEHOLD INCOME	98,626	130,523
<u>Relative Importance of Income Source</u>	(Percent)	
I. Crop Production	78.2	83.3
II. Livestock Raising	2.0	2.5
III. Crop Trading	0.6	1.1
IV. Agricultural Processing	0.6	0.7
V. Other Sources	18.7	12.5
<u>Efficiency Measures</u>	(FCFA)	
Net Crop Production Revenue/Person	10,173	9,718
Net Crop Production Revenue/Hectare	18,071	16,140
Net Farm Income/Person	10,500	10,216
Net Farm Income/Hectare	18,714	16,945
Net Household Income/Person	13,255	11,669
Net Household Income/Hectare	23,360	19,484

Source: 1978-79 EORD farm survey and Barrett, et al. (1981).

^aNet Farm Income is the sum of major income components I through IV.

trading provided important cash flow benefits (Ibid). But general averages do not reveal the full economic importance of livestock in EORD household economies.

An average of 12,651 FCFA gross income from livestock sales is a sizable contribution to the economy of the average traditional household, considering that the revenue derived from the sale of raw agricultural produce was only 10,172 FCFA. If one were to examine the income gained from livestock within just the selling subpopulation (those who sold at least one animal), livestock raising appears to have been more lucrative. Of the 9 ANTRAC zone hoe households who sold cattle in 1978-79, their average annual income from cattle was 60,344 FCFA. The 32 households who sold sheep during the year earned an average of 10,637 FCFA while the 52 goat sellers earned an average of 6,826 FCFA. For all the 63 hoe households who sold at least one animal (ruminant, in the ANTRAC zones), their average income was 19,658 FCFA.¹³ These earnings are quite good.

As for the relative earnings from each animal type, income from cattle was of course, relatively greater. On the basis of (gross) annual income earned from each type of livestock, 44 percent of their income (hoe subsample) was derived from cattle sales, 27 percent from sheep and 29 percent from goat sales.¹⁴ These proportions reflect underlying household sales patterns and relative prices. Cattle earned substantially more revenue per animal although these farmers only sold an average of 2 during the

year. Almost twice as many goats as sheep were marketed by this group of farmers which helps explain the higher total income gained from goat sales. But the lower average price of goats accounts for the average household income derived from sheep being more than that from goats. This is precisely what Herman also found to be true in his analysis of livestock income (Herman, 1983).

ANTRAC households offer quite a contrast. This group of farmers earned substantially more from sales of live animals, averaging as much as 241,779 FCFA for the 34 households who sold cattle in the one year period. From sheep sales, 30 households earned an average of 10,152 FCFA and 41 households earned an average of 4,909 FCFA from selling goats. The 71 households who sold at least one cow sheep or goat during the year earned an average annual income of 122,906 FCFA from livestock sales. These figures point to the considerable income being earned from livestock for those who are both able and willing to participate in livestock marketing. It has already been shown that this particular group of farmers, as a whole, have larger holdings (particularly cattle) and therefore have much more opportunity to profit from animal sales. In addition, ANTRAC farmers marketed their animals at more opportune times and locations which enabled them to capture both higher temporal and spatial prices. For example, they took advantage of high sheep prices between October and December which is reflected in their income derived from

sheep peaking noticeably at this time. What is particularly interesting to note is the significant earnings from sheep sales in period 7 (October/November) when demand for the upcoming Tabaski celebrations was very strong. Over 50 percent of their livestock earnings in that period came from capturing this surge in demand. Traditional households on the other hand, earned 32 percent of their period 7 livestock income from sheep. Note how both groups of farmers drastically reduced cattle sales at this particular time.

More can be said about the contribution of livestock earnings to the welfare of EORD families. These families are basically sedentary agriculturalists whose farming system is geared primarily towards grain production. But grain output in such a semi-arid area is greatly influenced by the vagaries of the yearly weather patterns. Given this situation and the limited non-farm employment opportunities available to most rural households, livestock are a very important means of taking up the slack in household income. Ouedraogo's grain flow analysis at the EORD village level for the same group of farmers included in this study, helps shed more light on how significant animal sales revenue were to most households (Ouedraogo, 1983).¹⁵

To begin with, most households in the EORD were deficit grain producers in 1978-79. This led to the average family having to purchase more grain than they sold during the year. Households varied in their marketing practices. Only a quarter of all households both sold and purchased

grain. Of the three-quarter remaining households, 9.6 percent sold without purchasing grain, 14.3 percent had no recorded transactions while 50.5 percent only bought grain for farm family use. ANTRAC households with many family members tended to buy more food. The household sales or purchase behavior differed depending upon which of the above categories they fell into. For those who sold as well as purchased grain, they had relatively heavy sales 2 to 6 months after harvest and relatively heavy purchases when agricultural production activities (planting and weeding) were greatest. Of those who only purchased grain, most of their buying (48 percent) took place before the end of August. But at the same time, their annual buying pattern was more balanced throughout the year than those households mentioned above.

Ouedraogo's assessment revealed a lack of marketed and marketable surplus on the part of most households as well as a large number of those who were exclusive grain purchasers. How did they finance such purchases and other needs? When annual household cash flow is stratified with respect to level of agricultural technology used, agroclimatic zone, and level of the zonal grain sales and purchases, Ouedraogo concluded that:

Crop sales is not the first contributor to cash revenues (except in Ougarou zone on average). The average household relies more on livestock and non-farm enterprises to generate cash income...those households without grain sales generate a significant larger percent of their cash through livestock and non-farm sales than households with grain sales (with or without repurchases)....The importance of crop revenues in

the cash flow is not dominant as might have been expected. In most instances, the most important source of cash is livestock (Ouedraogo, 1983).

Thus, we see that livestock are an integral part of the survival strategies of many smallholder farmers in the crop/livestock systems of eastern Upper Volta.

Another relationship one might consider (examined further in Chapter 5) is whether or not an increase in food production, which might lead to a decrease in household grain purchases, would likely lead to an increase or decrease in livestock offtake from these mixed farms.

Little's research in semi-arid Kenya among the Ii Chamus "agricultural Maasai" revealed a negative relationship between grain production and livestock sales and Ouedraogo also demonstrates the same general relationship in the EORD. Using cross-sectional data, Little found that increases in crop production did not lead to a decrease in livestock holdings because the investment role of animals was not altered (Little, forthcoming). As in the EORD, these people in Kenya also relied heavily on livestock sales to meet their cash income requirements to purchase farm family grain.

8. Major Livestock Traders

Some households were heavily engaged in livestock trading. It is fair to say that anywhere from two to three times as many ANTRAC households (compared to the hoe subsample) were engaged in cattle trading--but such households were not systematically identified in the survey (Ouedraogo

and Wilcock, 1980). In a few cases, some households were more actively involved in buying and trading animals (primarily cattle) than producing and marketing crops. A brief look at some of these households is enlightning.

Four households each had over 10 sales transactions during 1978-79. One household had 10, another 11 and the other two had 12. Only one (ANTRAC) appeared to be a major cattle trader (based on the number of cattle bought and sold). This household sold 40 cattle over the year and earned a sizable 3,114,000 FCFA. Only 1 sheep and 1 goat were sold by this household in addition to the cattle. This made their recorded gross income from livestock equal to 3,126,000 FCFA which is the most any household earned from raising livestock.

Of the three other households, one was mainly involved in goat trading (selling 13) while selling only a few sheep (3). The others sold a combination of sheep and goat with one selling more small ruminants than any other household in the entire EORD sample--6 sheep and 20 goats (plus 1 cow). This family earned almost 40,000 FCFA from these sales of small stock and 15,000 FCFA from the one cow they sold.

FOOTNOTES TO CHAPTER III

¹ Based on Eddy's (1981) study.

² All observations below the first quartile are removed as well as all observations above the third quartile. The average is calculated from the remaining observations.

The general livestock categories represented in all tables are really representative of a heterogeneous commodity. This contributes additional variability to prices.

³ Although the sample statistics were greatly influenced by one farmer who sold 9 of the 17 cattle marketed during this period, this farmer was not the only one who started selling at this time. Even when suspected cattle traders are excluded, the sample statistics still indicate a moderate upswing in sales starting in period 13.

⁴ The close proximity to large cattle markets of the farmers in Herman's Pouytenga sample area helps explain the higher figure reported by Herman. As Vengroff points out, this is unusual for most Voltaic farmers but the commercial orientation of many ANTRAC households in the EORD sample must be the principle reason for the difference in findings here and the VLP study.

⁵ Thirty eight percent of sorghum/millet acreage was sorghum alone, 38.6 percent sorghum and millet together, and 18.5 percent just millet alone (Lassiter, 1981).

⁶ All distant trading of small ruminants was done in the dry season and most during the harvest season.

⁷ This difference is largely due to the relatively greater number of cattle owners in the ANTRAC subsample along with their having larger herds.

⁸ The survey did not identify major cattle traders. All those who participated in the survey were asked to declare their main productive activity and they all said it was crop production.

⁹ These figures pertain to only the group of households that sold at least one animal of the type in question. The average small ruminant sales level is not the sum of the separate average sales of sheep and goats because the subsample of households selling sheep was not exactly the same as the subsample selling goats.

¹⁰ These figures, particularly on herd size are considered reasonably accurate although this survey encountered the common problem throughout West Africa of obtaining precise figures regarding livestock.

¹¹ This does not completely agree with the information gathered by the Village Livestock Project's survey. As a result of their survey, they maintain that, "Gourmantche cattlemen tend to specialize in cattle production. They, unlike their noncattle-owning fellow tribesmen, sell few, if any, goats and sheep" (Vengroff, 1980).

In the EORD survey, most sheep and goats sales did come from noncattle owners. However, it is also true that the average ANTRAC household with 6-15 head of cattle sold more sheep and goats (3.08 verses 1.91-1.76 as shown in Table 3.12) when they did sell a small ruminant.

¹² Based on the data of the entire hoe subsample (see Appendix B) and figured at the average annual sales for the maximum number of animals in the herd size category.

¹³ These same figures for the entire hoe subsample are not very different--see Appendix B.

¹⁴ For the entire hoe subsample, the only difference is the relative greater earnings from sheep verses cattle.

¹⁵ The following discussion draws heavily from Ouedraogo's study. His findings were based on an analysis of villages with known important grain marketing participation.

¹⁶ These villages were in the 5 ANTRAC zones but not including villages 26 and 27.

CHAPTER IV

MODEL OF FARM LEVEL LIVESTOCK MARKETING

1. Introduction

The unit of analysis in this study is the farm household which both consumes and produces goods. Therefore, a household has some attributes of a firm as well as a typical family unit. In this chapter, the aspects of a household-firm model to which livestock sales relates is presented. Then, after an economic model of household sales behavior is developed, a statistical and empirical model is constructed in order to evaluate the relationship between household sales of small ruminants and cattle and a set of explanatory variables.

2. Household-Firm Model

Depicting family farms as both household and firm finds its theoretical roots in the writings of such authors as Chayanov (1966) and Nakajima (1969). These authors developed some of the first neoclassical models of a household-firm that maximizes its welfare function in an attempt to reach a subjective equilibrium.¹ Nakajima formulated models for semisubsistence and commercial farms, including situations in which labor markets may or may not exist. But he did not incorporate non-agricultural activities or

leisure (explicitly). Notable modifications of these earlier household-firm behavior models (to include non-agricultural activities and leisure) and their applications can be found in the writings of Becker (1965), Barnum and Squire (1979), Jorgenson and Lau (1969), Lau et al. (1978), and Strauss, (1981). All household-firm models contain the same components: a household utility function, production function, and both time and budget (income) constraints.

Several advantages of these models in the context of research on farming systems have been pointed out by Crawford:

First, they examine the household in an integrated framework which is theoretically consistent with producer and consumer maximizing behavior. Second, their format and assumptions are by now fairly standard, hence easily interpreted by other researchers. Third, when expressed in mathematical form, their properties can be derived rigorously (Crawford, 1982).

Both Crawford and Nakajima however, make note of the complexity of farming systems in developing countries where a farm household is both a production and consumption unit, "....it appears exceedingly difficult to theorize on the working of subjective equilibrium...."

(Nakajima, 1969 cited in Crawford, 1983). Farm households in eastern Upper Volta are indeed complex--many households both consume and sell their productive output, sell their own labor and hire or exchange for labor outside the household. Many also produce several different products using multiple inputs. Because of this complexity and data limitations, the analytical model

developed in this dissertation is not an attempt to arrive at a complete household production/consumption equilibrium. The main objective is to assess (limited to partial equilibrium analysis) the extent to which certain household socioeconomic factors explain short run sales behavior--especially such factors as household cash needs. The household-firm model is the theoretical framework upon which this analysis is based. This model as it applies to Upper Volta is discussed further in Appendix C. The discussion below abstracts from this general model to the specifics of the problem at hand.

Using the theoretical framework of the household-firm model, along with consumer and trade exchange theory, the problem at hand can be formulated in the context of an internal household exchange arrangement. In this case, certain factors in the general model must be considered fixed for the reasons stated earlier.² That is, we assume here that a household produces just two goods and uses only family labor in the production of these goods and does not sell its labor. Additionally, the household can either consume or market its productive output. The period of analysis is one crop cycle.

Thus, the assumptions are: (1) no labor market ($N = 0$); (2) leisure (L) remains constant; (3) Z goods are not explicitly analyzed ($Z = 0$); (4) a household has two productive outputs--crops (own consumption = C_c) and livestock (own consumption = C_v); (5) there is only one productive input, family labor (H); and finally, (6) the

family has a fixed amount of market-purchased goods for the period, (M) . With these assumptions, the household utility function and income equation will respectively take the following forms:

$$(12) \quad W = U(C_C, C_V, \bar{L}, \bar{M}),$$

$$(13) \quad \bar{M} + p_1 C_C + p_2 C_V = p_1 F(H_1) + p_2 G(H_2),$$

where:

p_1 = price of crops

p_2 = price of livestock

$H = H_1 + H_2$

The equilibrium conditions would be:

$$(14) \quad p_1 F' = p_2 G',$$

$$(15) \quad \partial W / \partial C_C = U_C' + \lambda p = 0, \text{ and}$$

$$(16) \quad \partial W / \partial C_V = U_V' + \lambda p = 0$$

Solving simultaneous equations 13-16 will determine the values of H , H_1 , H_2 , C_C , C_V in equilibrium. Then the equilibrium levels of output (F and G), the quantities to be sold, $(F - C_C)$ and $(G - C_V)$, and total income $(M + p_1 C_C + p_2 C_V)$, would be determined. It follows that the equilibrium values of $(F - C_C)$ and $(G - C_V)$ are functions of their prices.

In Figure 4.1, a household production possibility frontier is presented for its production of the two outputs, crops and livestock, along with the relative market price line between crops and livestock and the household's utility function (W). Given this particular production transformation curve and relative prices, the

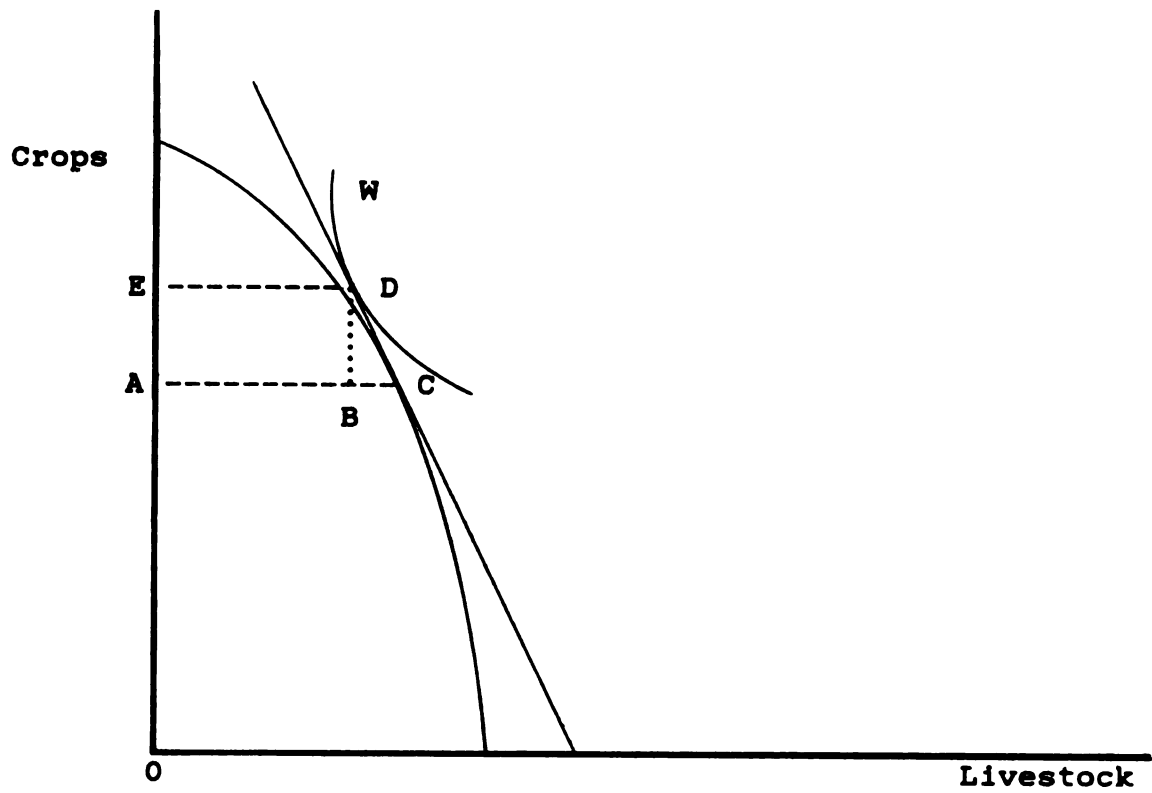


FIGURE 4.1

Household Equilibrium: Two Goods

household's productive optimum level would be where the marginal rate of transformation equals the marginal rate of substitution in exchange, point C. The household maximizes its (constrained) utility function when it equates the marginal rates of substitution in exchange and consumption, point D. But crop production (OA), defined above as $F(H_1)$, falls short of desired consumption (OE), giving rise to a situation where they face $C_c > F(H_1)$. One option the household has is to trade BC amount of livestock resources, defined above as $(G-C_v)$, for BD amount of grain so their maximum welfare is realized at point D. That is, BC number of livestock could be sold and the receipts used to purchase grain.

The availability of grain is of the utmost concern to many semisubsistence EORD households. Food reserves at any given time during the year may not be adequate to meet household needs because of crop failure, insufficient production, errors in estimating household food needs or especially high grain storage losses. One main reason for developing the livestock sales models is to examine the extent to which sales of livestock is influenced by household socioeconomic characteristics such as the need to make this type of tradeoff between livestock and foodgrain (exchanging $[G-C_v]$ for $[C_c-F]$). In other words, what is the elasticity of say, small ruminant sales with respect to grain purchases? Due to insufficient data, the analysis will not be able to fully measure nor account for every possible tradeoff a household

may make between all the variables in its welfare objective function.

