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Livestock Development and Range Utilization in Lesotho

Brent M. Swallow, Ray F. Brokken, 'Mabaitsi Motsamai
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May 1987

(b)

LIVESTOCK DEVELOPMENT AND RANGE UTILIZATION IN LESOTHO

by

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PREFACE

The research reported below was undertaken under the joint institutional auspicies of the Institute of Southern African Studies at the National University of Lesotho, and the Research Division of the Lesotho Ministry of Agriculture and Marketing. Two research projects, operating jointly but under seperate institutions and funding, provided most of the support and guidance for the research. At the Institute of Southern African Studies the research was conducted as part of the Agricultural Marketing Research Project. At the Ministry of Agriculture and Marketing the research was supported with both personnel and resources provided by the Farming Systems Research Project.

The Agricultural Marketing Research Project at the Institute of Southern African Studies is a three-year project which began in September 1984 and is scheduled to continue until August 1987. The project is being conducted jointly by the University of Saskatchewan in Canada and the National University of Lesotho with funding provided by the International Development Research Centre (Canada). Brent M. Swallow is the Project Leader, Limpho Sopeng is a Research Assistant, and Gary G. Storey is the Project Supervisor.

The Farming Systems Research Project was a seven-year project which began in July 1979 and ended in June 1986, based at the Research Division of the Ministry of Agriculture and Marketing. The Project was conducted by Washington State University and the Ministry of Agriculture with external funding provided by the United States Agency for International Development, Contract No. AID/afr-1517. 'Mabaitsi Motsamai is the Head of the Marketing Section of the Research Division, and Ray F. Brokken was the Marketing Specialist with the Project between June 1984 and October 1986.

Both the Agricultural Marketing Research Project and the Marketing Specialist with the Farming Systems Research Project arrived in Lesotho with some mandate to conduct research into the marketing of livestock and livestock products. From a review of relevant conceptual literature, however, it quickly became apparent that to analyze marketing, it is necessary to also understand production and utilization as interdependent components of a single livestock system. None of the researchers felt that adequate analysis of the Lesotho livestock system had been completed to date. The idea of a broad research project on the production, utilization and marketing of livestock and livestock products was a natural result.

The three principal researchers received enthusiastic support from their supporting institutions. Involvement by the Agricultural Marketing Research Project was supported by the Project's Steering Committee and by the International Development Research Centre. The Marketing Specialist and the Head of the Marketing Section at the Research Division were supported by both the Ministry of Agriculture and Marketing, and the Washington State Farming Systems Research Project. In addition, key support for survey research costs was provided by a research grant provided by the Southern African Centre for Cooperation in Agricultural Research (SACCAR), with funding from the Swedish Agency for Research Cooperation with Developing Countries.

It was decided that the research should be conducted in three phases: the first phase should be a review of all relevant Lesotho-specific and conceptual literature; The second phase should centre around a survey of livestock owners; and the third phase should be an analysis of the survey results and hypothesis testing within a solid conceptual framework.

Preliminary results of the survey have already been published in three different reports: Cattle Marketing in Lesotho (Swallow, Mokitimi and Brokken 1986); Lesotho Hides and Skins Marketing Symposium (Motsamai and Brokken 1986); and The Economics of Wool and Mohair Production and Marketing in Lesotho (Hunter 1987). Final results of the survey have recently been published in A Survey of the Production, Utilization and Marketing of Livestock and Livestock Products in Lesotho. That report should be viewed as a companion to this one.

In this report a conceptual model of the overall Lesotho livestock system is presented first. This is followed by financial analysis of the cattle, sheep and goat enterprises held by the surveyed households. A conceptual model of livestock / range interactions is presented, specified for Lesotho conditions, then used to analyze a variety of livestock and range development programmes. A number of conclusions, recommendations and suggestions of research priorities conclude the report.

Previous drafts of components of this report have been presented at a number of seminars, and useful comments were received each time. In Lesotho a well-attended open seminar was delivered at the National University of Lesotho as a part of the Institute of Southern African Studies seminar series. Following that a small private meeting was held with the Honourable Advisor to the Ministry of Agriculture, where Dr. Phororo provided a number of very useful comments.

In February 1987 one of the authors, Brent Swallow, presented an earlier draft of this paper at a number of international venues. This paper was given a very thorough review at each of these seminars. At the International Livestock Centre for Africa in Addis Ababa, Ethiopia, Addis Anteneh and Stephen Sandford were both gracious hosts and critical reviewers. At Virginia Polytechnic Institute and State University, Tom Johnson, Brady Deaton and George Norton provided particularly useful comments. At the University of Saskatchewan Murray Fulton and Hartley Furtan had a number of important criticisms. At the International Food Policy Research Institute and the World Bank, both in Washington D.C., Alberto Valdez and Ridley Nelson were gracious in taking time out from their busy schedules to organize seminars of great value to the presenter.

Special thanks go to John Hunter, Chris Weaver, Wesley Combs, John Shoup, and Dan Phororo for their particularly helpful comments. John Hunter's mathematical skills were of particular help for the model presented in chapter 4. Bertha Buberwa was of tremendous help in typing and compiling the report during Swallow's final days in Lesotho.

All errors and ommissions remain the sole the responsibility of the authors.

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1. INTRODUCTION

1.1 PROBLEM

Lesotho's livestock industry has long been a vital component of the economic and social structure of the country. Historically Basotho have long invested in cattle and have extracted many valuable products from those cattle including meat, milk, dung and draught power. Basotho rapidly adopted angora goats and merino sheep which generate cash income through sales of wool and mohair, and provide meat and milk to meet subsistence requirements. Because of their subsistence and economic importance, cattle, sheep and goats have also become important in ceremonies and social obligations.

While there is evidence to suggest that livestock remain one of the best investments available to individual Basotho, there is cause for concern about the future of the livestock industry. The statistics indicate that there is a low marketed offtake of animals and animal products, wool and mohair are of low quality, fertility rates are low and mortality rates high, and an inequitable ownership pattern leaves many households with an insufficient number of cattle for draught purposes. At the same time the range experts report that the range is heavily overstocked and will continue to degenerate unless stocking rates are reduced substantially.

Pim (1935) and Staples and Hudson (1938) were among the first of a series of analysts to state concern about the future of Lesotho's livestock industry. While there is general agreement about the need for solutions, agreement about what those solutions should be is far less than unaminous. Four types of initiatives have been undertaken in recent years: (1) the construction of marketing infrastructure; (2) the experimental implementation of grazing associations; (3) the extension of production information, animal health care, and improved breeds; and (4) the forced culling of animals judged to be of inferior genetic stock (very little actual implementation of this one recently). While these initiatives have invariably been justified for their supposed effects of reducing the stocking rate and increasing animal and range productivity; their actual consequences cannot be quantified because of the general lack of basic information regarding livestock production practices, product utilization and marketing patterns, and the decision environment of the livestock owners.

Fortunately within the last few years a condusive climate for debate on livestock development has emerged in Lesotho. Tenure of grazing land was one of the issues addressed at the `Land Act Policy Seminar', held in March of 1984. A few months later a number of livestock development issues were discussed at the `Seminar on the Development of Productivity of Mountain Livestock'. Most recently, a `Workshop on Grazing Associations in Lesotho' was held. Proceedings from all three seminars have been published. However, missing from all three of these seminars was a sound basis of technical, economic and social research to guide decision makers.

A small number of social scientists have recently attempted to fill the conceptual and empirical gaps which exist in the Lesotho livestock and range development literature. Dobb (1985) analyzed the Lesotho experience with grazing associations and the social institutions which affect range use and livestock management. Lawry (1986) examined a number of economic and institutional elements of the Sehlabathebe Range Management Association in commendable detail. Swallow, Mokitimi and Brokken (1986) examined cattle marketing. Most recently Combs and Hunter (1987) examined a number of issues related to livestock development in Lesotho, including marketing, forced culling programmes, and the appropriate livestock mix. Hunter (1987) examined the economics of wool and mohair production and marketing in great detail.

Missing from the recent Lesotho literature is an analysis of the Lesotho livestock / range complex which incorporates all of the related biological, economic, social, and ecological factors within an integrated framework. Such an analysis is the purpose of this report.