The reasons why farmers raise animals (to be discussed further in the next section) will have an impact on a household's decision to make tradeoffs between the elements in its welfare function. For example, if a farmer raises animals strictly for social prestige, he is likely to be more reluctant to sell his animals than if he raises them expressly for their liquid asset value for the times when he would need to purchase grain. Livestock production is different from crop production, adding to the complexity of mixed farming systems. The economic behavior of African pastoral households regarding market offtake from their livestock holdings has been examined and debated by several researchers. Some researchers (most recently Low, Kemp and Doran, 1976, 1980b) propose that pastoralists view their cattle strictly as a store of wealth. Thus, they claim, these livestock producers exhibit nonmaximizing behavior (in terms of maximizing income from beef production) and attempt only to meet a target income. Others (such as Jarvis, 1980; and Shapiro and Ariza-Nino, 1983), refute this argument by illustrating how pastoralists' behavior is consistent with maximizing income from their livestock enterprise. The critical point of evidence for or against one of these positions usually turns on the interpretation of a short-run negative response to

changes in price. But an important factor regarding livestock is the multi-period (e.g. several years in the case of cattle) production cycle. In each short-run period, one could be at several possible points in this cycle.

Since the greatest share of livestock output in Africa originates from the extensive, pastoral production system, most livestock production and marketing research has focused on pastoralists. Mixed farm households are producing the same commodity so the above discussion does have some relevance to the question of how Voltaic crop/livestock farmers respond to economic factors such as price and household needs. Hill's work on the northern Ghanaian cattle trade among agriculturalists (as we are examining here in the EORD) revealed how this type of West African farmer is commercially oriented towards the management of his livestock. For some time, there was a common misconception (mainly derived from some anthropological sources) that cattle owners in Africa were reluctant to sell their cattle except in dire circumstances. But as Hill points out, "the primary anthropological sources do not state that cattle are not sold commercially except in time of famine...". Furthermore, she states, "the herd is not an end in itself, as it is with the Fulani and other pastoralists, but rather a means to an end" (Hill, 1970). Livestock raising in the farming systems of Upper Volta (to be expanded upon in the next section) appears to serve a dual purpose. The animals

provide some sustenance and at times they are sold to meet immediate cash needs. They also serve as a store of wealth and a form of investment.

Given that the EORD survey covered only one year, the empirical analysis of livestock sales in this study is short-run. This is a more appropriate analytical time frame for small ruminants than cattle. Thus, the inter-relationship between livestock and grain mentioned above pertains more to sheep and goats than to cattle. The cattle model in particular was developed in full recognition of the fact that, first, the biological nature of cattle implies that production takes place over a long period of time during which many economic decisions are made. Secondly, as research on the behavior of African livestock raising specialists (pastoralists) has shown, an analysis of supply response to price may reveal no response or results can be ambiguous (Low et al., 1980a; Jarvis, 1980). This study involves a different group of livestock producers who are more integrated into the market economy than most pastoralists but similar problems with the economic analysis of livestock production may prevail due to the nature of the product in question. The purposes served by maintaining livestock ownership on EORD farms and the elements of an economic sales model will be the next topic of discussion.

3. Role of Livestock in the Household Economy

The model of EORD households has shown that the household decision making process can make the strict profit maximization of each productive activity subordinate to the optimization of a household welfare objective function that incorporates all productive and consumption components within the household (Lipton, 1968). Risks and uncertainties in agricultural production are critical realities that farm households in developing countries explicitly incorporate in their production/consumption decisions. In following this behavior pattern, households must consider adequate consumption of food (produced and purchased) and consumer items (most obtained through purchase and trade), security which is especially related to long run survival, as well as social/cultural relations in the community at large, including social status, power, kinship ties, etc. (Shapiro and Arizano, 1983).

The main household activity among the farmers covered in the 1978-79 EORD survey is grain production for home consumption. Most families have only a limited surplus of grain production available for marketing. Receipts from the few other commercial activities they may be engaged in, are combined to purchase household needs and pay expenses. Livestock are kept on these farms for a variety of reasons, one of the most important of which is cash income. But they also provide meat,

milk (although little is consumed by most households), manure, and skins. The cash income earning potential of livestock is recognized by farmers in this semi-arid region as a valuable means of insurance against crop failure in any given year. When farmers in mixed farming areas of semi-arid Africa are asked why they sell their animals, many of them say they do so to meet immediate cash needs. In several research studies of African mixed farming systems (De Boer et al., 1983; Eddy, 1979; Gefu, 1982; Herman, 1983; Hill, 1970; Holtzman, 1982; Josserand and Ariza-Nino, 1982; Okaiyeto, 1980; Vengroff, 1980; etc.) these cash needs are said to be primarily food purchases with clothes, tax payments, etc. often being mentioned as secondary. In two Upper Volta marketing studies, 69 percent and 73.5 percent of the responding farmers said they sold an animal (large or small ruminant) to buy grain for home consumption (Herman, 1981; CID, 1980 and Vengroff, 1980). A SEDES study of small ruminants in north and central Upper Volta reported that 33 percent of sheep sales receipts went to buy food while 54 percent of goat sales receipts were spend on food purchases (Dumas et al., 1974). An ILCA study (1980) observed that farmers in the humid mixed farming zone of West Africa tended to market their small ruminants in response to events external to the economics of herd management. We have already seen how important revenue from livestock sales is to EORD farm households in having

enough funds available to buy foodgrain. Livestock (primarily cattle, sheep and goats) are thus a source of income and a form of investment, savings, and security against difficult times. Cattle in particular hold some social/cultural values (prestige, aesthetic significance, etc.) (Eddy, 1979; Gefu, 1982; Herman, 1983; Holtzman, 1982; Shapiro and Ariza-Nino, 1983; Wilson, 1982). Farmers' attitudes (in the EORD) toward investment and savings were examined by Tapsoba (1981). His analysis shows that the percentage of those who would buy cattle increases as the amount of money at their disposal increases--partially as a function of cattle being a large, indivisible acquisition. But what is more important is that significantly more farmers, with increasing sums of money on hand, expressed a hypothetical desire to purchase animals than any other form of investment or savings alternatives such as banks and other formal savings institutions, trading or putting it into production factors.

On mixed farms, there exists the potential for some important mutually beneficial interactions between livestock raising and other household enterprises --especially organic fertilizer from manure, draft animal power, and crop residue as animal feed. Farmers in the EORD do use animal manure, demonstrated by the fact that anywhere from 35 to 100 percent of farmers' maize fields in 1978-79 were fertilized with animal manure and compound wastes. Animals were at times, corralled on various fields

or some manure was transferred to fields. This input to crop production was not directly measured in this study but its application was common and important in light of the rather limited use of chemical fertilizer. The utilization of animal power in the EORD is documented by Lassiter (1982) who found its use to be disappointing in 1978 compared to its potential benefit. Higher productivity and cultivated acreage per worker among ANTRAC farmers compared to hoe farmers did not lead to higher per capita income. There is some feeding of crop residue to animals but not on a consistent, uniform basis. ANTRAC farmers, as one might expect, do give their animals (particularly their ANTRAC animals) some supplemental feed--moreso during the dry season. Thus, it appears the physical linkages between livestock production and other farming activities in the EORD are there but not as strong at this time as they might be.

Apparently only a few ruminants in the EORD survey were slaughtered for home consumption while milk was not consumed to any great extent, except among children (in part because so few hoe households owned cattle). Only 2 cattle, 23 sheep and 68 goats were recorded as being slaughtered for home use within the sample of 477 farm households. None of these cattle were slaughtered for sacrificial purposes while 15 sheep and 48 goats were. Undoubtedly, all animals slaughtered at home, whether for sacrifice or not were consumed.³

4. Economic Model and Model Formulation

4.1 Household Marketing Decision Making

In this section, the decision on the part of farmers to market livestock is examined. This is followed by a brief look at a few other studies that have attempted to empirically analyze farm level sales in West Africa.

4.1.1 The Decision Process

Many efforts have been made to understand and model small farmer behavior (Hardaker, 1979). This is a difficult undertaking but the ultimate objective should not necessarily be the perfect representation of the farmer decision making process from a behavioral standpoint since it would be without prescriptive content (Ibid). But developing a framework to understand the context in which farmers make decisions is a relevant objective. Translating such a conceptual framework into a quantitative model permits the measurement of the influence of alternative actions or environmental changes on the process being studied (De Silva, 1981). Since livestock production in the EORD is basically a secondary household activity to crop production and animals serve a multitude of purposes, these households make production/marketing decisions under circumstances different from pastoralists who specialize in livestock production. Concerning livestock marketing, a household in a mixed farming system must evaluate the entire household welfare function (often involving a combination of several

activities) before making a decision to sell or not sell an animal. That is to say, factors external to the livestock enterprise are constantly incorporated into the livestock management decision process and can have a significant impact on marketing decisions of all enterprises.

Looking at the situation from an enterprise standpoint, a household at any given time, can choose to sell/dispose of an animal or keep it until later.⁴ The basic decision involves evaluating the expected gains or losses from keeping the animal against the expected costs of keeping it. The expected gains include (1) an increase in the animal's value as a result of weight gain and (2) a flow of benefits both economic and social. On the cost side, there are costs associated with herding, feeding, watering, health maintenance, crop damage and the risk of loss or reduction in value (due to death, theft, sickness, etc.). Opportunities to sell are sometimes limited at certain times or in certain locations. A seller has to consider the costs and benefits of not taking advantage of an opportunity to sell when, for example, a buyer passes through the area. In addition, the financial gain forgone by not selling in a given period and investing the funds elsewhere (as in another animal, other assets or a bank) are also a cost of delaying a sale.

A farmer may also include subjective factors in his

evaluation. He may not like the behavior or performance of an animal or group of animals. Members of a household may not "want" to have the animal(s) around due to social, cultural, or personal preferences. Sometimes having animals to care for can be an inconvenience and a source of social friction as when a farmer's animals damage a neighbor's crops. This (crop damage by livestock) is cited as a continuing problem in Upper Volta (Herman, 1983; CID, 1980; Vengroff, 1980). All these factors a household might include as costs of raising an animal.

The sale decision rule (in net present value terms) can be summarized as:

Sell if: Expected Costs > Expected Gains

This rule represents a household's evaluation of the following factors when the analysis is restricted to a one period analysis⁵:

$$rPW + C - \frac{P(\partial W / \partial \theta)}{\theta} + B$$

where:

r	= interest rate or, more generally, the rate of return available from an alternative investment
P	= the price of meat or price/kilo/liveweight
W	= weight of animal
C	= costs of keeping the animal one more period
$\partial W / \partial \theta$	= weight gained by the animal in one period
θ	= age at sale
B	= flow of benefits derived from a live animal

This formula contains the three main types of costs

involved in keeping an animal one more period, represented by the two terms on the left hand side (LHS), while the two main types of benefits are on the right (RHS). The first term on the left, rPW , indicates a cost of not selling which is the return forgone by not investing sale receipts (PW) somewhere else. All the various costs of keeping an animal such as those mentioned above are embodied in the C term. In a mixed farming system, the opportunity cost of labor must be considered as Delgado pointed out in his Tenkodogo study. But in the EORD this cost was not found to be as high as Delgado implied it would be. This is primarily because of economies of scale in herding not fully accounted for by Delgado as well as the young age of those who tend a household's herd (their labor has a low agricultural opportunity cost). The first term on the RHS represents gain in the value of an animal derived from weight gain ($\partial W / \partial \theta$) times price (P), where price and weight are based on equivalent terms. The multifaceted flow of benefits associated with an animal are captured in the B term.

In departing from the above enterprise model, what is of interest in this study is the extent to which certain household characteristics and current circumstances (factors outside the livestock enterprise) help explain a household's decision to sell or not sell at any given time within a year. The cash income derived from animal sales is one of the most important reasons why

farm households in eastern Upper Volta raise cattle, sheep and goats. That is to say, in a household's sales decision process, they incorporate another factor, N , representing a household's immediate need for the animal. This need could be social (e.g. gift, festive consumption, etc.) or economic (cash or meat usually). In the context of a mixed farming system, this need might be fulfilled from other sources. As such, the household must evaluate whether these other sources have a higher or lower opportunity cost compared to livestock. If livestock are the relatively cheapest way of fulfilling this need, this factor (N) would enter the above equation on the left. Additionally, not satisfying this need is a cost to the household. Now the household would evaluate:

$$C + rPW + N \begin{matrix} > \\ - \\ < \end{matrix} P(\partial W / \partial \theta) + B$$

The sales decision rule becomes:

Sell if: Expected Costs + Needs > Expected Gains

Most of the time $N = 0$ but when it is positive, it tilts the balance of the equation in the direction of a sale. This decision rule has been cast in the framework of the decision to sell each animal a household owns. But the various needs of a household are not usually identifiable with any one particular animal unless it is a special social/cultural/religious need such as the preference for a ram during the Moslim Tabaski celebration. This study will focus on the economic (cash) needs of a household.

The decision to sell will also be framed as an evaluation of the relationship between household financial needs and the use of a household's livestock holdings to meet these needs--as discussed earlier.

The Upper Volta Village Livestock Project's livestock marketing study found that even though most farmers have a reasonably good understanding of the most profitable time to market their animals, they are often compelled to sell in response to circumstances within the household rather than when they would prefer to sell them (CID, 1980; Vengroff, 1980). Although these animals are a commodity (available for autoconsumption), their exchange value is apparently quite important. In one year (1978-79), only about 90 small ruminants in the EORD sample were slaughtered for home consumption compared to approximately 810 that were sold during the same period. The commercial value of livestock is evident in this behavior. As Schneider (1979) states, concerning African cattle owners, the managers of a good that takes on monetary characteristics "will conduct management strategies differently than if it were merely a commodity, if the return from managing it as a financial asset is greater than managing it for other, subsistence reasons".

4.1.2 Other Related Research

This author is aware of three other related studies that empirically examined livestock sales decisions at the farm level in West Africa. Herman (1983) analyzed

cattle sales of Voltaic herdsmen (all of whom were cattle owners). Using regression analysis, he estimated and tested for effects on price of several important characteristics specific to the animal sold and the circumstances of the sale. His price model for first-buyer cattle sales included such variables as animal age, sex, region, seller's ethnicity, season, seller's claim to market information, buyer and type of market. He concluded that there is little evidence to support the claim that herdsmen face a bargaining disadvantage in selling their cattle. Herman's sample differed somewhat from the EORD sample in that he included only cattle owners who were close to one of three Voltaic markets. The data were collected between April 1976 and March 1977, two years before the EORD survey was conducted.

Shapiro and Ariza-Nino (1983) modelled optimum ages for cattle sales in an extensive (pastoral) livestock production system under sahelian conditions in West Africa. Based on a capital theory model of herders' decisions concerning the age at which to sell animals, they were able to closely simulate the sales behavior of sahelian pastoralists. One conclusion they drew was that the age of sale is not likely to be altered by economic variables.

The work done by Okaiyeto (1980) in Kaduna State, Nigeria involved settled Fulani. This study, conducted between September 1977 and December 1978, also included only cattleowners. Okaiyeto used analysis of correlation

coefficients, and regression analysis to assess the nature of the relationship between certain household characteristics and economic activities of these crop producing Fulani. Principal factor analysis was used to group both the reasons given for cattle sales and the distribution of sales revenue which were disbursed into factors that could help explain the variation in the decision to sell. He found that the age of an animal accounted for most (70.4 percent) of the total variation in the reasons given for selling an animal. Expenditures on clothing was reported as explaining the greatest part (50.3 percent) of the total variation of the reasons given on how income from cattle sales was disbursed. Interestingly, the use of sales revenue for food purchases was rated third behind social/cultural obligations. Relatively greater expenditures on consumer goods rather than food may be an indication that the people in Okaiyeto's sample were a wealthy subpopulation.⁶ Okaiyeto's study corresponds closely with the objectives of this dissertation in that he related household characteristics and circumstances at the time of sale to the decision to market an animal. The households he studied were also in a farming community, in a similar semi-arid climatic zone. However, he was examining a somewhat different type of seller (a wealthier class and all were cattle owners), in another country, which placed them in a different social/cultural and economic setting.

4.2. Model Variables

It is important to point out that certain information about market transactions during the EORD survey were not collected. Most important, those surveyed were not asked why they sold an animal or what they intended to do with sales receipts.

The sales model developed here is primarily an analysis of the relationship between the flow of funds into a household (as from animal sales) and both the outflow of funds (expenditures) within a given period of time, and a set of household characteristics. As we saw earlier, it is quite clear that not every family sold an animal during 1978-79. Those who did, typically sold only a small portion of their animal stock. It should be emphasized that not selling is as much a marketing decision as is selling. Thus, including the population of all potential sellers in a market analysis as opposed to just those who did sell is a major aspect of the empirical model estimation in this study. Retaining this often discarded information will provide additional insight into the household animal marketing process. More will be said about this later but one added insight is the extent of farmer market participation which can be measured by using information from non-sellers.

In this analysis, the sale of healthy ruminants is modeled to be a function of particular household characteristics as well as certain circumstances surrounding a

household at the time of sale.⁷ Two basic models are developed, one for small ruminants, another for cattle. Again, we are more interested in the analysis of small ruminant sales; primarily because the production and marketing of these smaller animals corresponds closer to the short run framework of the household model developed earlier. Small ruminant holdings are more divisible, fewer resources are invested in them while the market for them has been shown to be more readily available in terms of time, place and buyers. Cattle, on the other hand, are more a store of wealth and their production cycle is much longer than that of small ruminants while they also require more labor/management inputs. Thus, small ruminant holdings are more conveniently liquidated (relative to cattle) to meet immediate cash needs. Households in this analysis are stratified according to their use of agricultural productive technology--hoe verses animal traction. Important differences between these two groups have already been shown in their ownership and marketing patterns of cattle and small ruminants. Most notably, only a third of the hoe farmers in the EORD subsample owned cattle (compared to about three-quarters of the ANTRAC subsample).

Monies at the disposal of any household are fungible. But estimating the association between the financial needs and expenditures of a household and the sale of animals should give some indication of the degree of direct association between these needs and animal sales

as postulated earlier. Given that EORD households are basically semisubsistence households, it is assumed that limited amounts of cash are kept on hand from period to period. Therefore, the probability and quantity of ruminant sales is hypothesized to be a function of the household circumstances and characteristics presented below.H8H

4.2.1 Small Ruminant Sales Model

(1) Deflated price of small ruminants. This variable reflects the current expected market value of an animal, relative to that of foodgrain. Small ruminant prices are average monthly, regional prices which would represent the prices prevailing in each of the three livestock production zones during a particular period of observation.H9H These prices are deflated by an average EORD grain priceH10H to reflect the exchange value of an animal in relationship to one of the most important consumer items, foodgrain.

(2) The (weighted) ratio of cattle holdings to small ruminants holdings. The weights are Tropical Livestock Units to reflect the relative size and significance of each animal type.H11H This ratio could also give some indication of the degree of specialization in livestock raising. For those families with no cattle, this ratio would be zero (since cattle is the numerator). This variable also differs more between households than over time since household herd compositions did not vary much during the survey year. Of two households with the same

number of cattle, the one with more sheep and goats would have the lowest ratio. If two households own the same number of small ruminants, the family with the fewest cattle would have the smallest cattle:small ruminants ratio.

(3) Purchases of food grain, most of which would be millet and sorghum. Expenditures on grain is deflated by an average EORD grain price so that the variable is a rough estimate of the quantity of grain purchased. The exchange of livestock for grain was discussed earlier when the household-firm model was reviewed. Thus, these expenditures are expected to be significantly (and positively) correlated with small ruminant sales. Most of these households are semisubsistence grain producers who often do not produce enough to satisfy their needs for a whole year and who have limited excess grain storage capabilities. As household grain reserves diminish, the sale of an animal offers one of the few options most families have to acquire funds to purchase food.

(4) Expenditures on livestock production such as for feed, medicine, salt and herding labor expenses. These livestock enterprise costs are small and would be easily met with receipts from the sale of a sheep or goat. A positive sign would be expected for this variable.

(5) Expenditures on crop production such as for seed, fertilizer, hired labor, equipment and tools. Expenses for agricultural inputs were actually minimal, during

1978-79, especially for chemical inputs. A weak association is anticipated for this variable.

(6) Income from nonagricultural activities. Other sources of household income are expected to offer a household other cash income options with which to meet financial needs, thus reducing the need to sell a small ruminant. Therefore, a negative relationship may exist between this variable and sales.

(7) Different seasons which are defined and/or determined by crop production and weather cycles. There are three identifiable seasons concerning household small ruminant marketing: (1) periods 2 - 5 (June-September) which is the cultivation period when the need for food is great but grain reserves and crop revenue are usually lowest. Crop production inputs plus labor are likely to be purchased during this time. This is also the wet season when some farmers maintain that sheep and goats are in their worst condition since these animals are often tethered to keep them from damaging crops (therefore they tend not to eat well); (2) periods 6 - 9 (late September through December) which is the harvest season and beginning of the dry season; and (3) the remainder of the year (dry season) when some farmers feel these animals are in their best condition because they can roam freely to eat. During this time of the year, the demand for small ruminants for the celebration of social/religious events (e.g. Tabaski) and for export is highest.¹²

(8) The regional location of the household. There are

three basic agroclimatic zones in the EORD that are pertinent to livestock production/marketing. The northern zone has less than 600mm of annual precipitation with a probability of 90 percent. In the central portion of the EORD, there is more than 600mm but less than 800mm of precipitation (P=90%). In the south, there is more than 800mm of precipitation (P=90%).

(9) Whether or not a household is a hoe or animal traction household. The hoe and animal traction subsamples represent two classes of farm households.

(10) Ethnicity of the household. The majority of the people in the survey are Gourmantche but there can be important differences between them and the few Fulani in the sample. The VLP study and Herman both report different marketing behavior on the part of the Fulani compared to other ethnic groups.

(11) Number of youths in a household. Larger (in terms of members) households have a bigger labor pool from which to draw upon for all household enterprises. Children under the age of 14 supply most of the labor for livestock raising. Therefore the more children in a household, the less likely the family will encounter labor bottlenecks which might force the household to sell an animal. Additionally, if there is a labor constraint, small stock are much more likely to be disposed of than cattle.

4.2.2 Cattle Sales Model

Many of the same variables in the small ruminants model would be included. Only where there are substantial differences will there be much discussion below of the variable.¹³

(1) Deflated price of cattle. As with small ruminants, the average price of cattle would represent the approximate current market value of cattle. This average price is deflated by the average price of grain. Price is expected to be a major determinant of sales. One main reason perhaps, why farmers sell many cattle around period 8 (November) is they can obtain some of the best prices of the year as well as maximize the exchange value of cattle for grain during a time when their grain purchasing power is the greatest of the year. Sales also are low during periods 11 and 12 (February and March) when prices are low due to the poor condition of cattle and the exchange value of livestock for grain is also the lowest of the year. Vengroff (1980) also found this sales pattern to be true in the VLP's market study. Since cattle can provide large sums of money when sold, farmers may be more sensitive to price than with their small ruminants.

(2) The weighted ratio of small ruminant to cattle holdings. As in the small ruminant model, the weights are TLUs.

(3) Purchases of foodgrain.

- (4) Expenditures on livestock production.
- (5) Income from nonagricultural activities. Many households who own and market cattle are involved in several other market oriented activities. Thus, cattle trading may be positively related to this variable.
- (6) Purchases of other cattle. As mentioned in the discussion of sales decision making, a household may sell cattle to acquire other, usually younger, animals as a form of continued investment when the rate of return to some of their present cattle begins to level off or decline. Most farmers who purchased cattle did say wanted to build up their herd.
- (7) Different seasons. Cattle production and marketing is highly influenced by weather cycles which determine the availability of fodder--in turn, affecting their condition and their management. In this respect, the seasonal pattern dictated by the wet and dry climatic seasons are considered relevant seasonal distinctions.
- (8) Traditional or ANTRAC household.
- (9) Ethnicity of the household.
- (10) Household size. Larger families are expected to have a need for larger sums of money than smaller families. It is also true that they are likely to own more cattle.

Two-sided tests of statistical significance will be used in judging the significance of model variables. The critical alpha level of all variables will be 10 percent.

5. Analytical Model

5.1 Nature of the Analytical Problem

The research problem identified above is to examine ruminant sales behavior of EORD crop/livestock farmers. There are two interesting facets of this marketing phenomenon. These suppliers consist of producers who are current, active suppliers over a particular period and those who exhibit their own market behavior by not putting their animals on the market. There is the possibility that some factors may have a proportionately greater effect on the probability of a household selling an animal (entry/exit into the market) than on the quantity of animals sold by a household. Observations over time on changes in total supply from these suppliers would reflect both of these adjustments. On the other hand, cross-sectional data that includes those who participate and those who do not participate in the market offers the opportunity to estimate both quantity adjustments of household suppliers who actively sell animals and quantity adjustments due to behavior of entry/exit of households into the market. To the extent to which cross-sectional data represents a portion of the population at large, this latter behavior may be termed the market participation rate (Thraen, Hammond, and Buxton, 1976).

This study employs cross-sectional data to gain insight into the livestock sales behavior of crop/livestock farmers. It may be important in policy formulation

to be able to distinguish between, among other things, the elasticity of farm supply with respect to price and the elasticity of the proportion of farm suppliers with respect to price. Or put another way, do increases in price (or changes in other factors) have a greater influence on the number of animals sold by those who generally sell or on the probability of these and others entering/exiting the market place? Additionally, the reasons for not selling may be due to several reasons such as a response to market prices, no pressing need to sell an animal in order to buy foodgrain in the current period or an animal may not be mature enough to market at that particular time of the year. Rather than eliminate those household observations when no sale occurred, the Tobit model can incorporate this information to more fully explain the range of household behavior.

5.2 Choice of and Statistical Formulation of The Tobit Model

An analysis based only on households who sold animals would, as was said, discard a substantial amount of information. For example, in the subsample of traditional EORD farmers surveyed in 1978-79, less than 15 percent of them sold a small ruminant in any given month during the year. Including those who did not sell enables one to decompose market activity. The Tobit model has proven to be a useful tool in providing estimates of this type of market activity (Capps, 1983; Schmid and White, 1984; Thraen et al., 1978).

The model, developed by James Tobin, is a combination of probit and multivariate regression analysis. Tobin applied his statistical method to cross-sectional demand data and demonstrated how it is possible to derive the expected probability that a household would purchase a particular dairy product and the expected amount of consumption of that product. The Tobit model is outlined in Table 4.1 below.

TABLE 4.1

Description of the Tobit Model

$$(1) \quad \begin{aligned} Y &= \beta X' + \varepsilon & \text{if } \beta X' + \varepsilon > 0 \\ Y &= 0 & \text{if } \beta X' + \varepsilon \leq 0 \end{aligned}$$

$$(2) \quad E[Y] = \beta X F(z) + \sigma f(z)/F(z)$$

$$(3) \quad E[Y^*] = \beta X + \sigma f(z)/F(z)$$

$$(4) \quad \partial E[Y]/\partial X = F(z) (\partial E[Y^*]/\partial X) + E[Y^*] (\partial F(z)/\partial X)$$

$$(5) \quad \partial E[Y^*]/\partial X = \beta (1 - zf(z)/F(z) - f(z)^2/F(z)^2)$$

$$(6) \quad \partial F(z)/\partial X = f(z) \cdot \beta/\theta$$

where:

- Y = dependent variable, e.g. household sales
- $E[Y]$ = unconditional expected value of sales, which reflects behavior of all households
- $E[Y^*]$ = conditional expected value of sales for those who do sell
- X' = vector of independent variables
- β = vector of unknown coefficients
- ε = vector of independent, normally distributed random variables with 0 mean and constant variance, σ^2
- z = $\beta X/\theta$
- $f(z)$ = the standard normal density function
- $F(z)$ = the cumulative standard normal density function

Source: McDonald & Moffitt (1980)

Equation (1) defines the limited dependent variable, sales, as containing a number of observations clustered at the limit, zero (in this case), and all other observations ranging above the limit.¹⁴ Equation (2) defines the unconditional expected value, $E[Y]$, which accounts for the behavior of all economic units (farm households in this case). For only households that sell, the conditional expected value of sales, $E[Y^*]$, is defined in equation (3). The expected value will always be greater than or equal to the unconditional expected value. This relationship is apparent by writing the equivalent of equation (3) as $E[Y^*] = E[Y]/F(z)$ (McDonald and Moffitt, 1980).

A decomposition of the change in $E[Y]$ (for all households) with respect to any regressor is obtained in equation (4). The right hand side of equation (4) represents the change in $E[Y]$ for those households above the limit, plus the change in the probability of being above the limit (i.e. probability of selling), weighted by $E[Y^*]$. The elasticity of the probability of selling, $\eta F(z)$, and the elasticity of the conditional expected value of selling, $\eta E[Y^*]$, sum to equal the elasticity of unconditional expected value of selling, $\eta[Y]$.

It is important to observe that market behavior factors can be derived from Tobit model results (McDonald and Moffitt, 1980). If one were interested in the response of a dependent variable, Y , to a particular varia-

ble, X , then the elasticity of the dependent variable with respect to this explanatory variable can be stated as:

$$E_{PX}^O = E_{PX} + E_{PrX}$$

where E_{PX}^O = total elasticity with respect to X
 E_{PX} = quantity elasticity of participants with respect to X
 E_{PrX} = elasticity of the proportion of house holds in the market with respect to X

(Source: Thraen et al. ,1976)

Note from the Tobit model above that it is possible to decompose the change in $E[Y]$ with respect to any X . In equation (4) the first term on the right hand side gives the change in $E[Y]$ for those (market participants) above the limit (zero sales), weighted by the probability of selling. The second term gives the change in probability of being above the limit weighted by $E[Y^*]$. If "P" were price, then multiplying each term in equation (4) by the ratio $P/E[Y]$, yields the total price elasticity of the expected value decomposed into two components:

$$\eta_E[Y] = \eta_E[Y^*] + \eta_F(z)$$

The magnitude of these components of total price elasticity indicates the relative changes in probability or quantity adjustments due to a change in price which was mentioned earlier as a potentially useful distinction (Hagemann, 1981).

Cragg (1971) developed another model which is a generalization of the Tobit model in the sense that it is

a more general model which includes the Tobit model as a testable special case.¹⁵ This model utilizes the attribute of the Tobit model in which a single set of parameters determines both the probability that $Y = 0$ and the distribution of Y given that Y is positive. In some cases, the Tobit model cannot accurately represent the observations. Such a situation arises when most observations are zero but the most frequent range of positive observations is not around zero. Cragg's model offers a possible solution by having one set of parameters determine the probability that $Y = 0$, and another set to determine the density of Y , given that Y is greater than zero.

Other procedures for dealing with censored samples have been offered by Heckman (1976,1979) and Amemiya (1973) as pointed out in Cragg (1983). Heckman of example, suggests a two-step procedure to overcome the limitations of using OLS and allowing for the differences between censored and truncated samples (we have a censored sample in this study which will be explained a little later).¹⁶ These approaches were not adopted in this analysis of farm level livestock sales primarily because of the extra difficulty and computational expense involved in using these alternatives.

In this study we have a situation where any given household either sold or did not sell an animal during a certain survey period (approximately one month in this instance). At the same time, when they did sell, they

may have sold one or more animals. The dependent variable of interest, sales, is thus a limited dependent variable where many observations take on the value of zero. The decision to sell or not is a matter of qualitative choice. Employing a qualitative response model enables one to assess the probability (or likelihood) that a decision-maker, with a given set of attributes, makes one choice rather than the alternative (Capps, 1983).

The problem can be formulated as a regression model:

$$Y = \beta X' + \varepsilon$$

Y is sales, β is a vector of unknown coefficients corresponding to a vector of explanatory variables, X' , while ε is the error term. Since there are observations (X') on those households where $Y = 0$, and we never observe negative sales, we have a censored sample distribution of Y 's.¹⁶

Ordinary least squares (OLS) is not an appropriate estimator of this model (Capps, 1983; Schmid and White, 1984). It can be shown that with OLS, $E(\varepsilon) \neq 0$ which results in biased and inconsistent estimates of β . Note that in the above regression equation, Y would take on the value of 1 or 0 depending upon whether there was or was not a sale. The problem of heteroscedasticity (where all the disturbances do not have the same variance, leading to a loss of estimator efficiency) arises because the variance of the error term varies directly with the values of X' . When $y = 1$, $\varepsilon = Y - \beta X'$ and when $Y = 0$,

$\varepsilon = -\beta X'$. Consequently, the variance of $E(\varepsilon^2)$ varies with the expected value of Y . This implies that $E(\varepsilon^2) = E(Y)[1 - E(Y)]$ (Goldberger, 1964).

The Tobit model is considered appropriate for estimating censored data (Capps, 1983; Schmid and White, 1984). The model can be represented as follows:

$$\begin{aligned} Y &= \beta X' + \varepsilon & \text{if } + \varepsilon > 0 \\ Y &= 0 & \text{if } + \varepsilon \leq 0 \end{aligned}$$

where $i = 1, 2, \dots, N$
 N = total number of observation
 Y = dependent variable--number of animals sold
 X' = vector of independent variables
 β = vector of unknown coefficients
 ε = an independent normally distributed error term with zero mean and constant variance σ^2 .

This model assumes that the quantity sold can be formulated as an index "I" which is a linear function of the explanatory variables X_1 to X_N :

$$\begin{aligned} I_i &= \beta X_1 + \beta X_2 + \dots + \beta X_N \\ \text{for } i &= 1, 2, \dots, N \end{aligned}$$

This allows the original dependent variable to be redefined with a lower limit of zero (representing a critical threshold):

$$\begin{aligned} Y &= I & \text{if } I \geq 0 \\ Y &= 0 & \text{if } I < 0 \end{aligned}$$

But household behavior is not uniform. It must be assumed that the differences in their behavior can be captured by a random variable ε with 0 mean and σ standard deviation. Now sales behavior can be assumed to be:

$$\begin{aligned} Y &= I - \varepsilon & \text{if } I - \varepsilon \geq 0 \\ Y &= 0 & \text{if } I - \varepsilon < 0 \end{aligned}$$

For some households, their index is assumed to fall short

of $\varepsilon(I < \varepsilon)$ while there will also be a distribution of sales for those whose critical value exceeds ε . The probability that a household does or does not sell is represented as:

$$\text{Prob}[Y > 0 | I] = \text{Prob}[I > \varepsilon | I] = F(1/\sigma)$$

$$\text{Prob}[Y < 0 | I] = \text{Prob}[I < \varepsilon | I] = 1 - F(1/\sigma)$$

where $F(z)$ = value of the standard normal cumulative distribution at z .

Maximum likelihood estimation of the Tobit model β 's is the preferred approach (Schmid and White, 1984). The likelihood function of a given sample could be considered as being generated from T observations so ordered that the first S observations are positive ($Y > 0$) and the remaining $T-S$ observations are zero ($Y = 0$). Then the likelihood function becomes:

$$L = \prod_{i=1}^S \frac{1}{\sqrt{2\pi}\sigma} \exp[-1/2\pi\sigma^2(Y - \beta X')^2] \cdot \prod_{i=S+1}^T [1 - F(\beta X'/\sigma)]$$

F is the standard normal cumulative density function. This likelihood function is often transformed into logarithms. By setting the derivatives of this transformed function with respect to the β 's = 0, the result is normal equations that determine the maximum likelihood estimates of the β 's. These equations are non-linear. The problem for the model estimator is to estimate in an iterative fashion (repeated attempts at maximization), the values of the unknown coefficients and σ that maximizes the probability of observing the behavior in the sample.

FOOTNOTES TO CHAPTER IV

¹ Subjective equilibrium is defined as maximization of utility subject to an income constraint.

² Such as data limitations--this study does not have data on the other household components, and because of the complexity of mixed farming systems.

³ The meat of an animal that was sacrificed was most likely consumed by more than just one household.

⁴ The following discussion follows closely Shapiro and Ariza-Nino (1983).

⁵ The decision rule can be derived from a model developed by Ariza-Nino cited in Shapiro and Ariza-Nino (1983), page 6. This model computes the factors for this formula in present values.

⁶ Schillhorn van Veen, personal communication, 1983.

⁷ Marketing of unhealthy animals is not included since the decision to sell them is basically one of forestalling complete loss of the animals' monetary value.

⁸ These factors are those for which there are sufficient, accurate data. Tax payments (livestock or otherwise) for example were not recorded.

⁹ Average prices are derived from the EORD survey. The three livestock production zones are basically a north, central, and southern breakdown which are explained in Table 5.1. It must be recognized that these prices are only a rough approximation due in part to the fact that small ruminants are not a homogenous commodity and there were only a limited number of price observations during the survey.

¹⁰ The grain prices, computed by Ouedraogo (1983), are an average of prices recieved and paid for grain during the month in question--mainly sorghum and millet--for the whole EORD.

¹¹ The TLU for cattle is 0.7 and for small ruminants, 0.1.

¹² The date for Tabaski and all Moslim holidays are not fixed to our calender but to a Moslim calender. The Moslim calender follows a uncorrected lunar cycle which

shifts approximately eleven days each year relative to the solar calendar. Therefore, these holidays are held on different days of the year over a thirty-three year period (Herman, 1983). During the EORD survey, Ramadan was held on August 5, 1978, Tabaski was celebrated in November and the Prophet's Birthday in February.

¹³ Two notable differences in the models is the restriction of the cattle model to the subsample of households in the 5 ANTRAC zones. Since so few cattle sales took place among traditional farm households, there was insufficient price variation outside the 5 ANTRAC zones.

¹⁴ This discussion follows closely Capps (1983) and Hagemann (1981).

¹⁵ This paragraph relies heavily on the material in Schmid and White (1984).

¹⁶ Capps (1983) defines a censored sample as one where the value of the dependent variable corresponding to some observable values of independent variables is itself unobservable. Truncated refers to samples in which independent variables corresponding to unobservable dependent variables are also not observed. The basic aspect of these types of samples is that they are observable over only part of their range. If, for example, we were attempting to observe the distribution of bullets shot at a target (more precisely, how accurate the shots were) some bullets may hit the target while others will not. We may not be able to observe how far some shot missed the target (e.g. those shots that missed the target completely). A sample of bullet holes in the target would be a truncated sample--the only information it contains is the sample of values in the observable range. On the other hand, if we knew how many shots missed the target (but not by how much), such a sample would be called censored. A censored sampled sample clearly contains more information than a truncated sample (Kendall and Stuart, 1973 cited in Schmidt and White, 1984).

CHAPTER V

ANALYSIS AND RESULTS

1. Introduction

This chapter presents the analytical results of the small ruminant and cattle sales model. The main objective was to investigate the nature of the relationship between sales and certain household characteristics and circumstances which would help explain the marketing behavior of EORD farm households. Another objective was to incorporate information on all livestock owners who did or did not sell an animal in each survey period in order to gain a greater insight into marketing behavior. Given that only a small fraction of potential sellers entered the market each period, the analysis of all livestock owners yielded a substantial number of zero observations of the dependent variable, sales, as well as some explanatory variables. Tobit analysis was used to test these models since it performs better than OLS for this type of analytical problem (as discussed in the previous chapter).