1.2 OBJECTIVES

The overall objective of this report is to provide public and private decision makers in Lesotho with insights critical to the development of the Lesotho livestock/range complex. Attainment of that overall objective is contingent upon fulfillment of the following subobjectives:

(1) develop a conceptual model which incorporates economic, biological and ecological elements of the livestock / range complex;

(2) quantify the model for Lesotho conditions;

(3) evaluate the total contributions of Lesotho's cattle, sheep and goat populations to the domestic economy. Total value will be composed of the values of "stock" products (meat, offal, hides and skins from both slaughtered and fallen animals), and "flow" products (milk, progeny, draught power, dung, wool and mohair). Values conferred financially (savings, liquid assets, store of wealth), socially (mafisa, ceremonies and bohali), and psychologically (prestige and status) will also be examined, though they may be intangible;

(4) determine the economic, ecological and institutional variables key to the decision making of Basotho stockowners, and likely responses to changes in those variables;

(5) Examine the importance of animal draught power in affecting management decisions and in making meaningful offtake comparisons and analyses;

(6) Examine the utilization patterns of animals dying from natural causes;

(7) Determine the importance of livestock as financial assets -- if cattle, sheep and goats conger utility as exchange and saving mechanisms, then they can be compared to alternative mechanisms with

regard to riskness, rate of return and liquidity;

(8) Examine both formal and informal markets for livestock and livestock products;

(9) Examine the importance of livestock in meeting social obligations, and in distributing livestock wealth within the community;

(10) Prescribe policies appropriate to the meeting of development objectives in the livestock sector.

1.3 HYPOTHESES

The following hypotheses will be tested in the course of the research:

(1) Economic factors dominate over social and cultural factors in determining how and why Basotho own and manage their livestock;

(2) Basotho regard their livestock as capital assets, and as capital assets livestock generate returns competitive with other available investments;

(3) The overstocking of Lesotho's rangeland is consistent with individual decision making based on economic criteria;

(4) Mafisa and sharecropping are flexible institutions for allowing individual households to maximize their production of crop and livestock products;

(5) Marketing channels which link stockowners are more important than other more formal marketing channels; and

(6) Much of the meat and offal from the cancasses of fallen animals is consumed.

1.4 RESEARCH METHOD

The research project was divided into three distinct components. The first component involved an extensive review of relevant Lesotho and international literature. This literature review was necessary to determine the `state of the art' of social science literature related to livestock and range development in Lesotho, and to establish an appropriate conceptual foundation on which further analysis could be based. The findings of this literature review were reported in a series of working papers. A summary of the some of the salient points of the international literature was reported in Cattle Marketing in Lesotho by Swallow, Mokitimi and Brokken (1976).

The second and largest component of the project was a survey of 537 livestock-owning households. The survey was based on the same conceptual

model as is presented here. That is, information was gathered on a variety of components of the livestock system -- technical, social, financial and household components -- all in the framework of livestock as investments and economic factors being the principal driving force of the overall system. Those data are presented in a separate report by the same authors which should be read as a companion to this one, entitled: A Survey of the Production, Utilization and Marketing of Livestock and Livestock Products in Lesotho.

The third component of the project -- interpretation of a broad range of literature, aggregate data, and data from the survey -- is the principal focus of this report. The analysis presented is centred around a conceptual model of the livestock system with four component subsystems -- livestock, range, society and household. The livestock subsystem consists of production systems in which five livestock species produce an array of valuable `flow' and `stock' products for both subsistence consumption and trade on commercial markets. The household subsystem is modelled as a utility maximizing unit facing strict resource constraints, production functions, and exchange conditions. The range subsystem produces vegetative matter as input into the livestock subsystem, and is affected in both the short term and long term by interactions with the livestock subsystem. The household, range and livestock subsystems are all intertwined through a complex set of economic and social relationships. The interactions between the subsystems are described in detail in chapter 2. Conceptual background for analysis of each subsystem is also presented.

Enterprise budget analysis is employed in chapter 3 to examine the financial input / output status of the cattle, sheep and goat enterprises. This is followed by analysis of stockowner attitudes toward their livestock enterprises.

A conceptual model of the livestock / range complex consistent with the treatment of cattle as economic investments is developed and specified for Lesotho conditions in chapter 4. The model is used to examine a number of livestock and range development programmes in chapter 5. Conclusions, recommendations, and suggested research priorities are presented in chapter 6.

2. THE LESOTHO LIVESTOCK SYSTEM

Over the past fifty years government institutions and donor agencies have committed a great deal of resources to the 'development' of the Lesotho livestock system. While it is not clear how successful these initiatives have been, it is clear that both problems and donor financing of projects remain and are likely to continue. For these initiatives to have greater development effect in the future it is important that those involved understand the intricacies of the livestock system and the decision mechanisms that affect it. With the importance of social factors, the communal use of resources, and the structure of the legal and political institutions, individual livestock-owning households are left with far fewer management options than their counterparts in Europe or North America.

In this chapter the livestock system is described with emphasis placed on the decision-making processes which may be affected to encourage development. For that purpose livestock development is here defined as changes in management, technology or institutions which lead to sustainable increases in the nation's net economic returns from the livestock sector. Increasing physical outputs per animal, per unit labour, or per unit land, are not goals in themselves. Rather, increasing physical productivity should be the purpose and focus of livestock development efforts only if it leads to increases in net economic returns to the nation as a whole, or to some socially-superior distribution of those returns.

2.1 AN OVERVIEW OF THE LIVESTOCK SYSTEM

In figure 2.1 a graphical depiction of the livestock system is presented. At the most general level, the system is composed of four subsystems: the household subsystem, the social subsystem, the range subsystem, and the livestock subsystem. These four subsystems are linked through a number of social, biological, economic, and ecological relationships to generate a complex overall system. In the livestock subsystem five species of animals -- cattle, sheep, goats, horses and donkeys -- convert feed resources into a variety of useful products. In economic terminology some of these are `flow' products; products like milk, progeny, draught power, dung, wool and mohair flow from the animals while they are still alive. Others are `stock' products -- meat, offal and hides -- which can only be utilizied when the animals die. If such things as prestige and status accrue to the owners of livestock, then they are `intangible' products.

Within the household subsystem decisions are taken to maximize utility generated from the consumption of goods, services and leisure subject to a number of resource constraints, production relationships and exchange conditions. The household subsystem interacts with the livestock subsystem through the sale and household consumption of products, the allocation of labour and management, and the allocation of investment funds.

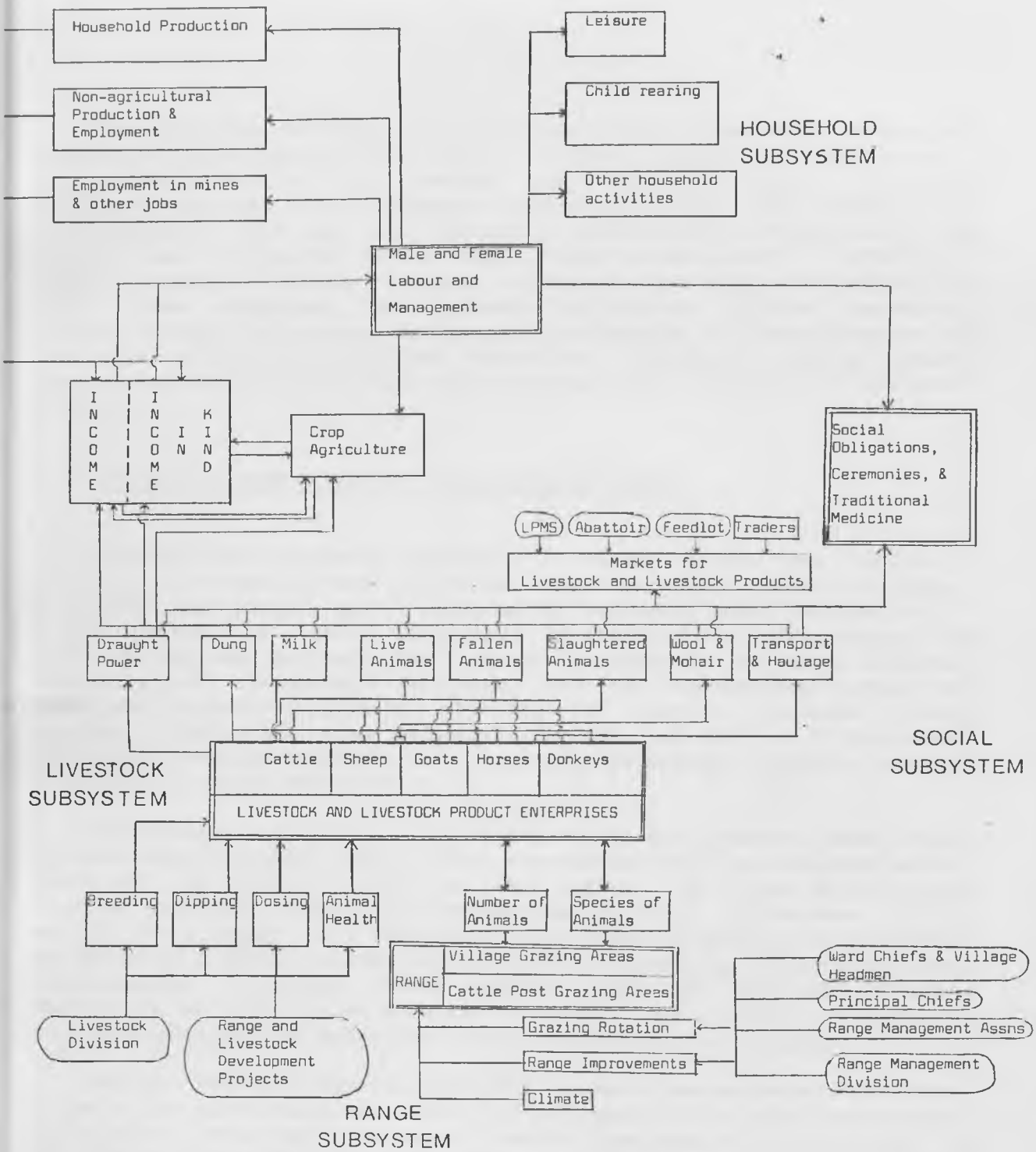

Figure 2.1 Graphical Depiction of the Lesotho Livestock System

The livestock and range subsystems are related through the grazing and browsing of the animals on the range. Primary output of the range -- vegetative matter -- is converted into secondary output -- livestock products -- through the biological processes within the animal. The relationship is not one way. Livestock productivity is determined by the quantity and quality of forage input, range productivity is affected by animal grazing. Social customs, ceremonies, and obligations affect the other three subsystems, and economic motivations provide the overall engine driving the system. Government intervention is concentrated on the provision of inputs into the production processes, grazing control regulations and institutions, and the markets for livestock and livestock products.

2.2 HISTORICAL DEVELOPMENT OF THE LIVESTOCK SYSTEM

Over the past 150 years Lesotho's livestock system has evolved in response to economic booms and busts, wars and peace, plenty and famine, rinderpest and health, and a continually expanding human population. A brief review of that historical development is enlightening for understanding what motivates the Basotho stockowners in their livestock ownership and management decisions; and for determining social and individual responsibilities in affecting the overall livestock / range complex. The review also challenges the myth of the ". . . traditional subsistence peasant society . . . virtually untouched by modern economic development" (World Bank 1975, p. 1).

The ravages of Shaka's wars of expansion and conquest swept across Southern Africa in the early 1800s devastating the established social, political and economic order of the region. The clans which grouped together under the leadership of Moshoeshoe, chief of the Bakwena, at the end of the lifaqane wars had lost most of their livestock during the wars so relied to a greater extent on cultivation for meeting their subsistence requirements. Eldredge (1986) suggests that the reduction in cattle numbers in the 1820s was as much due to drought and a cattle epizootic as to the hostilities and migrations which accompanied the lifaqane.

As the Basotho federation expanded southward and westward from Butha-Buthe in the 1820s and early 1830s, the influence of the white voortrekkers and traders concurrently extended from the Cape area of South Africa. By the time the Boers first traded goods, cattle, sheep and goats for Basotho agricultural produce, the Basotho had already been established as important agricultural producers in the region (Eldredge 1986; Kimble 1979).

Besides trade, successful raids on neighbouring tribes helped the Basotho to rapidly increase their herds of mixed-breed cattle, fat-tailed sheep and boer goats. The missionary Arbousset wrote that in the five-year period 1833 to 1838, 1500 cattle, 40,000 sheep, 35,000 goats and 200 horses had been imported into Lesotho through trade with neighbouring tribes. Hailey (1955) described the Basotho as a ". . . community that lived on raiding their neighbours' stock".

Under Moshoeshoe the distribution of livestock ownership became

important to the political, social and economic order of Lesotho. Much of the cattle wealth was owned by chiefs who lent the animals out on mafisa arrangements to lesser chiefs and to commoners. Under these arrangements the chiefs gained access to grazing lands throughout the country, while binding dispersed groups of people into a cohesive nation. In return for rights to the milk and progeny produced by borrowed animals, people with mafisa animals were expected to respect the authority of the chiefs and provide their services for both war and field work on the chief's land.

Milk, meat and social value were the most important products of the cattle, fat-tailed sheep, and boer goats owned by Basotho until the mid 1800s. After that time the introduction of the plough and subsequent increases in cultivated land resulted in an increased demand for cattle as draught animals. Wool and mohair became important products of the sheep and goat populations by 1875. Within a small number of years merino sheep and angora goats, first seen in Lesotho in the 1850s, became the dominant breeds (Hunter 1987, pp. 30-31). In 1873, 2000 bales of wool, each weighing 300 pounds, were exported from Lesotho (Pim 1935, p. 29).

The adoption of the merino sheep and angora goats was led by commoners who used income from migrant labour and agricultural production to purchase the animals imported from the Cape. The majority of the cattle wealth remained with the chieftaincy class through mafisa and other bohlanka arrangements. Hunter (1987) documents how the expansion in the number of small stock between 1875 and 1931 illustrates the aptitude of common Basotho for the pursuit of economic gain through the production and trade of goods. Relatively high prices of both wool and mohair made angora goats and merino sheep very attractive investments for households with surplus funds available. Earnings from migrant labour also became important for Basotho men wishing to make bridewealth payments (bohali or lobola) (Pim 1935, pp. 38-40).

Increases in the numbers of cattle, sheep, goats, horses and donkeys coupled with increased human populations to severely strain Lesotho's land base. This strain intensified particularly after 1868 with the annexation of Lesotho into British Territory and the final establishment of Lesotho's boundaries in 1872. The strain on land resources brought about four results in the livestock / range complex. Firstly, donga and sheet erosion became more severe in the lowland areas. Secondly, the system of maboella was introduced to protect lowland grazing areas. Thirdly, permament settlements were established in the mountain valleys formed by the Senqu River and its tributaries. Fourthly, the system of seasonal rotational grazing was started whereby animals were rotated from the cattle posts in summer to the lowland grazing areas in winter (Eldredge 1986; Kimble 1979).

Hailey (1955) identified four types of land which provide livestock fodder, each of which were controlled by different mechanisms. On arable cropland exclusive usufruct rights to raise crops were granted by chiefs so enpowered by the Laws of Lerotholi of 1922 and the Native Administration Proclamation of 1938. After harvest the crop residue from maize and sorghum were generally considered to be communal property, while the residue from wheat could be retained by the cultivators for their own use.

In the lowland wards pasture land was divided into two categories:

open grazing land and reserved grazing land (maboella). Maboella are grazing lands which are reserved for rotational or winter grazing with some areas reserved for such specialized uses as the production of thatching grass. Ward Chiefs and Chiefs were responsible for the administration of maboella. Principal Chiefs including the Paramount Chief, were responsible for the use of mountain grazing lands. In some mountain areas permament settlements were prohibited, and livestock owners were expected to make arrangements with the relevant chief before establishing a cattle post from where the animals would be grazed during the summer months.

Swallow, Mokitimi and Brokken (1986) and Hunter (1987) have recently demonstrated the variability of the livestock populations, and the important fact that 1931 marked the highest recorded numbers of cattle, sheep and goats for Lesotho. Hunter (1987, pp. 42-47) suggested that since 1931 livestock populations have been oscillating around a 'steady-state' population of two million animals. Hunter (pp. 47-56) has also shown how the sheep / goat population ratio has changed over time in response to changed economic conditions facing the owners of these animals.

2.3 SOCIO-CULTURAL FACTORS AFFECTING THE LIVESTOCK SYSTEM

Throughout the 1800s the distribution of livestock was an important influence in binding the Basotho peoples together. Moshoeshoe managed to protect sufficient stocks of cattle throughout the lifaqane and into the following years to facilitate rapid expansion of his political influence.

> At the heart of the Basotho unification was the mafisa system. This was a patronage system of socio-economic relationships in which a rich cattle-owner loaned one or more head of cattle to a poor man without cattle. Often this occurred after cattle had been captured in battle. The chief kept the cattle captured by his people in raids, but distributed them among his subjects. Each man who took cattle into his keeping became responsible for the care and well-being of the animals, and received in exchange the right to the milk produced and occasionally to some of the offspring (Eldredge 1986, p. 86).