2. Small Ruminant Sales Model

2.1 Data and Empirical Formulation

Based on the earlier discussion of household sales behavior and the Tobit statistical model, a model for

empirical analysis was developed.¹ The cross-sectional analysis of small ruminant sales between May 1978 and April 1979 involved the use of periodic observations (covering 13 survey periods) from a random sample of 274 hoe and 96 ANTRAC households. This yielded 4271 periodic observations.² An observation for each explanatory variable had to be included for every period, whether sales was positive or zero.³ Mathematically, the empirical model of small ruminant sales was:

$$\begin{aligned} \text{SALES}_{it} = & b_{it} + b_{it}\text{DPRICE} + b_{it}\text{CSR} + b_{it}\text{GRAIN} + \\ & b_{it}\text{ANEXP} + b_{it}\text{CROPEXP} + b_{it}\text{NONAGR} + \\ & b_{it}\text{YOUTHS} + b_{it}\text{TECH} + b_{it}\text{ETHNIC} + b_{it}\text{SEA1} + \\ & b_{it}\text{SEA2} + b_{it}\text{NORTH} + b_{it}\text{CENTRL} + \varepsilon \end{aligned}$$

where: $i = 1, 2, \dots, N$ (households)
 $t = 1, 2, \dots, 13$ (period)

Various model forms and variable combinations were tried before the author arrived at this final model structure.⁴ This model is considered the best theoretical and statistical model for addressing the research problem under the circumstances in which this research was done.

Table 5.1 provides a brief explanation of the model variables which were outlined in greater depth in Chapter IV. The dependent variable, SALES is the number of animals sold by household "i" in period "t". DPRICE, ANEXP, CROPEXP and NONAGR are expressed in monetary terms. The first variable, DPRICE is an average of prices received each period for all small ruminants in the three climatic

TABLE 5.1

Variable Notation for Small Ruminant Sales Model^a

SALES	= number of small ruminants sold
DPRICE	= farm gate price in FCFA/average grain price ^b
CSR	= ratio of cattle to small ruminants, weighted by TLU ^c
GRAIN	= expenditure for food grain in FCFA/average grain price ^b
ANEXP	= expenditure for livestock production in FCFA
CROPEXP	= expenditure for crop production in FCFA
NONAGR	= net receipts from nonagricultural activities in FCFA
YOUTHS	= number of youths (0-14 yrs) in the household
TECH	= 1 if the household uses hoe technology
ETHNIC	= 1 if the household is Fulani
SEA1 ^d	= 1 if period=2-5: cultivation and wet season
SEA2 ^d	= 1 if period=6-9: harvest season and dry season
NORTH ^e	= 1 if in northern region: less than 600mm (P=90%) rainfall zone
CENTRL ^e	= 1 if in central region: >600mm but <800mm (P=90%) rainfall zone

^aThese represent observations for each household in any one of 13 survey periods.

^bAverage of grain prices paid and received (per kilogram) in the EORD (in FCFA).

^cTLU for cattle = 0.7 and 0.1 for small ruminants.

^dPeriod 2-5 is June through the third week in September. Period 6-9 is the last week in September through December. The periods not included represent the post harvest, dry season.

^eThe region not included is the southern region, >800mm (P=90%) rainfall zone.

zones pertinent to livestock production (see Chapter 2, Section 2 for a discussion of these zones). This average price was deflated to hold expenses incurred in raising animals, crop production expenditures and net receipts from commercial activities. CSR represents the weighted ratio of the number of cattle owned to the number of small ruminants owned (weighted by TLU units).⁶ GRAIN is the expenditure on foodgrain for home consumption deflated by the average of prices received and paid for grain during the EORD in the given period of observation. In effect, this variable is a rough approximation of the quantity of grain purchased. Variable YOUTHS is the number of children (0-14 years of age) in the household. The other independent variables, TECH, ETHNIC, SEA1, SEA2, NORTH and CENTRL are binary (0 or 1) dummy variables. If a household practices traditional farming methods (using hand-hoe technology), TECH takes on the value 1 for that household and is zero for those households using animal traction. If the members of a household are Fulani, ETHNIC would be 1 and 0 otherwise. Variablesold and is zero for those households using animal traction. If the members of a household are Fulani, ETHNIC would be 1 and 0 otherwise. Variables SEA1 and SEA2 are seasonal dummy variables which take on the value of 1 if a period falls within the season they represent or they take on the value of zero otherwise. Variables NORTH and CENTRL are regional dummy variables which are 1 when a given household resides in that region of the EORD and are zero otherwise. The remaining season and region are not included in the model

to avoid the problem of multicollinearity which would arise if they were included. These binary variables shift the intercept of the equation, reflecting their respective influence on sales.

2.2 Results and Summary Statistics

A full model was run with all variables included. But the variables NONAGR, CROPEXP, and YOUTHS were found to be quite insignificant in their correlation with small ruminant sales. A general linear test (F-test) indicated that if these three variables were excluded from a reduced model, they all were not statistically different from zero. But the full model showed that earnings from non-farm activities (NONAGR) had its anticipated negative impact on sales but not to a statistically significant degree. That cropping expenses (CROPEXP) did not appear to have much statistical association with sales may be explained by the fact that variable inputs to crop production (such as fertilizer) are minimal on EORD farms. Additionally, the model illustrated that the more young members in a household (YOUTHS), the less animals they marketed--presumably because the family had more people to tend to the animals. Having more youths perhaps reduces the possibility of labor bottlenecks (created by competition for labor between livestock and crop production), particularly during the cultivation period. But the statistical non-significance of the number of youths suggests this is not an important variable with regard to explaining sales patterns. Therefore, these three variables were dropped from

the model and the discussion below is of a reduced model (the full model is presented in Appendix D.

The reduced model was empirically estimated using OLS and the Tobit estimator, LIMDEP.⁷ The estimation results are presented in Tables 5.2 and 5.3. It is important to note that unlike in OLS statistical regression, the β coefficients in a Tobit analysis (see Table 5.2) cannot be directly interpreted as the derivative of $E(Y)$ with respect to an explanatory variable X which would tell how much (on average), Y will change if X changes (Schmidt and White, 1984). The sign of β does tell the direction of influence of the regressor on $E(Y)$. But the level of this influence is in fact smaller (in absolute value) than the coefficient β would indicate. The correct interpretation of a one unit change in an explanatory variable on the dependent variable is the associated β coefficient multiplied by the probability that the dependent variable is non-zero (Ibid). This probability varies over households but is approximately equal to the sample proportion of sales. The "t-ratios" produced by a Tobit analysis can be used to test the hypothesis that the associated coefficients are significantly different from zero.

A general comparison can be made between the OLS and Tobit analysis based on the information in Table 5.2. Adjusted (as outlined in the previous paragraph) Tobit regression coefficients are given in column 3. These

TABLE 5.2

OLS and Tobit Parameter Estimates of the
Small Ruminant Sales Model

OLS Analysis		Tobit Analysis	
Variable	Parameter Estimate (Standard Error)	Regression Coefficient	F(z) · B
DPRICE	-0.826* (0.473)	-9.82	-0.63
CSR	-0.001* (0.001)	-0.06	-0.004
GRAIN	0.428** (0.099)	3.00	0.19
ANEXP	0.074** (0.005)	0.15	0.009
TECH	0.076** (0.025)	1.27	0.08
SEA1	0.010 (0.025)	0.16	0.01
SEA2	-0.007 (0.023)	-0.32	-0.02
NORTH	0.103** (0.033)	1.77	0.11
CENTRL	0.083** (0.031)	1.78	0.12
CONSTANT	-0.008 (0.045)	-7.30	-0.47
R ² = 0.054 MSE = 0.379		(No R ² computed) MSE = 0.376	

Note: OLS analysis was done with SPSS and Tobit analysis with LIMDEP.

* Statistically significant at the 10% level.

** Statistically significant at the 1% level.

Table 5.3

Summary Statistics for Tobit Analysis of Small Ruminant Sales

Variable	Beta	Asymtotic t-ratio	$\frac{\partial F(z)}{\partial X}$	$\frac{\partial E[Y^*]}{\partial X}$	$F(z)$	$\frac{\partial F(z)}{\partial X}$	$E[Y^*]$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
DPRICE	-9.8200**	-2.25	-0.3359	-0.0951		-0.5363	
CSR	-0.0569*	-1.85	-0.0019	-0.0006		-0.0031	
GRAIN	3.0040**	3.64	0.1028	0.0291		0.1640	
ANEXP	0.1467**	4.22	0.0050	0.0014		0.0080	
TECH	1.2730**	4.23	0.0435	0.0123		0.0695	
SEA1	0.1580	0.60	0.0054	0.0015		0.0086	
SEA2	-0.3187	-1.20	-0.0109	-0.0031		-0.0174	
NORTH	1.7700**	4.41	0.0605	0.0171		0.0967	
CENTRL	1.7810**	4.57	0.0609	0.0173		0.0973	
CONSTANT	-7.2990	-13.80					

Note: The unconditional expected value of Y, at the sample mean X, is 0.1027. The conditional expected value of Y, at the sample mean X, is 1.5964. The standard error around the Tobit index is 3.6743. The predicted probability that $Y > 0$, at the sample mean X, is 0.0642. Column (1): Tobit coefficient. Column (2): Regressor asymptotic t-ratio. Column (3): Change in probability of a sale, given a change in each regressor. Column (4): Change in $E(Y)$ for those above the limit (zero sales) weighted by the probability of a sale. Column (5): Change in probability of being above the limit, weighted by $E(Y^*)$.

* Statistically significant at the 10% level.

** Statistically significant at the 1% level.

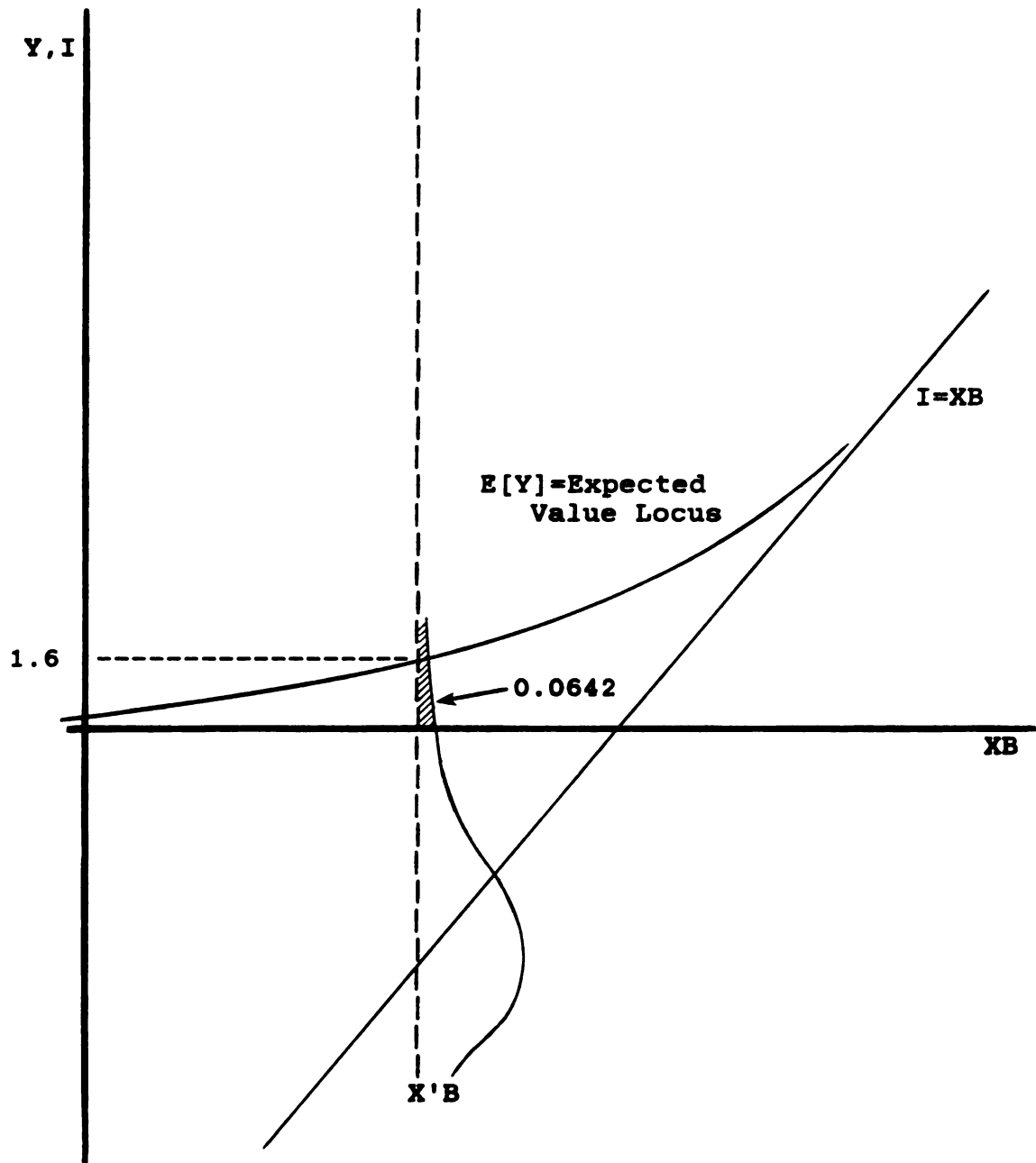


FIGURE 5.1

The Total Expected Value Locus of Small Ruminant Sales:
Shaded Area Shows $P(Y>0:X',B)$

coefficients are roughly the same magnitude of the OLS parameter estimates, except in a few cases. One generalization to be made is that in comparison to the Tobit analysis (column 3), OLS overstates the impact of DPRICE, GRAIN, and ANEXP on the dependent variable, sales. On the other hand, OLS underestimates the impact of all the other variables CSR, TECH, SEA1, SEA2, NORTH, CENTRL on sales. The coefficient of determination, R^2 for OLS is low, not unusual for discrete dependent variable models (Capps, 1983; Kennedy, 1980). But R^2 in Tobit analysis is not a good measure of goodness-of-fit without finding its upper limit (Capps, 1983).⁸ The computer package used to do the Tobit analysis did not compute an R^2 . The reported mean squared errors (MSE) of both techniques are quite similar. Given the problems in applying OLS to a censored data model and the associated advantages of Tobit analysis, the remainder of the discussion below will be limited to the results of the Tobit analysis.

Summary statistics of the Tobit analysis are contained in Table 5.3. All values are calculated at the sample means. Columns one and two contain the independent variable coefficients and their asymptotic t-ratios. Column three shows the change in probability of selling an animal associated with a change in each independent variable. Columns four and five show the two components of a total change in expected-Y, $E(Y)$, given a change in each explanatory variable. Figure 5.1 provides a graphical interpretation of the Tobit results. At the mean values of all

explanatory variables, approximately 1.6 small ruminants is expected to be sold in a given period (about a month) if a sale is made, with a predicted probability of 0.0642. These values are of course, close to the marketing levels within the EORD survey sample.

Examination of columns one and two in Table 5.3 suggest the model has done well at illustrating how household socioeconomic factors explain some of the variation in household small ruminant sales. The results are reasonable, with expected signs. All explanatory variables except the two seasonal dummies are statistically significant by surpassing the alpha level of 10 percent stated earlier as the critical level. The variables, price (deflated by grain prices), the ratio of cattle owned to small ruminants owned, grain purchases, livestock raising expenses, the type of farm category, as well as regional dummy variables have a significant influence on sales (all except the cattle:small ruminants ratio at the 1 percent level).

In the model, DPRICE (deflated price) was significant at the 1 percent level in its correlation with sales. Apparently many households sold small ruminants even though prices were seasonally low. Households must be considering other more important factors than price when they sell. One of these factors is likely to be pressing needs for cash as discussed earlier. Many households do find it necessary to sell a sheep or goat at the same time to meet similar social or financial obligations which has a depres-

sing effect on local prices. An exception to this would be when demand is also strong such as just before the Tabaski celebration. In addition, the model variable in question (DPRICE) reflects the relationship between small ruminant prices and the price of foodgrain. Small ruminant prices as a whole do not vary greatly from month to month. But grain prices do have a rather pronounced seasonal cycle. A fall in grain prices relative to somewhat stable small ruminant prices leads to a rise in DPRICE. Therefore, the pattern of sales being negatively related to DPRICE may indicate that households were reacting to changing grain prices that reflect the availability of grain. The seasonal movement in goat sales did seem to follow seasonal grain prices rather closely (see Appendix B for a graph).

As expected, grain purchases also had an important influence on sales. The significance of this variable (at the 1 percent level) is consistent with farmers' statements and other research findings that farm households often sell these animals to buy grain. This tradeoff between grain purchases and livestock sales was mentioned earlier as the interrelationship of most interest to this study of mixed farming systems. Foodgrain purchases were in fact shown to be one of the most significant variables in the model and to be more significant than (deflated) prices.

It is interesting that livestock expenses were somewhat more significant than the two variables mentioned above. Farmers must have financed many of their livestock enterprise costs with sheep and goat sales. Households

with cattle are likely to have more of these expenses.

Whether or not a household was using hoe or animal traction technology was one of the most statistically significant explanatory factors. The large coefficient for hoe households may be partially explained by them being a larger portion of the statistical sample as well as their higher overall sales level. An earlier examination of the sales pattern within each of the two subsamples did reveal differences in their commercial activities.

The model also shows there were higher sales during the crop cultivation period (SEA1), also known as the hungry season. This is not surprising since financial needs and stresses are often greatest at this time of the year. Sales during the harvest season (SEA2) were shown to be lower than the hungry season and late dry season. Food at this time is more plentiful and revenue from grain sales may reduce the need to sell. Also, sheep and goats are not allowed to roam freely during the harvest season in order to keep them out of fields. This restricts their diet so they may often be in better shape during the dry season. But there was little statistical association between small ruminant sales and the seasons of the year. This corresponds with other research findings which mention the limited seasonality to small ruminant sales when other factors are considered.

The region in which a household was located is also revealed to be highly associated with sales behavior.

There was not much difference in the level of sales between the north and central areas. But both were higher compared to the south which has fewer potential sellers and less environmental uncertainties (such as low rainfall--necessitating animal sales to make up for short falls in crop production).

The ratio of cattle to small ruminant ownership appeared to diminish the level and probability of household small ruminant sales (at the 10 percent level of significance). This variable was positive for only those households owning cattle (since the number of cattle owned is the numerator). Earlier in Chapter 3 we saw that households without cattle were more involved in marketing small ruminants--a fact this variable seems to bring out since it has a negative sign.⁹ One should note that this variable varied more between households rather than within households because family herd composition did not change very much during the survey year. Among those households with cattle, those with large holdings had fewer small ruminant sales. Owning more cattle is an indication of greater wealth and perhaps less immediate need to sell a sheep or goat (because of other means of meeting financial obligations).

The last two columns in Table 5.3 show the two components (a decomposition) of the total change in $E(Y)$, given unit changes in each independent variable. A comparison between these two components reveals that changes in any regressor led to a greater change in the probability of

being above the limit zero (i.e. there being a sale) than to a change in conditional expected value (i.e. the level of sales). That is, greater changes in overall household sales levels came from market entry or exit rather than the number of animals sold. We saw before that families sell only a few sheep or goats at any one time.

Elasticities of some explanatory factors with respect to sales are given in Table 5.4 . Columns one through three show respectively the elasticity of the unconditional expected value, the elasticity of the conditional expected value, and the elasticity of the probability of being above the limit of zero sales. In the same vein as above, percentage changes in the explanatory variables were more likely to affect the probability of selling rather than the conditional expected value of the dependent variable. What this tells us, for example, is that a 1 percent change in the average price level of small ruminants (deflated by the price of grain) will alter the number of animals sold by an estimated 0.39 percent, of which 0.06 percent would be due to adjustments in the quantity of animals marketed and 0.33 percent due to entry or exit of households to/from the market place. This also says that 85 percent of the total adjustment of farm households to changes in the relationship between small ruminant and grain prices is a change in their market participation rate (market entry/exit).