Phororo (1979) described the mafisa system as it existed in the late 1970s as a system based on a 'share-alike' ethic where wealthy households loan animals to poor households in a redistribution of wealth so that more households have access to milk and draught power produced by the animals. Information from the 1985 Livestock Holders Survey suggests that the social motivation, while still important, is being replaced by economic motivations in mafisa arrangements.

> "In fact, borrowing and lending of animals through mafisa now appears to be one of the important management techniques available to Basotho. Households which lack access to key financial, labour, management or range resources enter into mafisa relationships with other households with complementary resource bases so as to maximize their joint returns from the livestock enterprises" (Swallow et. al 1987).

When asked why they loaned animals to others on mafisa, 61.2 percent of the respondants gave economic reasons for loaning cattle, 67.5 percent gave economic reasons for loaning sheep and goats. For borrowing animals from others on mafisa, economic motiviations were even more important: for cattle 70.9 percent, for sheep and goats 79.1 percent. Further information from the 1985 Livestock Holders Survey suggests that mafisa is now quite a flexible institution. Products from mafisa animals are sometimes used by the owner, sometimes used by the keeper, and sometimes shared between the owner and keeper.

During the 1800s livestock were important in other forms of bohlanka or debt-servitude relationships. Under a bohlanka relationship, a chief made payment of lobola (bohali) or bridewealth in the form of cattle on behalf of a man who was in turn bound in servitude to the chief (Kimble 1979, pp. 49-53). There is no evidence to suggest that bohlanka practices continue today, while bohali payments certainly do continue.

Attitudes towards bohali varied, and continue to vary tremendously. The Paris Evangelical Mission Society missionaries viewed bohali as a source and symbol of great evil in Basotho society:

> "In Basutoland it is not the woman who brings a dowry to her husband; it is the latter who delivers one to the parents of the betrothed. This dowry consists of a certain number of cattle, ten, twenty or thirty oxen or more, according to the social status and personal charms of the young woman, who thus becomes the legitimate property of the spouse. Although, properly speaking, this transaction cannot be called a sale, since, in the case of temperamental incompatability, for example, married women are always left with the possibility of liberating themselves; its effect is none the less to maintain them in a state of inferiority and subjection which is the usual condition of women in all countries in which Christianity has not yet emancipated them.
>
> "'Marriage by cattle' leads to polygamy . . . There would be no end to it if one wished to enumerate the evils which polygamy engenders" (L. Duviosin 1885 in Germond, Chronicles of Basutoland, 1967).

The preceeding quotation contrasts greatly with the words of Phororo:

> "Though the social conventions of bride price (bohali), the transfer of grazing animals between families encourages sharing of the benefits and burdens of rural life . . . These practices have contributed signficantly to the survival of the Basotho as a nation in that the society's cohesiveness and its members' sense of responsibility to the community have always been maintained and promoted (1979, pp. 17-19).

Questions about bohali were asked during the 1985 Livestock Holders Survey (see Swallow et. al. 1987). To determine the relative importance of bohali transfers compared to other factors, respondants were asked to categorize the number of cattle, sheep and goats which left their herds during the preceeding year. The data are summarized in table 2.1.

Table 2.1 Disposition of Cattle, Sheep and Goats by a Sample of Households

Type of disposition	Number of Animals Cattle	Sheep	Goats
Gift/bohali	93	135	156
Died	177	329	272
Sold/traded	100	540	186
Slaughtered	87	605	257
Stolen	54	487	96
Lost	--	--	25
Payment of shepherd	4	271	--
Total disposition	515	2367	992
Total HH with species	462	250	235
Total species numbers	3447	13654	8088

Source: 1985 Livestock Holders Survey

The data presented on table 2.1 illuminate a number of interesting aspects of the Lesotho livestock system, many of which will be addressed in later sections of this report. With respect to cattle, the data indicate disposition (including some live animals traded between households as herd replacements) of 14.9 percent of the herd during the year. The two largest components of offtake were death (34.4 percent) and sales (19.4 percent), followed by gifts and bohali transfers (18.1 percent). The gross disposition rate for sheep (17.3 percent) was slightly higher than for cattle; for goats (12.3 percent) the rate was slightly lower. Neither sheep nor goats were as important as cattle in bohali transfers. Bohali transfers were the fourth largest category for disposition of goats, and the least important category for sheep. Bohali transfers were 5.7 percent of all sheep dispositions and 15.7 percent of all goat dispositions. From these data it appears that bohali transfers were of moderate significance in total dispositions of cattle and goats, but of little significance in total disposition of sheep.

Besides bohali and mafisa, social utility is conferred upon livestock for their importance in certain ceremonies, celebrations, and traditional medicines and charms. In the 1985 Livestock Holders Survey, respondants were asked to give the reasons why decisions were made to slaughter animals. These are reported in table 2.2.

Ceremonies accounted for 77.1 percent of cattle slaughter, 35.1 percent of sheep slaughter, and 32.3 percent of goat slaughter. The relative sizes of these animals explains much of these differences. Without refrigeration it would be virtually impossible for any single household to consume an ox, bull or cow, so friends and neighbours would naturally be invited to share. Ceremonies and celebrations are thus the opportunities available for the slaughter and consumption of these large animals, while sheep and goats are small enough that they may be routinely slaughtered for home consumption. The most important ceremonies for animal

slaughter are funerals, balimo ceremonies (an offering to appease ancestoral spirits), weddings, welcome baby celebrations, and initiation ceremonies.

Table 2.2 General Reasons for Livestock Slaughter

Reason	Number of animals		
	Cattle	Sheep	Goats
Home consumption	21	369	173
Funerals	39	56	11
Welcome baby celebrations	5	41	8
Initiation ceremonies	4	15	14
Weddings	9	13	3
Sale of products	1	-	1
Balimo ceremonies	13	35	23
Other	4	40	24
Total	96	569	257

Source: 1985 Livestock Holders Survey

Particular types of animals appear to be important for particular types of ceremonies or traditional rites. For example, a black ox is slaughtered at the beginning of boys' initiation schools. The fat from around the stomach of black sheep is an important ingredient in a number of charms and medicines prepared by traditional doctors -- ngaka (personal communication with Ntate Ntsane 26/3/87).

2.4 HOUSEHOLD FACTORS AFFECTING THE LIVESTOCK SYSTEM

What species, types and ages of livestock should we have? When, where and how should we sell, purchase or slaughter our animals? Should we graze our animals at the cattle posts or in the village area throughout the year? Where and when should we sell our wool and mohair? These are among the most important of the many questions which face rural Basotho livestock owners. The answers to these questions -- management decisions -- depend crucially on the interactions between the household unit and the livestock enterprises.

It is useful to conceptualize the household as an entity which seeks to maximize its utility subject to a number of production relationships, exchange conditions, and resource constraints. Utility is derived from the consumption of goods and services, and leisure. Goods and services may be produced within the household (services like raising children, collecting fuel from the fields, carrying water, cooking meals); within enterprises controlled by the household (non-agricultural enterprises like weaving, thatching, brewing joala or agricultural enterprises like growing maize,

growing sorghum, raising cattle); or by trading household produce or labour for goods and services produced by others. Production functions describe the input / output relationships for each good or service produced; exchange conditions describe the number of units of good or service 'A' which are required to fetch one unit of good or service 'B'; and the availability of labour constrains the production of every good.

With this conceptual model as background, it is apparent that the following interactions will be important to the livestock system: (1) household demands for livestock and non-livestock goods and services will depend on the number, sex and age of household members; (2) options for the production of goods and services in other enterprises will affect the labour, management and capital allocated to the production of livestock products; (3) household demands compete with external markets for livestock products; and (4) the sex and residential status of the household head and other household members take on additional importance if there is a sexual division of labour within the household.

The system of labour migration which forces people to continually oscillate between Lesotho and South Africa permeates every aspect of Basotho life including the livestock system. The influences may be summarized into the following points: (1) the absence of males from many households strains the available household resources of labour and management to the point that most productive activities are adversely affected; (2) income remitted from migrant earnings eases the demands to sell livestock and livestock products to meet basic and emergency cash needs; (3) young men who wish to accumulate sufficient resources to make bohali payments often migrate to the mines, save their mine earnings, then purchase livestock to import back into Lesotho (See Pim 1935, Van der Wiel 1977, and Murray 1981 for case studies of this practice. Note that import restrictions imposed in the early 1980s have severely curtailed this practice); and (4) since livestock are one of the most secure and highest paying investments available to Basotho migrant workers, it is a preferred form of investment for saving migrant remittances until they can be drawn upon to support the family after the man retires from the mines (Lawry 1986, p. 13). The effect of migrant labour on livestock ownership is illustrated in table 2.3 taken from Lawry (1986, p. 17).

Table 2.3 Average size of cattle, sheep and goat holdings, by residential status of male household heads (averages for households owning type of livestock

	Cattle (n=178)	Sheep (n=119)	Goats (n=90)
Resident	10.0	107	23
Absent	6.2	35	13
All male-headed households	8.2	85	21

Source: Lawry (1986, p. 17), large sample survey, 1985

The absence of male household members through labour migration has disparate affects on different household enterprises due to a distinct sexual division of labour in Lesotho households. Female household members generally bear the responsibilities of raising children, collecting water, gathering wood and dung fuels, cooking meals, growing vegetables, raising poultry and swine, and hoeing fields; while male household members are charged with raising livestock and performing animal draught field operations. Hailey (1955) was very harsh on Basotho men when he discussed this sexual division of labour as follows:

> "It appears that the Basuto have always claimed to be pastoralists rather than cultivators; but such claims are common in many parts of Africa, and do not necessarily imply that the land is better adapted for grazing than for cultivation, or that the community has a greater aptitutde for raising stock than for producing foodstuffs. Often indeed it means no more than that the men prefer a pursuit which permits them to leave to the women the more onerous part of rural life, such as hoeing and weeding (pp. 10-11).

2.5 INTERACTIONS WITHIN THE LIVESTOCK / RANGE COMPLEX

Range management and conservation officers in Lesotho and the rest of Africa are concerned about rangelands which are stocked with livestock numbers beyond their carrying capacity, and the resulting long-term range degradation which is suspected to occur. Stocking rates beyond carrying capacity were estimated for white-owned, individual South African farms as early as 1922 (South African Drought Investigation Commission) and for Lesotho as early as 1935 (Staples and Hudson).

The Concept of Carrying Capacity

The definition of carrying capacity used by Staples and Hudson,

> . . . the rate of stocking which results in no reduction in the quantity of feed produced or quality of the pastures over a period of time,

is very similar to the definition used by Hardin (1977). Staples and Hudson admitted that carrying capacity "varies considerably with topography, climate and past use", and that it was impossible for them to estimate "at all accurately the true carrying capacity" (p. 26) of Lesotho's rangeland. Nonetheless, they did continue to supply an estimate of 5,324,000 small stock units to be the carrying capacity with existing methods of grazing but with proper distribution of stock (p. 27). Reporting on private farms in South Africa, the South African Drought Investigation Commission stated that "other things being equal", the stock carrying capacity of any farm could vary as much as 100 percent from year to year depending on the rainfall (pp. 242-3).

Carrying capacity estimates are often stated as very precise numbers,

though they continue to be very gross approximations. As Sandford (1983) put it,

> there is very little agreement in particular situations about what the right level of stocking is. Equally eminent experts can disagree, not by small percentages, but by factors of four or five, about the right stocking rate, and many estimates of overstocking are manifestly absurd because, if true, the livestock concerned would have been dead of starvation long ago rather than, as is simultaneously estimated, growing in number (p. 13).

Pratt, a range ecologist, made the following statement about carrying capacity:

> Carrying capacity is simple in concept but complicated in use and utility. . . . The number of animals that a given area can reasonably support depends on the animals concerned (including their feeding preferences and requirements, their expected productivity and watering regime, and on the range management strategy adopted (including provision of drought and recuperative rest and the intended frequency of burning). Variation in one factor can change carrying capacity by 50 percent. An increase of that magnitude could follow the substitution of browsing animals for grazers in certain types of bushland, and a similar decrease could be associated with provision for rotational resting and burning. There is also methodological variation, depending on whether carrying capacity is calculated in terms of feed supply and requirements, or assessed in terms of ecological conditions. The latter method (normal in anglophone Africa) is usually more conservative than the former (associated more with francophone Africa)" (Pratt 1984, p. 27).

Thus, precise carrying capacity estimates must be viewed with considerable caution. In Lesotho, carrying capacity estimates are often stated in terms of animal units. The aggregation of five different livestock species into animal units may seriously bias these estimates.

Stock Units and Multiple-Species Grazing

Where more than one species occupies a selected rangeland as in Lesotho were cattle, sheep, goats, horses and donkeys share the range, or in East Africa where these domesticated animals share the range with a variety of wild animals, the different species must be aggregated for the purposes of establishing stocking rates and carrying capacity estimates. The concept of the animal unit (or livestock unit or large stock unit) is generally applied in Africa to establish those aggregations. The standard unit often used in Lesotho is one cow (of a weight of 450 kilograms), with or without a calf at side. Other types of cattle and other species of livestock are converted to the standard unit on the basis of relative liveweight. Conversion rates now used by the Range Management Division in Lesotho are: one animal unit = one cow
= one horse
= five sheep
= five goats
= one and one quarter donkeys

A more detailed set of conversion factors, suggested by the Conservation Division of the Ministry of Agriculture in 1977, is given in table 2.4.

Table 2.4 Recommended Animal Unit Conversion Factors

	Animal Units
Cattle	
Weaned calves	0.60
Yearlings	0.70
Mature cows with or without calf	1.00
Bulls, 2 years and older	1.30
Horses and Donkeys	
Yearlings	0.75
Two-year olds	1.00
Three years and older	1.25
Basotho ponies, mature	1.00
Donkeys	0.50
Sheep and Goats	
Weaned lambs or kids under 12 months	0.12
Ewes or does with or without young	0.20
Rams or bucks	0.26

Source: Conservation Division (1977)

These liveweight-based conversion factors are based on the relative dry matter requirements for each type of animal. No attempt is made to separate requirements into those for maintenance, growth or lactation as has been proposed by the F.A.O. (1972). Perhaps more importantly, no allowance is made for the different grazing habits of the different species.

The grazing habits of animals are determined by a combination of anatomical and behavoiral characteristics. The important characteristics include face and mouth shape, thickness and mobility of the lips and tongue, shoulder height and neck length, physical size, and dentition. Of these characteristics it is primarily dentition which determines the classification of ruminants (a group which includes cattle, sheep, goats, and antelope) as either grazers or browsers. Grazers generally draw grasses into their mouths through the action of their tongue and lips, then swing their heads to break off those parts of the plant with a low breaking strain. Because of their fibre content, these tend to be the leaves. Alternatively, browsers draw the stem into their mouths and strip off the leaves by a movement of their heads (Pratt and Gwynne 1977, p. 91).

Besides head shape and dentition, other factors affecting grazing patterns are:
(1) the height of the preferred foilage from the ground;
(2) the body size of the animal and thus the amount of food required to meet maintenance requirements. In general smaller animals have lower absolute maintenance requirements than the larger animals and can afford to

be more selective. Of the domesticated animals in Lesotho, goats are the most selective and thus have the greatest ability to adapt their diet to the environment, sheep are intermediate feeders and cattle are the least selective;
(3) the fibre content of the plants; and
(4) the digestive physiology of the animal (McDowell 1984, p. 49).

All of these factors together mean that for each animal species there exists an optimum vegetation structure (Pratt and Gwynne 1977, pp. 91-93). Where the feed resources are less than optimal, as on most African rangelands, some mixture of animal species generally makes best use of available vegetation (McDowell 1984, p. 49).

Considering the heterogeneous mix of animal species and diversified plant populations most of Africa's rangelands, there has been surprisingly little research conducted on multi-species grazing. Pratt and Gwynne report on a situation of sheep, Thomson's gazelle and Grant's gazelle grazing on the same range. Introduction of the sheep resulted in competition between the sheep and Thomson's gazelle, limited competition between Thomson's gazelle and Grant's gazelle, and no competition between sheep and Grant's gazelle (Pratt and Gwynne 1977, p. 93). Further research on the grazing habits of the Thomson's gazelle, Grant's gazelle, kongoni and wildebeast, this time in combination with cattle, indicated that the antelope benefit from grazing with cattle. As the least selective of the domestic animals, a limited number of cattle can act to condition the grass stand for the antelope (McDowell et. al. 1983 as referenced in McDowell 1984, p. 50).

This complementarity between less selective domestic types of livestock and wild game has also been found in the United States. Analysis of the diets of sheep, angora goats, spanish goats and white-tailed deer (Bryant, Kothmann and Merrill 1979); wild horses, cattle and mule deer (Hubbard and Hansen 1976); and deer, elk, and cattle (Hansen and Reed 1975); all found significantly different dietary composition among species sharing the range. The magnitude of these differences determines the magnitude of the potential productivity gains from multiple-species grazing. Where attempts have been made to increase deer and antelope populations, it has been found that controlled grazing of domestic livestock has actually increased the carrying capacity for the more selective game animals. Terr and Drawe (1984) explain this as due to differences in optimal range conditions for the different animals. Range sites described as being in good to excellent condtion (see Conservation Division 1977) may be preferred by domestic livestock, but several stages further from climax are preferred by game animals.