Table 5.4

Calculated Elasticities From Tobit
Coefficients For Small Ruminant Sales^a

Variable	$\eta[Y]$	$\eta[Y^*]$	$\eta F(z)$
	(1)	(2)	(3)
DPRICE	-0.3898	-0.0587	-0.3311
CSR	-0.1027	-0.0155	-0.0873
GRAIN	0.0344	0.0052	0.0292
ANEXP	0.0224	0.0034	0.0190

^a Calculations were made at variable's mean value with all others held constant. The elasticity of the unconditional expected value in column 1 is decomposed into the elasticity of the conditional expected value, column 2, and the elasticity of the predicted probability, column 3.

TABLE 5.5

Decomposition of the (Deflated) Price Elasticity
of The Expected Values of Small Ruminant Sales

	DPRICE - σ	DPRICE ^a	DPRICE + σ
(Y)	-0.269	-0.425	-0.581
(Y*)	-0.041	-0.065	-0.089
(F)	-0.228	-0.360	-0.492

^a The standard deviation of DPRICE (σ) is 233 FCFA. All variables (including DPRICE) were held at their mean values.

TABLE 5.6

Decomposition of Grain Purchase Elasticity of
the Expected Values of Small Ruminant Sales

	GRAIN - σ	GRAIN ^a	GRAIN + σ
(Y)	-0.1590	0.0375	0.2340
(Y*)	-0.0240	0.0058	0.0359
(F)	-0.1340	0.0318	0.1980

^a The standard deviation of GRAIN (σ) is 958 FCFA. All variables (including GRAIN) were held at their means.

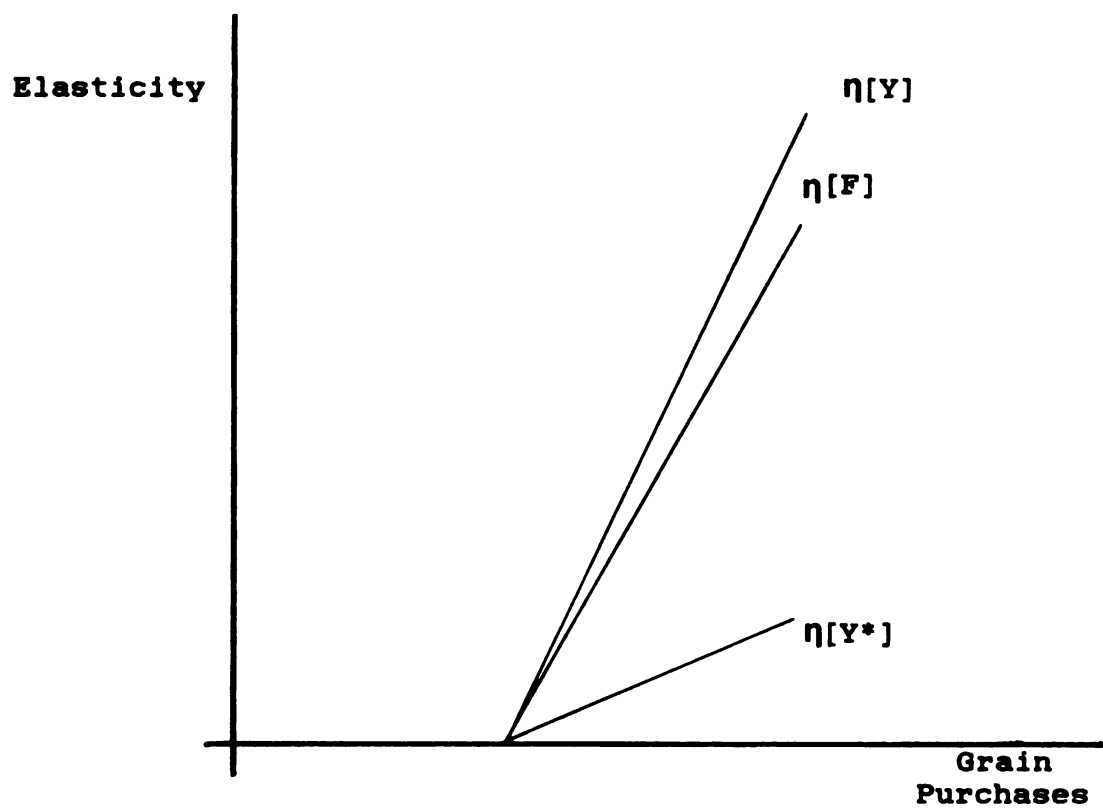


FIGURE 5.2

Decomposition of Grain Purchases Elasticity

The interrelationship between grain purchases and livestock marketing was discussed earlier as important to households in a mixed farming system. In the previous chapter this interrelationship was discussed in the framework of a household-firm model. The trading of livestock for cash to buy grain was seen as a means for households to make up for a short fall in the food supplies in order to maximize household welfare. The results of the household sales model showed that the total response of a single percentage change in grain purchases led to a 0.04 percent change in the marketing of small ruminants during the survey year. The entry or exit of households into the market accounted for about 85 percent of this adjustment to changes in purchases of grain. In general, the sales model revealed that in response to changes in sales explanatory variables, households responded more by deciding to sell (or not sell) as opposed to marketing more or less animals.

Additional insights can be gained by looking further at the elasticities with respect to the expected value of Y for the deflated prices of small ruminants and grain purchases. The elasticities of these variables with respect to $E(Y)$ was computed at their mean levels as well as at plus and minus one standard deviation from these means in Tables 5.5 and 5.6.¹⁰ The (deflated) price elasticity of the expected value changes from -0.25 to -0.53 at one standard deviation below the mean to one standard deviation above the mean (deflated) price level (see Table 5.5). On examining the components of this total change at these

different price levels--illustrated in Figure 5.2, it is apparent that the rate of change is much greater for the change in probability, $\Pi(F)$, from one standard deviation below to one standard deviation above the average price. This same pattern can be observed (see Table 5.6) in the change in elasticities of grain purchases.

3. Cattle Sales Model

3.1 Data and Empirical Formulation

To assess cattle sales, data from 118 hoe and 98 ANTRAC (cattle owning) households in the 5 ANTRAC zones were included in the analysis.¹¹ The final sample had 1431 periodic observations after attrition due to missing data for some variables. The empirical model was:

$$\begin{aligned} \text{SALES}_{it} = & b_{it} + b_{it}\text{DPRICE} + b_{it}\text{SRC} + b_{it}\text{GRAIN} + \\ & b_{it}\text{ANEXP} + b_{it}\text{CROPEXP} + b_{it}\text{NONAGR} + \\ & b_{it}\text{HHSIZE} + b_{it}\text{PURCH} + b_{it}\text{TECH} + \\ & b_{it}\text{ETHNIC} + b_{it}\text{SEA1} + b_{it}\text{SEA2} + \varepsilon \end{aligned}$$

where: $i = 1, 2, \dots, N$ (households)
 $t = 1, 2, \dots, 13$ (periods)

SALES, the number of cattle sold by a household in a given period is regressed against the same type of variables as in the small ruminant model except for the variables DPRICE, SRC, HHSIZE, PURCH, SEA1 and SEA2. Three of these variables are defined differently--DPRICE is the average price received for cattle in the 5 ANTRAC zones deflated by grain prices; SRC is the ratio of small ruminants owned to

that of cattle and SEA1 represents the dry season. PURCH is the number of cattle bought during a period while HHSIZE is the number of people in a household. A brief explanation of the model variables is given in Table 5.7 on the next page.

3.2 Results and Summary Statistics

Some explanatory variables (CROPEXP, SRC and ETHNIC) in the full model formulated above were found to have very little association with cattle sales. A general linear test (F-test) revealed that these variables are not as a group, different from zero. Farmers in the EORD use only limited amounts of purchased crop production inputs (CROPEXP) and it appears cattle sales do not coincide with these few purchases. Unlike the small ruminant model, CSR was not at all statistically significant in this cattle model. There may also have been too few Fulani in the sample for ETHNIC to be important here.

Tables 5.8 and 5.9 contain the estimation results of a reduced cattle model (see Appendix D for the full model). Compared to the Tobit analysis, OLS underestimated the association between cattle sales and the explanatory variables DPRICE, NONAGR, GRAIN, TECH, HHSIZE, and SEA2. But OLS overestimated the impact of the two other variables, PURCH and SEA1. R^2 for OLS was 0.085 percent while its MSE

TABLE 5.7

Variable Notation for the Cattle Sales Model^a

SALES	= number of cattle sold
DPRICE	= farm gate price in FCFA/average grain price ^b
SRC	= small ruminants to cattle ratio
GRAIN	= expenditure for good grain in FCFA/average grain price ^c
ANEXP	= expenditure for livestock production in FCFA
CROPEXP	= expenditure for crop production in FCFA
NONAGR	= net receipts from nonagricultural activities in FCFA
TECH	= 1 if the household uses hoe technology
ETHNIC	= 1 if the household is Fulani
HHSIZE	= number of people in the household
PURCH	= number of cattle purchased
SEA1 ^d	= 1 if period =1,7-13: late dry season
SEA2 ^e	= 1 if period =6-9: early dry season, post harvest

^aThese represent observations for each household in any one of 13 survey periods.

^bAverage of grain prices paid and received (per kilogram) in the EORD (in FCFA).

^cThe TLU for cattle is 0.7 and .01 for small ruminants.

^dPeriod 1 is May and periods 7-13 is mid-October through April. The wet season is the excluded season.

^ePeriods 6-9 is the last week of September through December.

TABLE 5.8

OLS and Tobit Parameter Estimates of Cattle Model

OLS Analysis		Tobit Analysis	
Variable	Parameter Estimate (Standard Error)	Regression Coefficient	F(z) · B
DPRICE	0.113* (0.064)	1.743	0.210
NONAGR	0.016*** (0.004)	0.156	0.019
GRAIN	0.215 (0.159)	2.237	0.270
ANEXP	-0.021 (0.015)	-0.065	-0.008
TECH	-0.040 (0.047)	-0.723	-0.087
HHSIZE	0.007** (0.003)	0.157	0.019
PURCH	0.403*** (0.044)	2.625	0.317
SEA1	-0.035 (0.053)	-0.064	-0.008
SEA2	0.046 (0.059)	1.111	0.134
CONSTANT	-0.128* (0.069)	-17.490	-2.110
R ² = 0.085 MSE = 0.653		(No R ² computed) MSE = 0.007	

Note: OLS analysis was done with SPSS and Tobit analysis with LIMDEP.

* Statistically significant at the 10% level.

** Statistically significant at the 5% level.

***Statistically significant at the 1% level.

Table 5.9
Summary Statistics for Tobit Analysis of Cattle Sales

Variable	Beta	Asymtotic t-ratio	$\frac{\partial F(z)}{\partial X}$	$\frac{\partial E[Y^*]}{\partial X}$	$F(z)$	$\frac{\partial F(z)}{\partial X}$	$\frac{\partial E[Y^*]}{\partial X}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
DPRICE	1.743*	1.24	0.0131	0.0044	0.0317		
NONAGR	0.156**	3.07	0.0012	0.0004	0.0029		
GRAIN	2.237	1.11	0.0169	0.0056	0.0407		
ANEXP	-0.065	-0.26	-0.0005	-0.0002	-0.0012		
TECH	-0.723	-0.74	-0.0054	-0.0018	-0.0132		
HHSIZE	0.157**	2.95	0.0012	0.0004	0.0029		
PURCH	2.625**	5.57	0.0198	0.0066	0.0478		
SEA1	-0.064	-0.05	-0.0005	-0.0002	-0.0012		
SEA2	1.111	0.85	0.0083	0.0028	0.0202		
CONSTANT	-17.490	-11.20					

Note: The unconditional expected value of Y, at the sample mean X, is 0.0609. The conditional expected value of Y, at the sample mean X, is 2.416. The standard error around the Tobit index is 6.6105. The predicted probability that $Y > 0$, at the sample mean X, is 0.0245. Column (1): Tobit coefficient. Column (2): Regressor asymptotic t-ratio. Column (3): Change in probability of a sale, given a change in each regressor. Column (4): Change in $E(Y)$ for those above the limit (zero sales) weighted by the probability of a sale. Column (5): Change in probability of being above the limit, weighted by $E(Y^*)$.

* Statistically significant at the 10% level.

** Statistically significant at the 1% level.

TABLE 5.10

Calculated Elasticities from Tobit
Coefficients For Cattle Sales

Variable	$\eta[Y]$	$\eta[Y^*]$	$\eta F(z)$
	(1)	(2)	(3)
DPRICE	0.4678	0.0564	0.4114
NONAGR	0.0873	0.0105	0.0768
GRAIN	0.0209	0.0025	0.0184

Note: Calculations were made at variable mean values with all others held constant. The elasticity of the unconditional expected value in column 1 is decomposed into the elasticity of the conditional expected value, column 2, and the elasticity of the predicted probability, column 3.

was 0.653 which is much larger than that of the Tobit analysis. Due to the preferred Tobit technique for this type of analytical problem, the remainder of the discussion to follow will focus on the Tobit results.

The information in Table 5.9 shows that the model performed reasonably well. One variable, ANEXP has an unexpected negative sign, although it is not statistically significant. We have already seen that there is a high degree of association between livestock production expenses and small ruminant sales. Since nearly every household has sheep and goats, perhaps there was little need to sell cattle to pay for these (relatively small) expenses.

In contrast to the small ruminants model, the deflated price variable in this model suggests a positive response to price which is statistically significant at the 10 percent level. In this case, this deflated price was not expected to measure behavior in response to the relationship between cattle prices and grain prices to the extent that it did for small ruminants. Cattle prices do have a seasonal trend. This trend appears to be closely related to the weight and condition of cattle as well as the demand for export cattle. For example, both the number of cattle marketed and prices typically start to increase in August and may not turn back down until November. Most animals are sold during this period, not only because many sellers know they can get good prices but buyers are also willing to pay a premium for these animals (due to their relatively good condition and weight). At the same time, export demand

is fairly strong. This relationship between price and sales concurs with the results of Herman's price formulation model which demonstrated that "the supply of cattle is largely a function of price per head" (Herman, 1983).

The variable PURCH (purchases of other cattle) was the most statistically significant variable in the model--at the 1 percent level. Many farmers appear to have been reinvesting in another (presumably younger) animal that would bring higher returns in the future. It was indeed clear in the EORD survey that the cattle purchased by farmers were younger than those they sold.

A strong relationship between earnings from nonagricultural activities (NONAGR) and cattle sales indicates that many households involved in cattle trading are also very much involved in other commercial activities.

But there was only a weak, non-significant relationship between grain purchases and sales. Since almost every household in the EORD survey raised small ruminants (whose sales were significantly related to grain purchases), a household may not be as compelled to market their cattle in order to buy grain.

ANTRAC households marketed more cattle according to the model but the indicative variable, TECH was not significant. Not surprisingly, larger families sold more cattle, given that the variable HHSIZE (household size) has a t-ratio greater than the 1 percent level of significance. Larger households have greater financial needs (as well as

higher overall consumption expectations) and tend to own more cattle, all of which would help explain this finding.

It is somewhat suprising that none of the seasonal variables were significant. Perhaps the price variable may be taking up a lot of the seasonal variation in sales. The higher coefficient on SEA2 reflects the higher sales level in the early dry season, (late September to December) when cattle are at their maximum weight and in their best condition. In the late dry season, most weak animals have already been sold and many farmers generally prefer at that time of the year to hold on to their cattle until the next wet season so the animals can put on more weight.

Column three (Table 5.9) shows the change in probability of selling cattle with a change in each regressor. This change is greatest for (deflated) prices, grain purchases and cattle purchases. From comparing columns four and five, a change in any single independent variable leads to a greater effect on the change in the probability of a sale than the number of animals marketed.

Some elasticities were calculated and decomposed in Table 5.10. As with small ruminants, the overwhelming adjustment to changes in these factors would come from market entry/exit of households. In the case of changes in (deflated) prices, this entry or exit accounts for almost 88 percent of expected adjustments by households.

4. Conclusions

This chapter put forth the major empirical results of research on small ruminant and cattle sales among crop/livestock farmers in the EORD. Although the analysis could not model the entire farming system, certain household socioeconomic factors were found to be useful in modeling farm level market behavior. An added feature of this study was the inclusion of information from non-sellers in a Tobit statistical model.

Predictably, sheep and goat sales were strongly associated with cash needs--most importantly, grain purchases. Expenditure on livestock raising, the farm class (hoe versus ANTRAC), and regional location of the household were also found to be significantly associated with small ruminant sales. On the other hand, cattle sales were not as closely associated with grain purchases but were highly correlated with earnings from other commercial activities as well as purchases of other cattle. This would support the notion that cattle traders are frequently involved in other non-farm activities and are reinvesting in more (probably younger) cattle. The greater commercial activity of cattle owners may be one characteristic that distinguishes them from non-owners.

The livestock prices employed in this analysis were for all small ruminants or cattle which are not homogenous within each category. Thus, these prices are only representative of the general pattern of each animal type. Nevertheless, the response to price (livestock prices/grain

prices) was negative for small ruminants but positive for cattle. The negative correlation between small ruminant sales and price seems to reflect the relative greater importance of other factors in explaining the sales behavior of EORD farm households. Farmers have said that smaller stock are useful in meeting immediate cash needs, especially unexpected cash requirements. Farm sales of small ruminants in response to rising grain prices relative to stable small ruminant prices may also help explain this finding. However, cattle prices appear to have an important (positive) influence on farm cattle sales. This may indicate that those households selling cattle are better able than those selling small ruminants to take advantage of favorable prices and the terms of trade between livestock and grain.

Both models showed that most response to changes in sales explanatory variables was due to market entry/exit. This is not unexpected since we saw earlier that households tend to market only a few animals at one time. But by using data from non-sellers, a measurement of the probability of sales as well as the quantitative response was computed. The implications of these results and other findings in previous chapters will be discussed in the next chapter.

FOOTNOTES TO CHAPTER V

¹ The variables and data used in this analysis were only identified after the EORD survey was conducted. This, to some extent, constrained the analysis to only what survey data was both available and reliable. Missing observations further reduced the scope and size of the sample. Some possible explanatory variables such as labor input to livestock production were not included because labor data was collected for only a subset of the EORD sample and not for every household.

² 439 periodic observations were not included due to missing data.

³ This eliminated the possibility of including variables that were specific to the nature of transactions such as the type and characteristics of animals sold-- breed, weight, age, sex and also type of buyer.

⁴ In particular, one variation of the model presented here was DPRICE lagged one period. This did not improve the model's performance.

⁵ This average price is for non-sellers. The observed price was used for a household that sold an animal.

⁶ TLU units for cattle is 0.7 and 0.1 for each small ruminant.

⁷ Limited Dependent Variable Regression Program, Version Phelps.

⁸ LIMDEP does not provide sufficient output to determine this upper limit.

⁹ For a fixed number of cattle, the smaller the number of small ruminants owned, the larger the ratio of cattle to small ruminants. The model shows that a larger ratio is correlated with fewer sales. However, an offsetting factor is the earlier finding of greater annual sales from those households with larger herds of cattle. This relationship would dampen the above effect.