One recent attempt to model this multiple-species grazing and its effect on carrying capacity is reported in Nelson (no date). Nelson's model uses the forage factors developed by Smith (1965) from observations of foliage cover and use by two animal species to predict two linear substitution lines:

$$N1 = K1 - a\,N2 \qquad (2.1)$$

$$N2 = K2 - b\,N1 \qquad (2.2)$$

where K1 and K2 are calculated carrying capacities for animals `1' and `2', N1 and N2 are two constant trade-off values. Data for botanical composition and use by the two species stocked alone which correspond to the intercepts on figure 2.2. Trade-off rates 'a' and 'b' are calculated to determine the slopes of the two lines, and further calculations determine the maximum stocking rates of the two species for common use. Figure 2.2 presents the substitution rates for sheep and deer as calculated by Nelson.

If the substitution is as defined by the two linear substitution functions, then only three points on the envelope function are possible optima under different relative values, the intersection with the vertical axis where only deer are stocked, the intersection with the horizontal axis where only sheep are stocked, and the intersection of the two substitution curves. Hopkins (1954) suggests that the substitution function is actually a curve which passes through the three points. If this is the case then gains from common use are even greater (as defined by the dashed curve in figure 2.2) and any point along the curve may be optimal.

Information about grazing habits, field observations from both Africa and the United States, and the conceptual work all indicates multi-species grazing to be an obvious way to maximize secondary production (i.e. animal products) from the range. Where significant numbers of more than one species are grazed, as in Lesotho, application of the standard animal unit to estimate carrying capacity appears faulty. If standard animal units had been applied to the deer / sheep situation in Logan Canyon reported by Nelson, the combination of 34 percent less deer and 34 percent less sheep would have been calculated as the carrying capacity. Recognizing the importance of considering forage preferences in formulating grazing plans, researchers in northern Kenya have recently examined the preferences of camels, sheep, goats and cattle for 250 plant species and found the most dietary overlap between camels and goats and between sheep and cattle (Lusgi, Nkurunziza and Masheti 1984). With the combination of animals species that we have in Lesotho, it is conceivable that consideration of the botanical composition and use would indicate, ceteris paribus, a carrying capacity 50 - 100 percent greater than the current estimate. Obviously more research is required.

Livestock and Range Degradation in Lesotho

Reviewing the writings of the P.E.M.S. missionaries -- Arbousset and Casalis -- between 1833 and 1846, Germond (1967) came to the conclusion that both gully and sheet erosion became problems at about the time that Lesotho became a nation. Germond cited three reasons for this erosion: (1) overtocking of both domesticated and wild animals; (2) concentration of animals around natural fortresses to guard against stock theft; and (3) hill-side cultivation (pp. 71-72). Despite the 'writing on the wall' (pp. 61-72) described by Germond, little formal recognition was afforded the problem of overstocking until the famous Pim Report on the Financial and Economic Position of Basutoland published in 1935. Pim was obviously taken aback by the severity of Lesotho's erosion problem and the threat to both arable agriculture and livestock production it represented. Pim was convinced that overstocking and poor range management was resulting in "the destruction of the pasture [on] mountain slopes and . . . dongas in the

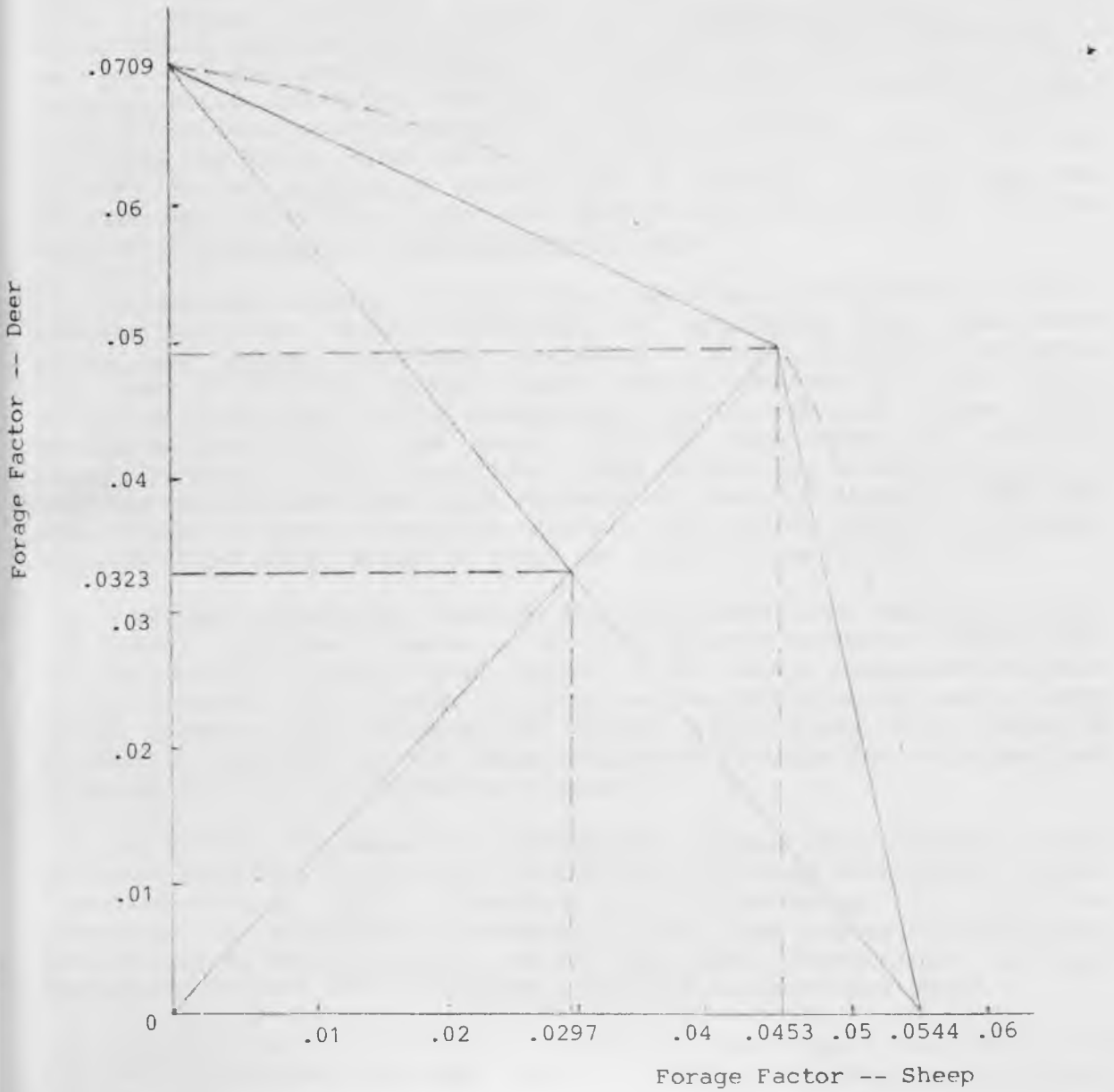

Figure 2.2 Carrying Capacity under Single and Multiple-species Grazing

Source: Nelson (no date)

deep belts of richer soil which lie below them" (p. 5). Overgrazing had also caused ". . .the replacement over some hundreds of thousands of acres of the grass by the almost inedible 'chrysocoma'".

Pim's great concern with the state of Lesotho's rangeland led in 1938 to An Ecological Survey of the Mountain Area of Basutoland authored by R. R. Staples and W. K. Hudson. Staples and Hudson identified three main types of vegetation: seboku grassland, letsiri grassland, and sehalahala scrub. Seboku grassland, properly called themeda triandra and commonly called "sweet veld" in English, is the most palatable grass species and at one time was the dominant species in Lesotho below 9000 feet on north-facing mountains and below 7000 feet on south-facing mountains. Letsiri grassland or "sour veld" was dominant at higher altitudes. By 1938 most of the seboku had "long since almost disappeared" in the lowlands and been replaced by an eragrostis association of grasses. By the same year approximately 13 percent of the total mountain area was overtaken with the unpalatable sehalahala or chrysocoma tenuifolia.

Overstocking between 1900 and 1936, and severe overstocking in 1929-1930 had led to the rapid encroachment of sehalahala into areas where seboku and letsiri previously dominated. Staples and Hudson estimated that "some 375,000 acres of the finest natural pasture in South Africa (sic)" had been lost due to overgrazing. For a number of reasons listed by Staples and Hudson, the heavy livestock populations of 1930 were rapidly reduced over the next five years so that the total population of 1936 was actually less than their estimate of carrying capacity made that year. Their estimate of carrying capacity with present methods of grazing, but with proper distribution of stock was 5,324,000 small stock units.

A series of carrying capacity estimates have been made since 1938. LASA (1978) presented a number of carrying capacity estimates ranging from 390,000 to 630,000 large stock units. The Range Management Division (1984) estimated the carrying capacity to be 374,110 animal units. Dobb (1985) presented an estimate of 395,221 large stock units based on information supplied for the Range Management Division for rangeland, and by Binnie and Partners (1978) for cropland.

All of these estimates are considerably greater than the most recent estimates generated by the Land Conservation and Range Development Project (unpublished data, 1986). Depending upon the percentage dry weight and percentage of utilization assumptions used, the current estimates vary from 147,182 to 255,116 animals units (see Land Conservation and Range Development Project 1986, Handbooks 1 to 9 for the procedure used).

A picture of the effects of stocking on the range since 1938 may be obtained by comparing the range profile prepared by Staples and Hudson with the range inventory recently completed by the Land Conservation and Range Development Project (see table 2.5). The data indicate that chrysocoma now occupy approximately 12.4 percent of the total land area, as compared to 13 percent of the mountain area in 1938. These data indicate an increase of approximately 4.3 percent of the total area of the country, or 129,000 hectares. Themeda triandra, once the dominant species, is now reduced to covering only 16.1 percent of the total land area.

Table 2.5 Range Vegetation and Land Types in Lesotho, 1986

Range vegetation type	Hectares	% of total area
Hyparrhenia (species)	285,129	9.8
Eragrostis-Aristida (species)	135,974	4.7
Themeda Triandra	468,868	16.1
Festuca caprina	346,230	11.9
Chrysocoma & Artemisia (species)	362,766	12.4
Leucosidea sericea (mixed shrubs)	123,418	4.2
Rhus erosa	108,440	3.7
Merxmuellera (species)	101,417	3.5
Shallow rocklands	160,296	5.5
Other land type		
Residential areas	58,153	2.0
Cultivated fields (active and fallow)	765,512	26.2
Boglands	2,168	0.1
Total	2,918,371	100.1

Note: When compared to the total area of Lesotho, these figures indicate a 3.2 percent error.

Source: Unpublished data, Land Conservation and Range Development Project, January 1987.

2.6 Livestock, Range and Social Institutions

Rangeland in Lesotho and elsewhere in Africa is often referred to as a `communal' resource and thus likely to be over-exploited. The `tragedy of the commons' described by Hardin (1977) is that none of the individuals sharing a communal resource take account of the social costs inflicted by their animals, so each individual stocks too many animals. The sum of these individual actions is overstocking by the group. The solution is private ownership of range land or direct government intervention.

This simple argument has been challenged on a number of counts. Ciriacy-Wantrup (1975) indicates the importance of separating the concept of `common property resource' from that of `open-access resource':

> "`Common property' refers to a distribution of property rights in resources in which a number of owners are co-equal in their rights to use the resource. This means that their rights are not lost through non-use. It does not mean that the co-equal owners are are necessarily equal with respect to the quantities (or other specification) of the resource each uses over a period of time. In other words, the concept as employed here refers to resources subject to the rights of common use and not to a specific use right held by several owners" (p. 26).

Applying this concept to the case of cattle owners on a common range, Runge (1981) argued that each cattle owner's decisions regarding the number of cattle to stock is conditioned on an expectation of the likely behavior of others. Mathematically, this was shown as a `nonseparable externality' entering the cost function of each cattle owner. Runge suggested that cattle owners in this situation would seek `assurance' about the actions of others by entering into some type of institutional arrangement for the making of joint stocking rate decisions.

Bennett, Lawry and Riddell (1986) appear to agree with Runge regarding the potential economic motivation for stock owners to find seek mutually advantageous stocking rate decisions through appropriate institutions. They draw a distinction, however, between the eras before and after the colonial intervention in Africa. In precolonial Africa, pastoral groups were relatively self-reliant and were dependent upon resource sharing for their very survival. With colonialism, external markets and entrepeneurship have become more important, consequently undermining the local institutions.

Village Grazing Areas

Eldredge (1986) cites evidence that the social institution of maboella was in existance in Lesotho by 1850. By 1900 maboella was one element of a complicated system of pasture rotation which included seasonal migration to mountain pastures and yearly burning of dead vegetative cover. The caretaker of the pastures called the mobehi oa leboella or mophuthi oa maboella was rewarded with the right to larger amounts of thatching grass (pp 144-146). Phororo (1979) distinguished two categories of maboella. The primary form of maboella reserves areas of thatching grass and crop lands from grazing during the summer months. The secondary form reserves certain areas of village grazing for winter use. Shoup (forthcoming 1987) identifies several maboella forms within each category.

Data summarized from the 1985 Livestock Holders Survey brings the current effectiveness of the maboella system into question. Table 2.6 indicates that 77.6 percent of the cattle, 39.0 percent of the sheep, 33.0 percent of the goats, 43.2 percent of the horses, and 29.3 percent of the donkeys owned by surveyed households were kept in village grazing areas throughout the year.

Table 2.6 Livestock Grazed in Village Areas Throughout the Year

	Cattle	Sheep	Goats	Horses	Donkeys
No. of HH grazing in village grazing areas	415	131	121	122	84
No. of animals grazed in village grazing areas	2674	5323	2669	278	181
Total No. of HH	462	250	235	273	250
Total No. of animals	3447	13654	8088	644	617

Source: 1985 Livestock Holders Survey

Cattle Post Grazing Areas

Principal Chiefs traditionally have been charged with regulating use of mountain grazing areas in their jurisdictions. Stockholders who wished to establish cattle posts would best make arrangements with the appropriate chief. Cattle posts are treated as private property, areas around the cattle posts are communal property. Following one of the recommendations of the Staples and Hudson report of 1939, a controlled system of rotational grazing was undertaken in many of the mountain areas. This system was designed to completely relieve some heavily degraded areas from grazing, and enforce a seasonal rotational grazing system on other areas. The dip tank area was adopted at the unit of grazing control.

In the early 1970s a grazing permit system was introduced to help monitor seasonal movements of livestock. Permits were issued by, or on behalf of, the Principal Chief and specify the number of animals which may be moved to a summer cattle post, the permitted location of grazing within a dip tank area, and the number of animals which may be grazed. (Amendments to the regulations enacted in 1986 reduce the importance of dip tank areas as primary grazing control areas.) Under the "Range Management and Grazing Control Regulations" of 1980, Principal Chiefs are to work under the direction of officers of the Ministry of Agriculture in enforcing a strict set of controls including: grazing permits, regulation of stock numbers in line with estimates of carrying capacity, dipping controls, and prohibitions of grass burning.

3. FINANCIAL ANALYSIS OF THE LIVESTOCK SYSTEM

Phororo (1979, pp. 19-20) described livestock as the most certain investment available to rural Basotho. Phororo cited a study by Guma and Mafoso (1976) in which a 14 percent rate of return was earned on capital invested in livestock. This high rate of return Phororo attributed primarily to low production costs. Fritsch (1984), Swallow (1985) and Swallow, Mokitimi and Brokken (1986) have recently stressed the importance of cattle as investment good in Lesotho. Over the period 1978 to 1984, the average real prime interest rate in Lesotho was zero, while the average interest rate on savings accounts was negative ten percent (Swallow 1985). This compares to the significant positive rates of return from livestock investments found by Lawry (1986). In 1977 Van der Wiel found that returning migrant workers were investing more earnings in livestock than in bank savings. Van der Wiel explained this finding very articulately:

> The relatively large sum of cash invested in livestock,particularly cattle, is the result of the superior facilitiesfor storing and investing wealth that cattle provide and the inadequate alternative investment opportunities (1977, p.16).

This evidence taken with historical evidence provided by Hunter (1987) and Swallow, Brokken and Mokitimi (1986), leads towards the acceptance of one of the hypotheses presented in chapter 1, that is that "Basotho regard their livestock as capital assets, and as capital assets livestock generate returns competitive with other available investments". Conclusive evidence on which to base acceptance of the hypotheses is presented in the following budgets for cattle, sheep and goat enterprises.