¹⁰ The other variables were fixed at their sample means in all computations.

¹¹ These were the only households willing to reveal information about their cattle.

CHAPTER VI

SUMMARY AND CONCLUSIONS

1. Problem Setting and Research Objectives

The livestock subsector in Upper Volta is a major contributor to national income (including foreign exchange earnings) and plays an important role in the lives of most rural Voltaics. Yet there are indications that its future as a leading industry based on an extensive production (open-range) system may be in jeopardy. Expanding crop acreage to feed a growing population will reduce the availability of grazing land and relegate livestock to areas with less water and poorer pasture. The further integration of livestock and crop production may be one way of increasing livestock productivity which would help Upper Volta avoid a fall in livestock production and exports if the extensive production system declines. But in order to formulate appropriate government policies to bring about fully integrated mixed farming systems, more needs to be known about the circumstances under which livestock production and marketing presently take place in existing mixed farming systems. Successful mixed farming and adequate supplies of livestock and livestock products will of course, be determined by both production and marketing parameters.

This dissertation focused on household marketing of cattle, sheep and goats in mixed farming systems of eastern Upper Volta. The main data base was the information gathered in a 1978-79 farm survey of hoe households (representative of the general farm population) and animal traction (ANTRAC) households. Factors external to the livestock enterprise have often been said to be important determinants of farm household sales. Therefore, the main objective of this study was an empirical analysis of the relationship between livestock sales and household socioeconomic characteristics which might help explain a household's decision to sell an animal. Since most EORD households did not produce enough grain to meet their own needs throughout the year, the use of livestock sales receipts to purchase foodgrains was examined closely. In addition, a special effort was made in the analysis to use information from non-sellers to gain greater insight into market behavior.

2. Review of Major Findings and Policy Implications

2.1 Livestock Production and Management in the EORD

Based on this study's brief descriptive analysis of livestock production, management and marketing patterns in the EORD, there are two particular aspects of livestock production and marketing that should be highlighted--one regarding the pattern of household labor use and the other regarding the market offtake rate of small ruminants as a proportion of total household holdings.

Family labor is the most important input in livestock raising which mainly involves guarding or herding animals. This task was found to be especially important during the crop cultivation period with a labor bottleneck most likely to occur in July and August when labor input to both crop and livestock production are greatest. It was clear in both subsamples that most labor allocated to livestock raising (63 percent and 73 percent in the hoe and ANTRAC subsamples respectively) was supplied by family members who were 14 years old or younger. Over the course of the year, family members 55 years or older contributed proportionally more labor in the hoe subsample than in the ANTRAC subsample. Also, there does not appear to be much entrustment of cattle to Fulani herdsman which appears to be more characteristic in the farming systems of other ethnic groups than the Gourmantche (who make up most of the population in the EORD).

In one sense, the low opportunity cost of child labor allocated to livestock raising could indicate that livestock production on these farms may not appear to be costly to households in terms of their most important productive resource, labor. However, families may have to make a choice between sending their children to school or limiting the number of animals they keep. School systems which occupy children's time when they traditionally perform the task of guarding a family's herds at critical periods during the agricultural season, could be a constraint on a family's ability to raise cattle and small ruminants.

Therefore, it is important that programs addressing livestock production and management as well as those involving primary education be aware of this possible constraint. Adjustments in rural school policies concerning the timing of sessions or the hours of classes to fit the labor requirements of the agricultural production cycle may also enable these farm families to continue a mixed farming system.

One aspect of the relationship between the crop and livestock enterprises that affects livestock marketing deserves mention--the residual time allocation of labor to livestock marketing. It was observed that farmers undertake more distant marketing and are generally more involved in marketing during the time they are not preoccupied with crop production. Technical innovations which decrease the labor requirement in crop production may leave more time for farm families to devote to livestock production and marketing.

The market offtake rate of small ruminants (as a proportion of total holdings) was discovered to be higher among households with the smallest herds. Limited overall family resources to meet financial obligations and few alternative income opportunities available to these herd owners is a likely explanation for this phenomenon. In light of this fact and because of the widespread distribution of small ruminants among the rural population (see Table 6.1), a greater number of farmers and more low income

TABLE 6.1

**Livestock Ownership, Sales and Contribution
to Household Annual Income^a**

	-----Subsample-----	
	<u>Hoe</u>	<u>ANTRAC</u>
<u>Percent of Households Owning:</u>		
Cattle	22%	64%
Sheep or Goats	91%	93%
Fowl	93%	93%
<u>Number of Animals Owned per Household</u>		
Cattle	2.6	7.6
Sheep	6.0	7.4
Goats	6.5	7.5
TLU ^b	3.8	8.2
<u>Number of Animals Sold Annually per Household</u>		
Cattle	0.10	1.10
Sheep	0.59	0.79
Goats	1.10	0.76
<u>Percent of Annual Household Income From Livestock Raising</u>		
	2.0%	2.5%

^a Based on the data from the five ANTRAC zones recorded in Tables 2.3, 2.4, 3.11 and 3.15 .

^b Tropical Livestock Units (from Jahnke, 1982):

camels	1.0
cattle	0.7
sheep	0.1
goats	0.1
horses	0.8
pigs	0.2
fowl	0.01

households would benefit if an emphasis of livestock development policy is placed on small ruminants. In the past, the production of these animals has not received as much attention in development programs and policy as cattle production. Given the basic need to address food and income security among the rural population, an emphasis on these smaller stock seems appropriate since they play an important role in household survival strategies. By virtue of their size, small ruminants do actually have several advantages over cattle. They are cheaper to acquire, and goats for example, are the hardiest of all ruminants in low rainfall areas. Smaller stock also require fewer production inputs on the part of the owner. The demand for small ruminants throughout West Africa is also expected to remain strong in the foreseeable future (Josserand and Ariza-Nino, 1982).

2.2 Models of Household Small Ruminant and Cattle Sales

For the most part, livestock in the EORD are raised in mixed farming systems to provide a source of income/security (primarily when immediate cash needs arise) and are an important means of reinvesting household earnings. Not every household did sell animals during the survey year. Not selling is in fact, as much a part of market behavior as is selling. Therefore, the information from non-participants was considered useful in understanding marketing behavior and was not discarded. However, incorporating observations on non-participants poses a

problem in statistical analysis. To overcome this problem of analyzing a sample where in some cases, the observation of the dependent and/or independent variables is zero, a Tobit model structure was adopted. In such situations, Tobit analysis has proven to be an appropriate analytical tool on both theoretical and statistical grounds. Tobit analysis is essentially a combination of probit and multivariate regression analysis. The technique enables modeled behavior to be decomposed into changes in both quantity and probability adjustments due to changes in explanatory variables.

Tobit models of monthly small ruminant and cattle sales were developed using cross-sectional household data. The models successfully demonstrated that certain household socioeconomic factors do explain part of household sales behavior. The small ruminant model contained more variables that were statistically significant than did the cattle model. This was not unexpected since the modeling approach corresponds closer to the role small ruminants play in the household economy and such a short-term (one year) analysis conforms better to the production and marketing cycle of these smaller animals.

2.2.1 Small Ruminant Sales

Monthly sales of small ruminants were found to be closely associated with the average (deflated) price of small ruminants, purchases of foodgrain, livestock production expenditures, the crop production technology employed

by a farm household (hoe versus ANTRAC), as well as with the region of the EORD in which a household was located. The model showed that the response to average small ruminant prices (deflated by average grain prices) was negative. Farm households are apparently marketing their small ruminants when small ruminant prices are seasonally low. In addition, as grain prices fall (portraying greater supplies of grain in the market), sales of small ruminants (mainly goats) decline. But there were other variables in the model that were more significant than this (deflated) price variable. Given that farmers frequently state that animals are raised in order to meet immediate cash needs, factors other than price must be more important in their marketing decision making. The fact that household needs which prompt sales often arise at the same time for many rural households undoubtedly has a dampening effect on local prices. A good example of this phenomenon occurs just prior to and during the crop cultivation period--often referred to as the hungry season. Household grain consumption is relatively high because of intense field work while grain reserves are usually low. Thus, many families are forced to buy additional grain with their receipts from livestock sales.

This situation is closely related to the strong correlation in the model between small ruminant sales and purchases of foodgrain. The relationship between small ruminant sales and grain purchases is one of the most important

aspects of this study since most farmers in the EORD were deficit producers during the 1978-79 crop year. Goat sales in particular, closely followed the rise and fall of seasonal grain supplies. The total elasticity of monthly small ruminant sales with respect to grain purchases was estimated to be 0.04 percent. In addition, the Tobit model revealed that 85 percent of the adjustment households made to changes in grain purchases can be expected to be the entry or exit of households from the small ruminant market place (i.e. a decision on the part of households to sell or not sell) as opposed to a change in the number of animals they would sell.

Therefore, the significant correlation between small ruminant sales and household expenditures on both foodgrain and livestock production, along with a negative correlation between sales and small ruminant prices gives some indication that EORD farmers do seem to be quite interested in and/or are compelled to meet cash needs with small ruminant sales. Marketing of animals among some of these farm households may also be affected by a lack of information or knowledge as to the best time to sell or they may be unable to sell at more opportune times (in terms of price and demand) because of certain market structural problems. These problems may be simply due to the isolation of the region and/or its poor transportation infrastructure. But one can conclude that an increase in the price of small ruminants alone may not necessarily elicit a strong market response from these farmers. Given the few, infrequent

sales by farmers in this area, an increase in supply of animals originating from this source (in the short term) would apparently have to come from a greater number of sellers rather than from a higher herd offtake rate.

One of the areas of greatest relevance to this study is the relationship between interventions aimed at the cropping enterprise and their impact on livestock sales. Interventions that increase or stabilize crop production, reduce the risks and uncertainty of grain production, or improve the quality and availability of grain throughout the year, will influence livestock sales. Relieving farmers of the need to sell small ruminants to buy grain at times when demand is not strong, or when the marketing system is not able to absorb them may enable farmers to do better at marketing animals on the basis of demand signals. Some form of credit program (monetary or in-kind like grain) or more off-farm employment opportunities which provide an alternative sources of funds to livestock sales revenue at the times of greatest income and food insecurity might improve the market flow of animals as mentioned above.

2.2.2 Cattle Sales

Monthly cattle sales, on the other hand, were found to be more closely related to (deflated) cattle prices, purchases of other cattle, the size of a household, and income from (non-cropping) commercial activities; but not food-grain purchases. In the model, prices (deflated by the

price of grain) were one of the most significant variables and response to price was found to be positive. A positive response to price is an indication that of many sellers are able to take advantage of seasonally higher prices which often coincides with the time of year when cattle are in good condition and/or demand (export primarily) is firm. Based on this cattle model, one can conclude that the influence of a one percent change in the average monthly (deflated) cattle price level would alter the number of cattle sold by 0.46 percent. Of this figure, most of the adjustment (88 percent) would come from the entry or exit of households from the market. Thus, policies that increase cattle prices will result in a response from mixed farmers but a large part of this response would come from a change in the number of sellers and not necessarily the number of animals sold by each household.

The model indicates that cattle traders (most of whom were in the ANTRAC subsample) apparently belong to the larger, more commercially active households. Only a third of the hoe subsample raised cattle compared to roughly two-thirds of the ANTRAC subsample. Therefore, the majority of EORD farm households are not involved in cattle trading.

Receipts from animal sales were found to be much more important to a household's cash flow situation than to its annual income. Livestock's contribution to annual household income averaged only about 2.0 percent in the hoe subsample and 2.5 percent in the ANTRAC subsample. On the

other hand, sales revenue at critical times during the year played a vital role in smoothing out household monthly income flow. This was true among the hoe subsample (mainly in regards to food purchases) as well as among the (wealthier) ANTRAC subsample (regarding ANTRAC expenses in addition to food purchases). The less significant correlation (compared to other explanatory variables in the model and to the small ruminant model) found between grain purchases and the marketing of cattle would indicate that small ruminant marketing is affected more than cattle by a household's need to buy grain. It should be noted that ANTRAC farmers gained substantially from the appreciation of their oxen which could more than cover all animal traction expenses during the year. Also, in a few instances some farmers actually earned more revenue from the sale of livestock and livestock products than crop production--a phenomenon that occurred more frequently in the ANTRAC subsample.

Major interventions in cattle marketing do not appear to be needed at this time. A program which educates cattle suppliers about seasonal prices and enables them to market more animals during periods of greatest demand (through provision of credit or dry season feeding schemes) may help them reap greater returns and allow supply to respond better to demand.

2.3 Other Conclusions and General Policy Concerns

There was a clear impression of an interest on the part of many households to start or increase their herd of

cattle or small ruminants. Cattle, in particular, are an important means of savings and investment. In the hoe subsample, 51 percent of the cattle purchased by these households were bought with the expressed intention of starting or increasing the household's herd while 47 percent of the cattle purchased in the ANTRAC subsample were bought for the same purpose. The cattle sales model also revealed that for every one unit of cattle (cow, bull, steer or oxen) sold in any given month, approximately 0.32 cattle were bought during that month by the same farm household.

The availability of other investment and savings alternatives besides livestock in rural areas may change farmers' attitudes towards livestock. With other alternatives available, they may also develop more of an interest in raising animals for marketable meat. Another related factor to consider is that the farm offtake rate may not necessarily improve as expected after production is increased with technical interventions if there are no other investment or saving options available to rural households. A greater animal survival rate, for example, may simply allow households to retain larger herds which gives them greater security but does not result in more sales. More off-farm employment opportunities and access to credit would provide families with other sources of income especially during critical cash flow periods. Livestock could be a reasonable form of collateral and with improved (livestock) market information, households may be able to be

more market oriented (e.g responding to price signals and consumer preferences) in their sales pattern. But in light of the need for other investment/saving alternatives (other than livestock) mentioned above, it is also important to keep in mind that more income might go into purchases of more animals and may not result in more timely animal sales.

It is evident from the preceeding assessment of livestock production and marketing among rural farm households in the eastern region of Upper Volta that livestock are important to the welfare of these households. There is clearly a statistically significant relationship between farm household livestock marketing and certain household socioeconomic characteristics at the time of sale. Livestock sales (especially small ruminants) are especially useful in smoothing out cash flow--something that is critical to the survival of many semisubsistence grain producers. This has to be considered both rational and efficient in a semi-arid area where there is substantial risk and uncertainty in crop production.

The above findings would be most appropriately considered in the context of their implications towards those Voltaic government policy objectives that are relevant to the development of the mixed farming subsector. Especially mixed farming is envisioned to play an important role in providing more livestock and livestock products if the extensive production system decline in productivity. It is

further assumed that the government's major national objective is primarily to expand (marketable) livestock production as well as to improve rural incomes and nutritional status, employment opportunities, and the general wellbeing of all citizens.

Government policies and programs to increase livestock production in mixed farming zones must be conceived with the understanding that under present conditions, a household's decision to market animals (primarily small ruminants in this case) appears to be closely tied to the circumstances surrounding the household. This extends the market decision making process beyond just the monetary profitability of the livestock enterprise. Thus, one of the basic implications of the motive behind much of livestock marketing in this area is that livestock development programs (or any other program for that matter) aimed at mixed farmers should give full consideration to the integration of household activities and the role which livestock play in the survival strategy of rural farm households.

A central theme of development policy to which mixed farming livestock policy should be aimed is towards providing food and/or income security for these households. There is evidence from this study that the more secure (wealthier) livestock producers marketed more of their animals when demand was at a seasonal peak.

There are of course, several constraints to increasing production and marketing in Upper Volta which cannot be overlooked--disease, seasonal shortages of water and feed,

poor management, inadequate or poor transportation and marketing infrastructure, etc. But the most salient point to be made is the need for more than just a production approach to increasing output. A comprehensive approach to development which takes the entire livestock production/marketing system into account within the framework of integrated household activities and objectives is more likely to succeed. With this as a foundation, the basic objective of any policy or technical intervention aimed at livestock should be directed at turning the livestock enterprise into a productive operation that is valued by livestock owners for its profitability such that they may become increasingly attracted to and interested in its financial success. This may have to be accomplished with small changes and an improved transfer of knowledge rather than major changes in the present farming system (e.g. the introduction of forage crop production may require too much of a change). The EORD has to some extent, more potential for expansion of livestock production on mixed farms than other regions because of its low population density. But on the other hand, the limited supply or poor distribution of some resources in the region, particularly water, plus the weak marketing infrastructure have to be given careful consideration.

3. Comments on Future Research

Voltaic farming systems, like most in the developing world, are complex, requiring much effort on the part of

researchers and policymakers to understand. This study is an attempt to add to the wider body of knowledge about these farming systems. Several areas of interest and concern about the livestock sector have not been addressed here, such as the demand for meat and other livestock products, livestock production constraints and the details of linkages with crop production, and meat marketing. There is a continual need for more information in these areas.

Further research could be conducted in several general areas involving assessments of farmer and household objectives, production and marketing constraints, the characteristics of the environment (ecological, infrastructure, socioeconomic, etc.) and the possible trends in agriculture development. The farm should be the focus and starting place for all investigations.

Future research concerning livestock marketing on mixed farms should investigate the multiple decision making process involved in a household's marketing decision as to when, where, or how to market either its sheep, goats or cattle. There may be advantages to diversified livestock marketing which could be better understood.

One other area closely associated with the research reported here is the need to better understand the allocation of resources and decision making in mixed farming systems. This will become more important as the countryside becomes more monetized and commercially active since several livestock products have high elasticities of de-

mand. Livestock have values to a household that are both endogenously (e.g. manure, milk, meat) and exogenously determined (e.g. the demand for livestock products). It would be fruitful for future research to examine, in a comprehensive manner (e.g. with a subsector approach), the manner in which endogenous and exogenous forces of demand for livestock do and will affect household decision making and resource allocation.

There is always a basic need to research the technical and environmental aspects of livestock production in the EORD which will impinge on any form of livestock development in the area. The nature of the interactions between household activities (especially crops and livestock) should be well documented and measured. This has particular relevance to the often mentioned livestock fattening activities suggested for mixed farming systems.

On-farm applied research of livestock fattening and improved animal nutrition would help provide important information as to the viability of intensive livestock production on mixed farms. There is preliminary evidence from other West African countries (and a little from Upper Volta) that cattle and small ruminant fattening can be a profitable household enterprise as well as provide more and better quality meat for major consuming centers. Much information would have to be gathered concerning the availability and source of feed, animals and markets. At the very least, research that enables farmers to cost effec-

tively provide dry season feed for cattle would improve the availability of animals produced by these farms.

Coupled with such efforts, data should be collected (over time) on regional and national seasonal prices of animals that would be bought and sold if intensive production were to be implemented. Accurate information (by weighing) of animal prices on a live and carcass weight basis would be useful.

In a general sense, the importance of livestock to rural households revealed in this study and by others who examined EORD farmers, points to the need for better and more enlightened data collection objectives in similar environments. The importance of livestock to households was not fully appreciated when the EORD survey was originally designed. This is especially true in similar situations where the central development thrust is not at first aimed at livestock but at crop production. A record on the origin, when and for what purpose cash income from all sources is dispensed is one specific topic future data gathering efforts should collect. Clearly, all household activities are integral parts of the whole farming system and should be treated as such in all levels of concern for the development of farm households in eastern Upper Volta.

Finally, one further comment about the analytical technique used in this study. Tobit analysis proved to be a workable approach for incorporating market non-participation behavior. This technique has been most frequently used in economic analysis to estimate demand relationships

but in this case, it was used to study aspects of supply. Some of the same principles apply in supply response as in demand where a threshold level of an explanatory variable does or does not bring forth participation in the market place. As was stated earlier, non-participation is as much a part of behavior as is participation. Therefore, in some cases more meaningful analysis of the full range of behavior (of a unit of analysis) can be accomplished with this approach than just using information on those who are active in the market place. Since demand and supply response involves a decision to buy or sell as well as how much to buy or market, Tobit analysis can be an appropriate tool for studying many situations in agriculture.

APPENDICES

APPENDIX A

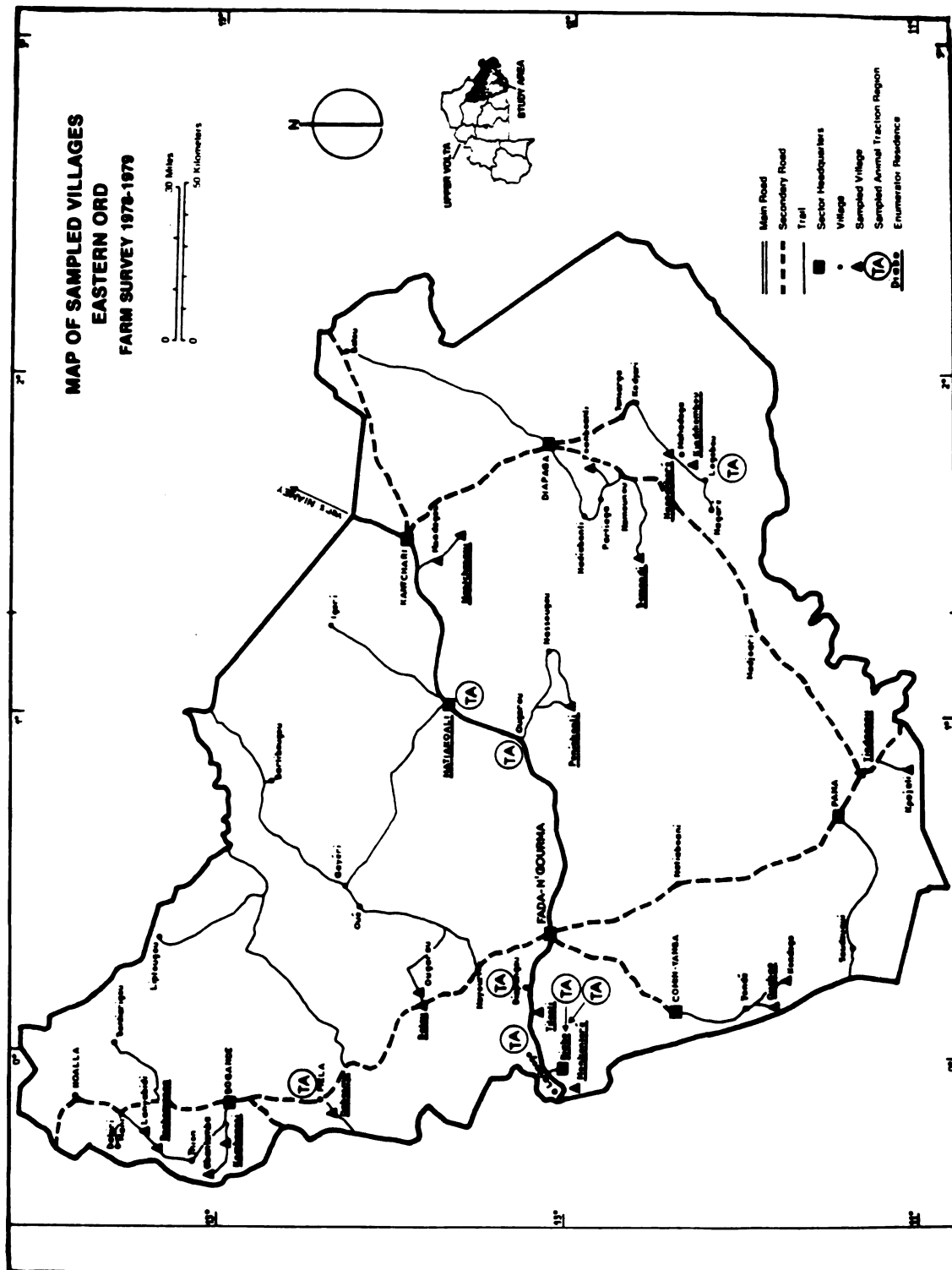
APPENDIX A

THE 1978-79 EORD FARM SURVEY

Overview

The primary data base for this study is from a 1978-79 farm level survey, conducted by a multidisciplinary team from the Department of Agricultural Economics of Michigan State University.¹ The survey was a major component of the EORD Integrated Rural Development Project which was funded by USAID and the government of Upper Volta. This survey monitored the economic activities of 473 farm household in 27 villages between May 1, 1978 and April 30, 1979 (covering the 1978 agricultural year). The "cost route"² method of data collection was utilized for gathering information on a broad spectrum of farm, off-farm and household activities based on weekly, monthly or one-shot interviews.

The eastern region of the country was divided into 12 zones to represent the general agroclimatic characteristics of the region. Within each zone, a random selection of farm households was taken to represent conventional farming systems which basically depend on the hand hoe as the major means of crop production. To assess issues concerning animal traction, a purposive sample of relatively successful ANTRAC farm households was also included in the survey. Therefore, after attrition, the final sample consisted of



Source: ORD de L' Est - Fada.

FIGURE A-1

Map of 27 Survey Villages

348 randomly selected tradition or "hoe" households and 125 ANTRAC households. Table 1.1 shows how these 473 households are distributed in the 27 villages across the 12 agroclimatic zones. The geographic location of each surveyed village is shown in Figure A-1.

For the purposes of this survey, a farm household was defined as a family production unit which jointly farmed at least one major field and controlled the grain output produced by that unit. It was important that the farm management decisions were made independently from other households. Thus, a farm household may consist of one or more nuclear families or an extended family (rarely would this include unmarried individuals). An extended family is often comprised of brothers, sisters, and sons with their wives and children.

Sampling Procedure

Villages served as the main structure for carrying out the survey. The village sampling was guided by the objective of trying to represent the most important farming systems in each major ecological zone. Villages were actually selected in clusters to minimize the travel time of enumerators to and from villages on motorbikes--established at approximately 25 kilometers. It was difficult to identify these clusters, but the villages were selected by following process:

1. Twelve "zones of interest" (about the size of a canton or subdivision) were identified according to a set

of criteria:

- a) distribution of population within the EORD;
- b) ability to represent the ecological zones enumerated by the EORD's Bureau of Agricultural Production on the basis of rainfall, soil, and cropping patterns;
- c) inclusion of five zones where animal traction was intensively used: Piela, Diabo, Logobou, Ougarou/Matiakoali and Diapangou;
- d) size of the eight sectors;
- e) accessibility on motorbike by supervisors;

2. Within the zones, lists were compiled of the 1975 census villages;

3. Random selection of two villages from each of the seven non-ANTRAC zones. In three of the five ANTRAC zones, one village was randomly selected and one village was purposively selected according to the number of animal traction adopters. In the two other ANTRAC zones, sampling was more intensive due to their greater importance. In the Logobou zone, two random villages were chosen because of the high population density. Three villages were purposively sampled in Diabo due to the high level of animal traction development in that area. In sum, there were 20 subjectively stratified villages (although randomly selected), along with 7 purposively selected ANTRAC villages. No effort was made to use probabilities proportional to village size. Since the EORD is thinly populated, it was assumed that village size does not have a significant bearing on farming systems.

In the 20 random villages, 18 households were selected at random within each village. The original 1975 national census provided the basis upon which to extract the names of the heads of nuclear households. Village meetings were

held to actually make the selections from an urn by a village representative. To assure village support of the survey, the village chief was purposively included in the sample as the 18th household (only if he had not already been randomly selected). During analysis, the non-randomly chosen village chiefs were excluded. To serve the purposes of evaluating animal traction in the EORD, the selection of households in the five ANTRAC zones was strictly purposive.

Fourteen enumerators, each assigned to two villages or regions, collected information from 36 farm households. All households were interviewed monthly to gather most of the basic input-output data. Six out of 18 households in each village (randomly selected) were interviewed weekly to get household member and field-specific labor data. As a result of this format, each enumerator visited 12 farm households weekly and the other 24 once a month, giving him the responsibility of administering an average of eighteen interviews a week.

Data was recorded by means of questionnaires. There were a total of 75, administered with different frequency--24 were monthly, 9 were weekly, 10 varied from being quarterly to single interview, and a final group of 32 single interview questionnaires were used during the final stages of the survey. To reduce expenses, some data was obtained from a (random) subsample of households. Labor allocation was collected from a one-third subset; cultivated acreage from a two-thirds subset.

Besides such sources as the aggregate (monthly) cash flow file, the data for this dissertation came from seven questionnaires pertaining exclusively to livestock:

<u>Questionnaire</u>	<u>Number</u>
1. Inventory of Livestock	55
2. Purchases of Animals and Animal Products	10
3. Sales of Animals and Animal Products	11
4. Livestock Expenses	12
5. Animal Feeding	13
6. Time Worked by Household Members in Livestock Activities	46
7. Changes in Animal Stocks other than Purchases and Sales of Animals	62

Data coding and data verification were done at the project's headquarters in Fada while data validation, processing and some initial preliminary analysis were conducted at the Centre National du Traitement de l'Information (CENATRIN) computer center in the capital city, Ouagadougou. The remainder of the analysis was accomplished at Michigan State University. Much of the analysis was done with SPSS but the Tobit analysis was done with LIMDEP.³

FOOTNOTES TO APPENDIX A

¹ The author did not participate in the data collection.

² A "cost route" survey makes use of multiple interviews, intermittently spaced out over the survey period. This method is utilized to overcome problems of farmer recall by frequently recording input-output data on questionnaires.

³ Limited Dependent Variable Regression Program (Version Phelps) which is a Fortran IV program for performing regressions using the limited dependent variable technique.

APPENDIX B

TABLE B-1

OLS Estimates of the Full Small Ruminant
and Cattle Sales Models

=====		
	SMALL RUMINANTS	CATTLE
Variable	Parameter Estimate (Standard Error)	Parameter Estimate (Standard Error)
PRICE	-.837** (.475)	.113** (.064)
CSR ^a	-.001 (.001)	-.018 (.028)
GRAIN	.443*** (.100)	.218 (.159)
ANEXP	.075*** (.005)	-.024 (.015)
TECH	.068*** (.026)	-.038 (.049)
SEA1 ^b	.009 (.025)	-.035 (.053)
SEA2	.006 (.023)	.048 (.059)
NORTH	.104*** (.033)	----
CENTRL	.086*** (.031)	----
CPNO	----	.402*** (.044)
HHSIZE	----	.007** (.003)
ETHNIC	.039 (.123)	.068 (.166)
YOUNG	-.002 (.003)	----
CROPEXP	-.006 (.011)	.009 (.017)
CONSTANT	.026 (.047)	-.116 (.072)
	R ² = .054 MSE = .379	R ² = .084 MSE = .654

* Statistically significant at the 10% level.

** Statistically significant at the 5% level.

*** Statistically significant at the 1% level.

^aThe species of the dependent variable was the denominator.

^bDry season for cattle.

APPENDIX C

APPENDIX C

HOUSEHOLD-FIRM MODEL

Each EORD household can be assumed to have a family utility function of the form:¹

$$(1) \quad U = U(Z, L, C, M)$$
$$U' > 0, \quad U'' < 0,$$

where:

Z = consumption of "Z" goods,
L = leisure,
C = own consumption of agricultural output, and
M = consumption of market-purchased goods.

These arguments are aggregates, both over household members and over one agricultural cycle. Therefore, both the distributional rules within the household and the role of seasonality are not included.

The objective of the household is to maximize U but it must do so subject to an income constraint and time constraint:

$$(2) \quad p(F - C) + wN + A = qM,$$

and

$$(3) \quad L + N + T + H = D,$$

where:

p = price of C;
q = price of M;
F = total agricultural output;
w = wages;

A = nonwage, noncrop, net other income;
 N = quantity of labor sold if $N > 0$ and
 quantity of labor purchased if $N < 0$;
 T = time allocated to production of "Z" goods;
 H = time allocated to production of $F = H_1$ (including
 both family and hired labor time) plus the
 production of $(F-C) = H_2$; and
 D = total available time.

Perhaps an explanation is required for "Z" goods and N . Becker (1965) introduced the concept of "Z" goods which are defined here as commodities that are produced and consumed by the household but are not sold because no market exists for them.² However, C goods can be marketed even though they are produced and consumed by the household. In contrast, M goods are consumed but not produced by the household. Labor that is hired is only employed in F production while production of "Z" goods is accomplished only with family labor. If a household is a net hirer of labor, $N < 0$, whereas H , the labor utilized in F production, exceeds by N the labor supplied to F production by household members. But for a household that is a net seller of labor, $N > 0$ and all F production labor is contributed by members of the household. When a household does not enter the labor market, either as a buyer or seller, $N = 0$.

Finally, the household's two production functions are defined as follows:

$$(4) \qquad F = F(H)$$

and

$$(5) \qquad Z = Z(T).$$

Both functions have positive and diminishing marginal

products. They are expressed here for simplicity as functions of labor but other inputs may be included. Decisions regarding the total stock of some inputs could be taken as being given. Migration, which would affect the total available household labor pool, could also be included. Making land a fixed factor, not determined within the model, may be justified if the planning horizon is one agricultural cycle. The emphasis, in the context of farming system in Upper Volta, would be on labor.

In a static, one agricultural crop cycle analysis, certain long-term decisions could be omitted from an analysis of Voltaic farm households. It would be reasonable to assume decisions have already been made about the desired level of saving and this quantity is included in the definition of the term A. Risk and uncertainty can play a crucial role in decision making. In short run analysis, risk is occasionally excluded (or included as simply a food reservation level) on the grounds that, its role is relatively less important when it can be assumed that longer term decisions have already been made at which time risk and uncertainty were fully incorporated. The household would to some extent then, be regarded as committed to a rather well-defined course of action for the duration of one crop cycle.

These are the basic elements of an agricultural household-firm model. With the knowledge that some factors are fixed in the short run (e.g. prices of outputs and wages) and with appropriate assumptions regarding the level of

certain components of the model (especially C, N, L and Z), it is theoretically possible to compute a (constrained) maximum solution to the household's utility function.

That is, a household is assumed to have a marginal utility of income (λ) and to choose the values of Z, L, C, M, and that maximize the Lagrangian function:

$$W = U(Z, L, C, M)$$

$$-\lambda(pF[D - N - T(Z) - L] + A + wN - pC - qM),$$

where the time constraint has been used to substitute for H, and $Z = Z(T)$ has been replaced by $T = T(Z)$ with $T' > 0$ and $T'' > 0$.

First-order conditions for a maximum are:

$$(6) \quad \partial W / \partial Z = U_Z' + \lambda p F' T' = 0,$$

$$(7) \quad \partial W / \partial \bar{L} = U_L' + \lambda p F' = 0,$$

$$(8) \quad \partial W / \partial C = U_C' + \lambda p = 0,$$

$$(9) \quad \partial W / \partial M = U_M' + \lambda q = 0,$$

$$(10) \quad \partial W / \partial N = \lambda(pF' - w) = 0, \text{ and}$$

$$(11) \quad \partial W / \partial \lambda = pF[D - N - T(Z) - L] + A + wN - pC - qM = 0.$$

Equations (8) and (9) are the standard first-order conditions from consumer demand theory. Equations (6) and (7) are similar if $pF'T'$ and pF' are considered as the price of Z and L, respectively. Equation (10) is the profit-maximization condition for labor transactions while equation (11) is a combined income and time constraint.

FOOTNOTES TO APPENDIX C

¹ Much of the following follows closely Barnum and Squire's (1979) discussion of an agricultural household-firm model.

² Examples of "Z" goods in Upper Volta would be food and fuel processing, metal working, the manufacture and repair of tools and implements, pottery and ceremonial objects; as well as investments in building houses, repairing fences, and an assortment of services such as recreation, protection, transportation and distribution (Hymer and Resnick, 1969 cited in Barnum and Squire, 1979).

APPENDIX D
OTHER SUPPORTING DATA

TABLE D-1

**Average Price Received for
Animals by Sex and Breed**

Animal		I	Sex	
/ Breed		I	Male	Female
		I		
Cattle:		I	(FCFA)	
	Zebu	I	42305	29025
		I	N=110	N=17
		I		
	Taurin	I	15940	20335
		I	N=3	N=2
		I		
	Metisse	I	26360	15900
		I	N=51	N=4
		I		
.....		I		
Sheep:		I		
		I		
	Peul	I	5000	1250
		I	N=2	N=1
		I		
	Bariba	I	3645	1805
		I	N=21	N=7
		I		
	Metisse	I	3465	2220
		I	N=137	N=36
		I		
.....		I		
Goats:		I		
		I		
	Peul	I	1750	965
		I	N=3	N=3
		I		
	Bariba	I	2360	1585
		I	N=19	N=20
		I		
	Metisse	I	2890	1665
		I	N=201	N=134
		I		

Note: Includes only healthy animals.
A male Zebu Maure averages 350-450 kg.
and a male Taurin N'Dama, 250-350 kg.
A Peul sheep can weigh 40 kg. at 3-5 yrs.
while a Peul goat, 26 kg. at 4-9 yrs.
(Source: CID, 1980)

TABLE D-2
Cattle Herd Structure

Age	% of Total	Bar Graph of Herd Composition
Hoe Subsample -----		
Females -----		
< Wean	11.8	*****
Wean - Reproductive	19.0	*****
Reproductive	33.9	*****
Reprod./Sterile	1.8	*
Males -----		
< Wean	13.3	*****
Wean - Reproductive	10.8	*****
Reproductive	9.5	*****
Reprod./Sterile	10.3	*****
ANTRAC Subsample -----		
Females -----		
< Wean	13.7	*****
Wean - Reproductive	14.7	*****
Reproductive	31.5	*****
Reprod./Sterile	1.2	*
Males -----		
< Wean	13.1	*****
Wean - Reproductive	16.6	*****
Reproductive	9.2	*****
Reprod./Sterile	29.9	*****

Note: Data is from herds in the 5 ANTRAC zones.

TABLE D-3
Sheep Herd Structure

Age	% of Total	Graph of Herd Composition
Hoe Subsample -----		
Females -----		
< Wean	18.5	*****
Wean - Reproductive	34.7	*****
Reproductive	4.2	****
Males -----		
< Wean	21.1	*****
Wean - Reproductive	10.6	*****
Reproductive	10.9	*****
.....		
ANTRAC Subsample -----		
Females -----		
< Wean	11.2	*****
Wean - Reproductive	18.7	*****
Reproductive	1.0	
Males -----		
< Wean	7.1	*****
Wean-Repr.	3.7	***
Reprod.	4.8	****

TABLE D-4
Goat Herd Structure

Age	% of Total	Graph of Herd Composition
Hoe Subsample -----		
Females -----		
< Wean	20.9	*****
Wean - Reproductive	34.6	*****
Reproductive	3.6	***
Males -----		
< Wean	17.3	*****
Wean - Reproductive	11.8	*****
Reproductive	11.8	*****
.....		
ANTRAC Subsample -----		
Females -----		
< Wean	22.2	*****
Wean - Reproductive	38.7	*****
Reproductive	2.1	*
Males -----		
< Wean	19.1	*****
Wean - Reproductive	8.7	*****
Reproductive	9.2	*****

TABLE D-5

Average Annual Animal Sales in Relation to Herd Size (Entire Hoe Sample)

Number of Animals Owned	Percent in Each Category	Cattle	Sheep	Goats
Cattle:				
None	70	.037	1.08	1.27
1-2	8	.250	.458	1.17
3-5	7	.227	.455	1.05
6-15	8	.538	.808	1.58
16-30	6	1.11	.947	.895
31+	2	1.60	1.80	1.00
Sheep:				
None	24		.182	.753
1-10	55		.628	1.47
11-15	12		.632	1.24
16-30	9		1.04	1.19
31+	*		1.00	1.00
Goats:				
None	16		.549	.647
1-10	55		.557	1.23
11-15	17		.309	1.02
16-30	10		.906	2.66
31+	1		1.33	1.00
Average		.197	.556	1.24

TABLE D-6
Cattle Sales Per Survey Period
(Entire Hoe Subsample)

Period	Month*	No.	No. of H-holds	!	Bar Graph of Number Sold
1	May	5	4	!	*****
2	June	8	7	!	*****
3	July	8	7	!	*****
4	J/Aug	5	5	!	*****
5	A/Sept	8	8	!	*****
6	S/Oct	7	5	!	*****
7	O/Nov	11	8	!	*****
8	Nov/D	1	1	!	*
9	Dec	16	6	!	*****
10	Jan	5	4	!	*****
11	Feb	4	4	!	*****
12	March	2	2	!	***
13	April	2	2	!	***
		==		!	
Total:		82		!	
				!	
Annual Average :		2.0		!	
				!	

Note: This table includes only those households that sold at least 1 animal during the year. Some households sold an animal during more than one period.

* Survey periods and months overlap--see Figure 2.4.

TABLE D-7

Sheep Sales per Survey Period

(Entire Hoe Subsample)

Period	Month*	No.	No. of H-holds	!	Bar Graph of Number Sold
1	May	10	10	!	*****
2	June	15	14	!	*****
3	July	12	11	!	*****
4	J/Aug	14	12	!	*****
5	A/Sept	27	20	!	*****
6	S/Oct	25	18	!	*****
7	O/Nov	34	15	!	*****
8	N/Dec	11	10	!	*****
9	Dec	7	6	!	*****
10	Jan	23	10	!	*****
11	Feb	12	9	!	*****
12	March	7	7	!	*****
13	April	20	16	!	*****
		===		!	
	Total	217		!	
	Annual Average:	2.1		!	

Note: This table includes only those households that sold at least 1 animal during the year. Some households sold an animal during more than one period.

* Survey periods and months overlap--see Figure 2.4.

TABLE D-8
Goats Sales per Survey Period
(Entire Hoe Subsample)

Period	Month*	No.	No. of H-holds	!	Bar Graph of Number Sold
1	May	36	20	!	*****
2	June	52	30	!	*****
3	July	68	41	!	*****
4	J/Aug	32	22	!	*****
5	A/Sept	34	24	!	*****
6	S/Oct	44	23	!	*****
7	O/Nov	25	16	!	*****
8	Nov/D	14	13	!	*****
9	Dec	17	16	!	*****
10	Jan	25	15	!	*****
11	Feb	26	22	!	*****
12	March	34	21	!	*****
13	April	23	18	!	*****
	===			!	
	Total	430		!	
	Annual Average:	2.6		!	

Note: This table includes only those households that sold at least 1 animal during the year. Some households sold an animal during more than one period.

* Survey periods and months overlap--see Figure 2.4.

TABLE D-9
Small Ruminant Sales per Survey Period
(Entire Hoe Subsample)

Period	Month*	No.	No. of H-holds	Bar Graph of Number Sold
1	May	46	28	! *****
2	June	67	41	! *****
3	July	80	50	! *****
4	J/Aug	46	32	! *****
5	A/Sept	61	40	! *****
6	S/Oct	69	36	! *****
7	O/Nov	59	29	! *****
8	Nov/D	25	21	! *****
9	Dec	24	22	! *****
10	Jan	48	21	! *****
11	Feb	38	29	! *****
12	March	41	28	! *****
13	April	43	33	! *****
		===		!
Total: Total		647		!
Annual Average :		3.2		!

Note: This table includes only those households that sold at least 1 animal during the year. Some households sold an animal during more than one period.

* Survey periods and months overlap--see Figure 2.4.

TABLE D-10

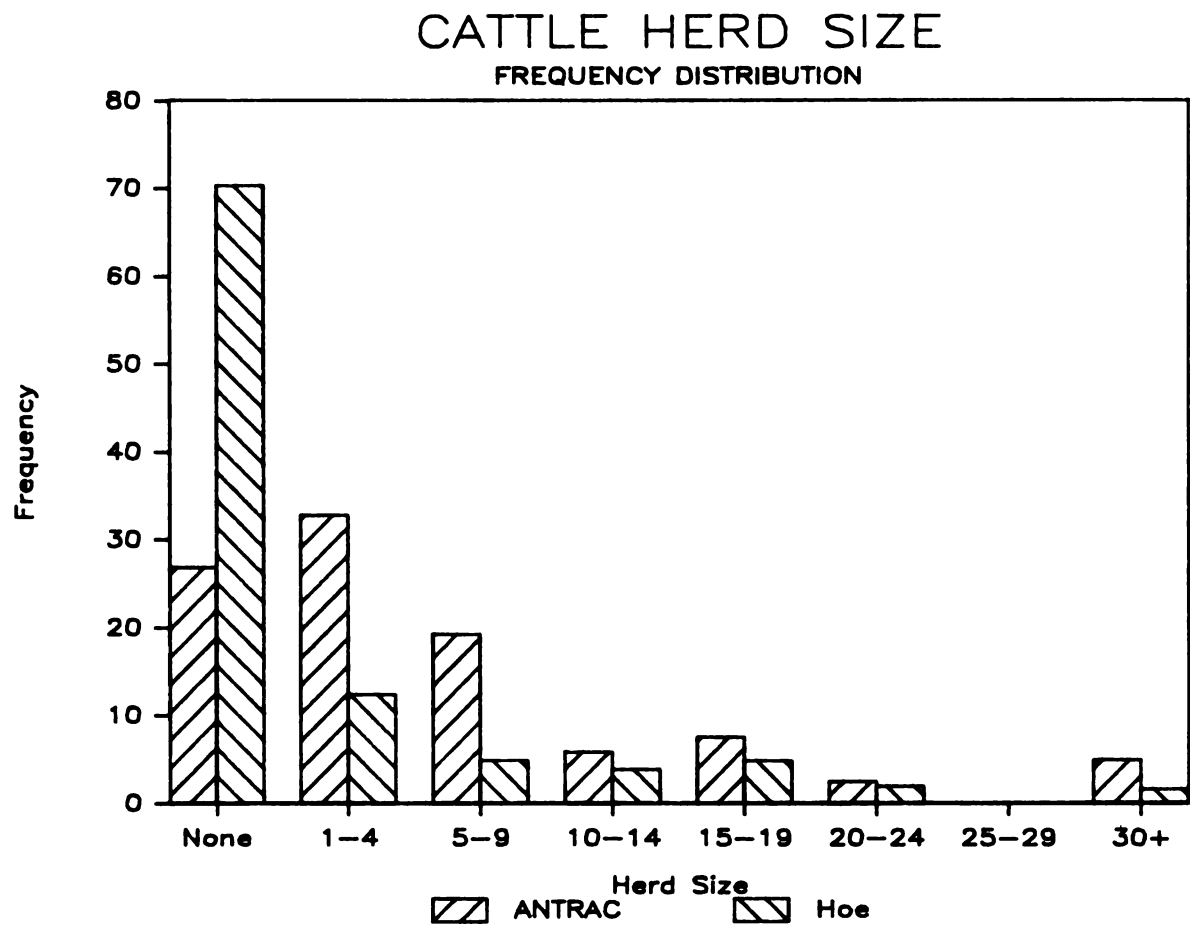
Average Household Income per Period From
Livestock Sales: All Hoe Households
(in FCFA)

Period	Cattle	Sheep	Goats	All Animals
1	26625	2155	3854	6033
2	24143	2675	4418	6647
3	27357	2386	3741	6290
4	31200	2463	2886	6386
5	17656	3870	2790	5492
6	55700	4717	3262	9531
7	20138	11350	3942	10113
8	27575	3555	1812	3611
9	70392	3942	2891	17580
10	54750	9110	6283	13943
11	14125	3465	3782	4882
12	25750	4121	5275	6371
13	16250	3822	3858	4531
Total Income:	2013275	718830	1059020	3791125
Ave/period :	31666	4433	3753	7801
# Sellers :	42	104	164	213
Ave/seller :	47935	6912	6457	17799
Ave/H'hold *:	6391	2282	3362	12035

TABLE D-11

Average Household Income per Period From
Livestock Sales: ANTRAC Households
(in FCFA)

Period	Cattle	Sheep	Goats	All Animals
1	21500	2733	3458	9746
2	160000	3318	4250	38447
3	126750	3312	2617	41963
4	16333	2515	2630	5748
5	442500	5100	1950	179430
6	134000	5125	4925	97150
7	21833	26308	3712	18323
8	285625	14500	6217	193179
9	359333	20250	2090	112895
10	65333	2175	7000	30621
11	100000	2000	2362	18575
12	49166	5000	3106	13382
13	221625	1300	9000	101789
Total Income:	8220500	304550	201250	8726300
Ave/period :	154154	7203	4101	66250
# Sellers :	34	30	41	71
Ave/seller :	241779	10152	4909	122906
Ave/H'hold* :	65764	2436	1610	69810

**FIGURE D-1****Frequency Distribution of Cattle Holdings**

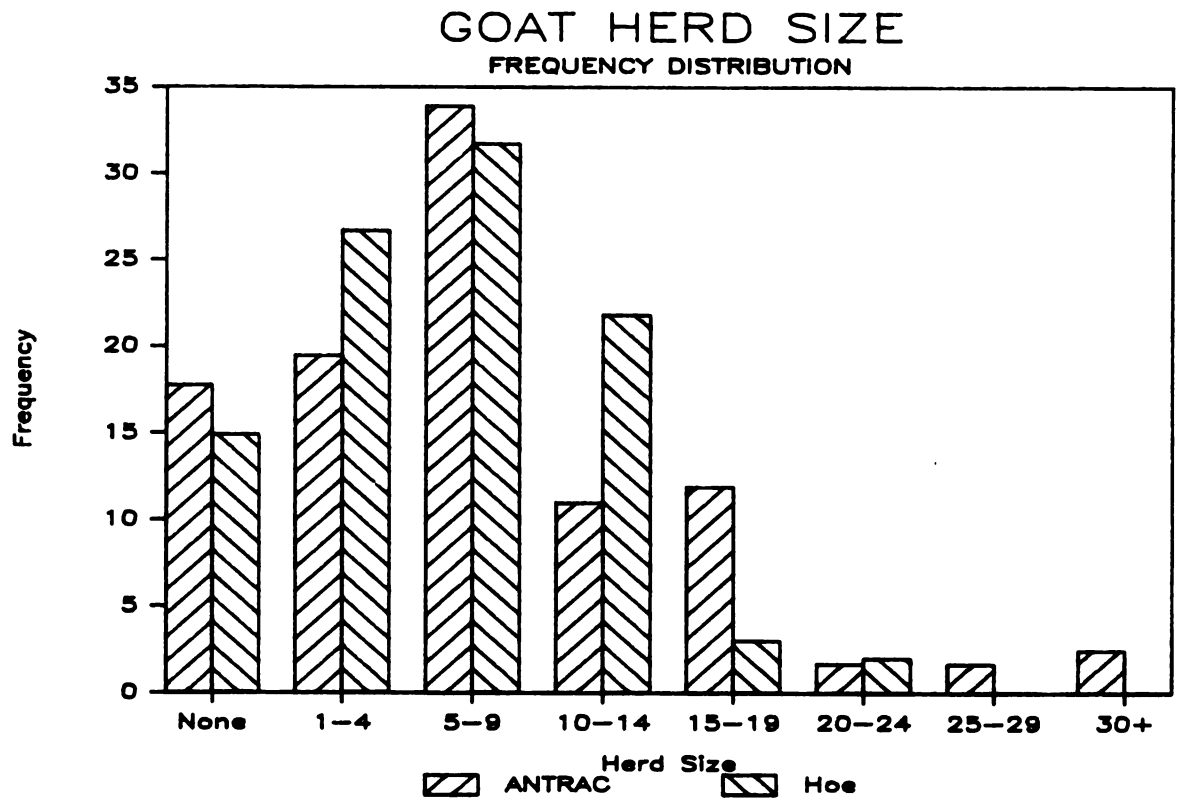
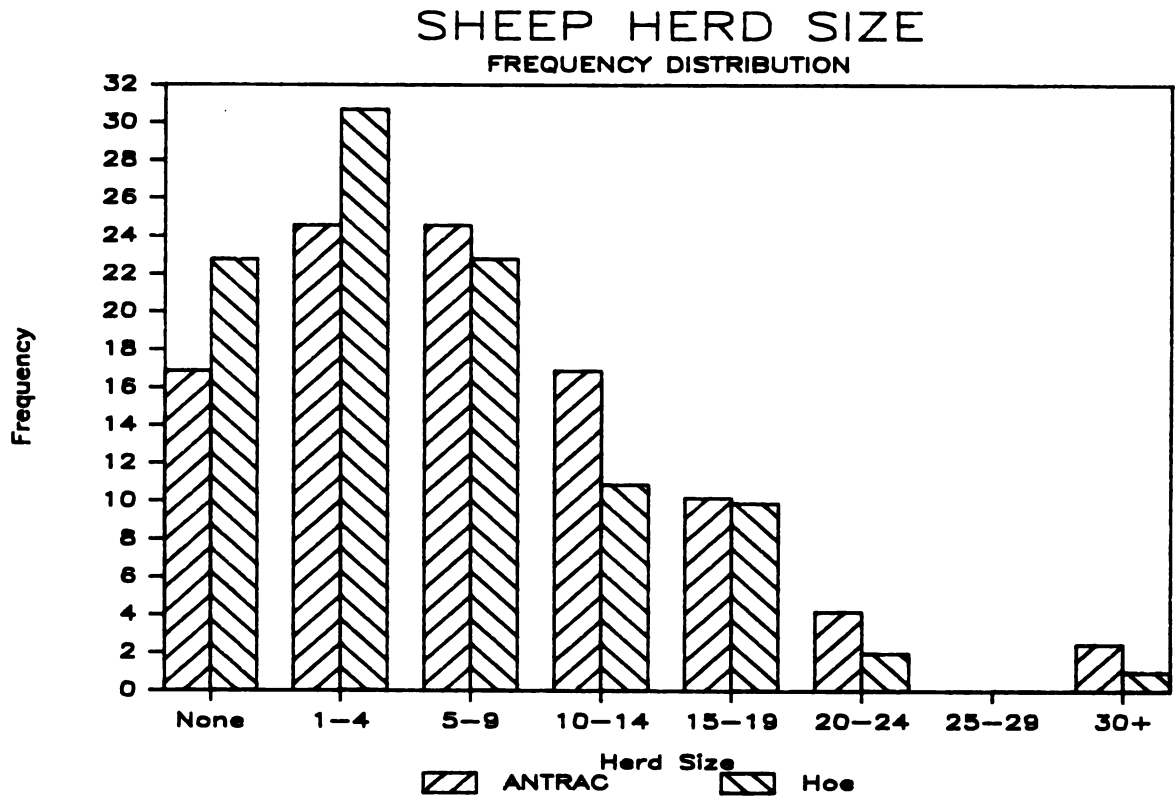


FIGURE D-2

Frequency Distribution of Small Ruminant Holdings

SMALL RUMINANT SALES AND GRAIN PRICE

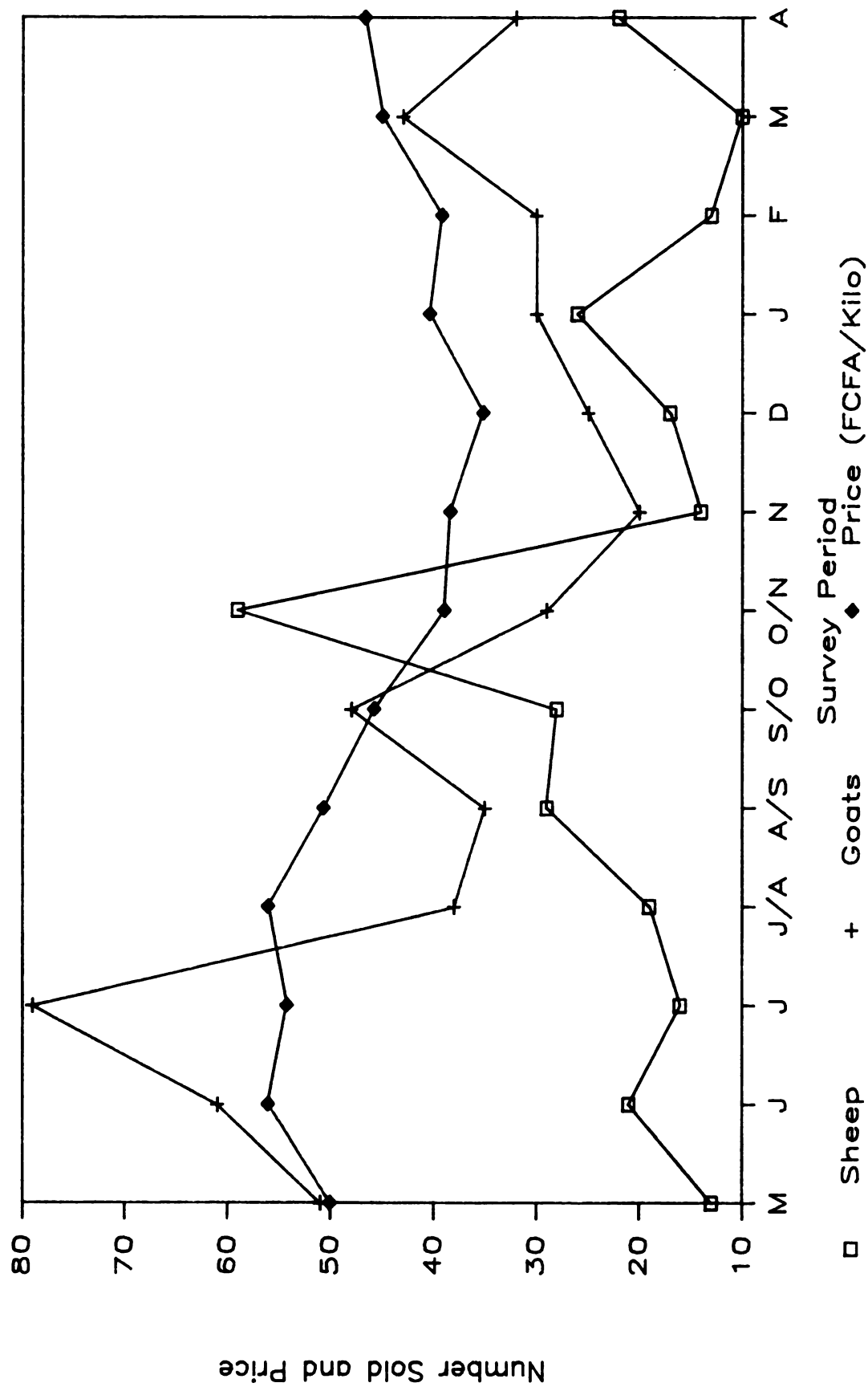


FIGURE D-3

Small Ruminant Sales and Grain Prices

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