Following the budgets is a set of information supplied by respondants during the 1985 Livestock Holders Survey. That information provides strong support for acceptance of the hypothesis: "economic factors dominate social and cultural factors in determining how and why Basotho own and manage their livestock".

3.1 LIVESTOCK BUDGETS

Lesotho's livestock populations generate a variety of valuable products: cattle produce dung (which is a vital energy source in energy-poor Lesotho), draught power, milk, progeny, and meat (from both slaughtered and fallen animals); sheep produce wool, progeny and meat; goats produce mohair, progeny and meat; and horses and donkeys produce transportation services, progeny and meat. The relative values of each of these products are very important for formulating policies to direct livestock development efforts. The following budgets have been prepared to establish the relative values for the three dominant livestock species--cattle, sheep and goats. In addition, the budgets generate `bottom-line' results regarding the profitability of alternative livestock enterprises, and aid in understanding the motivations of Basotho livestock owners.

The budgets are primarily based on data collected during extensive interviews conducted with 537 livestock-owning households between July and September 1985. Households were asked to provide information on all elements of their livestock enterprises. Three cluster areas were selected in each of six regions of the country -- northern lowlands, southern lowlands, foothills, Senqu River Valley, less remote mountains, and more remote mountains -- and approximately 30 livestock-owning households were interviewed in each of the 18 cluster areas. Among other things, respondants were asked to provide details on their livestock inventories as of June 1, 1985, their disposition and acquisition of livestock during the preceeding year, and all of their transactions involving livestock and livestock products during the preceeding year (see Swallow, et. al. 1987 for more information).

The following are aggregate budgets for all cattle, sheep and goats held by the 537 livestock-owning households. Of those households, 462 own or manage cattle, 250 own or manage sheep, and 235 own or manage goats. The average holding size is 7.46 cattle, 54.6 sheep and 37.5 goats for those households which own some animals of each species. Of the 537 households which own livestock, the average holdings are 6.42 cattle, 25.4 sheep and 16.4 goats.

The budgets show that as of July 1, 1985, the 537 households had a total of M902,592 invested in cattle enterprises, M620,055 invested in sheep enterprises, and M414,734 invested in goat enterprises, for a total investment of M1.94 million. Total costs of M162,854 -- 55.5 percent cash costs and 44.5 percent non-cash costs - or M47.25 per head, were incurred in generating products from the cattle investment. With that investment and variable costs, products worth a total of M224,850 were generated. The most important products of the cattle enterprise, in order of their contribution to total value were: draught (30.6 percent), products from fallen animals (17.8 percent), live animals for sale (13.8 percent), dung for fuel (14.2 percent), milk (11.4 percent), and home slaughter and consumption of live animals (11.2 percent). Of this total value only 14.1 percent were cash products, the remaining 85.8 percent were non-cash products. During the 1984/85 year the households incurred a small net increase in the value of the cattle capital base owing to a net increase in cattle numbers. With this net increase, total benefits exceeded total costs by M74,661, an amount equivalent to M21.66 per head or M161.58 for the average sized herd. The return to capital investment was 8.3 percent over the year.

The sheep investment of M620,055 by sample households was coupled with total variable costs of M91,609, or M6.71 per head, to produce products worth a total of M120,901. In contrast to the cattle enterprise, cash products of the sheep enterprise outweighed non-cash products by a ratio of M76,692 to M44,209. Wool alone accounted for 38.7 percent of all value. There was a net increase in the value of sheep assets of M15,489. Total benefits exceeded total costs by M44,781. This amounted to M3.28 per head, M179.07 per sheep herd or M16.40 per animal unit. The return to capital investment was 7.2 percent.

The goat enterprise was similar to the sheep enterprise in terms of the relative values of cash and non-cash products, with an even higher

percentage of total value being cash. The total investment in the goat enterprises was M414,784. Total costs amounted to M52,338, 44.9 percent of which were cash and 55.1 percent of which were non-cash. Total income was M80,193, 65.8 percent of which was derived from mohair sales alone, 14.1 perent from home consumption of slaughtered animals, 9.3 percent from consumption of fallen animals, and 10.2 percent from sale of live animals. Total benefits exceeded total costs by M41,842 -- M5.17 per head, M194.00 per goat herd, or M38.80 per animal unit. The return to capital investment was 10.1 percent.

Comparison of the three budgets illustrate remarkable similarities of the quasi-rent generated per animal unit, and the rate of return to capital investment. Cattle generate quasi-rents of M21.66 per animal unit, sheep generate M16.40 per animal unit, and goats generate M38.80. Rates of return to capital investment are likewise similar: goats are the highest at 10.1 percent, cattle next at 8.3 percent, and sheep lowest at 7.2 percent. This evidence provides very strong support for two hypotheses:
(1) Livestock owners in Lesotho treat their livestock as capital asset and manage their livestock inventories as portfolio managers (see Jarvis 1974). As portfolio managers these livestock owners seek to maximize their net returns, while at the same time spreading their risk among alternative investments.
(2) Biological and market restrictions constrain the total number of livestock to a point less than the open access or zero rent position. Substantial quasi-rents are generated from these restrictions.

Table 3.1 Enterprise Budget for the extensive production of cattle by 462 cattle owners in Lesotho

Production and Inventory Conditions	
Total households in sample	537
Cattle owners in sample	462
Average cattle per all livestock holding	6.42
Average cattle per cattle holding	7.46
Inventory -- bulls	361
-- oxen	1072
-- cows	2014
-- total cattle	3447 [1]
Disposition -- males lost or stolen	30
-- female lost or stolen	24
-- males died	71
-- females died	125
-- males marketed	75
-- females marketed	25
-- males slaughtered	46
-- females slaughtered	41
Acquisition -- calves surviving	381
-- males recruited	63
-- females recruited	51
Cows milked	422
Average yearly milk collection per cow	92 litres [2]

Table 3.1 (Continued)

Number of oxen span days -- ploughing	3932
-- planting	2208
-- cultivation	2537 [3]

Production of Cash Products

Males marketed	75
Females marketed	25
Hides marketed	30
Households selling milk	16
Milk sold per household selling milk	46 litres [4]
Cows milked per household	1.72
Dung sold	nil
Draught sold	Unknown [5]

Production of Non-cash Products

Males slaughtered	46
Females slaughtered	41
Hides used in household	253
Fallen males consumed	117
Fallen females consumed	67
Dung consumed as fuel	384,846 kg [6]
Own milk consumed in household	73,048 litres [7]
Oxen span days	8677

Product Prices or Imputed Prices

Male cattle sale price	335.64 maloti [8]
Female cattle sale price	236.39 M [9]
Male cattle purchase price	437 M
Female cattle purchase price	388 M
Male cattle inventory value	251.73 M [10]
Female cattle inventory value	177.29 M
Milk sales price	0.35 M/litre
Dung value	0.083M/kg [11]
Hides value	6.50 M/hide [12]
Oxen span draught value	7.93 M/day [13]
Kraal and cattle post value	400 M [14]

Investment, Costs and Returns

Investment

Kraals and cattle posts	184,800
Cattle -- bulls	90,875
-- oxen	269,855
-- cows	357,062
Total investment	902,592

Table 3.1 (Continued)

Cash Costs		
Hired labour	23,440	[15]
Veterinary supplies and medicine	6,170	
Salt	7,583	
Purchased fodder	3,536	
Other supplemental feeds	2,288	
Purchased herd recruits	47,319	
Total cash costs	90,336	
Non-cash Costs		
Family herding labour	57,974	
Own feeds	14,544	
Total non-cash costs	72,518	
Total costs of the cattle enterprise	162,854	
Total costs per animal	47.25	
Total costs per average herd (7.46 head)	352.45	
Gross cash income		
Male animal sale	25,173	
Female animal sale	5,910	
Milk sale	443	
Draught rental	Unknown	
Hides sale	195	
Total value of cash products	31,721	
Gross non-cash income		
Products from -- slaughtered males	15,439	
-- slaughtered females	9,692	
-- fallen males	17,873	[16]
-- fallen females	22,162	
Hides used in household	1,645	
Own milk consumed in household	25,567	
Oxen draught power	68,809	
Kraal dung consumed in household	31,942	
Total value of non-cash products	193,129	
Value of net change in capital assets		
Male animals	8,055	[17]
Female animals	4,610	
Net change in value of capital assets	12,665	

Table 3.1 (Continued)

Summary Financial Statistics

Total cash, non-cash and capital stock income	237,515	
Cash, non-cash and capital stock income per animal	68.90	
Cash, non-cash and capital stock income per average sized herd	514.03	
Total quasi-rent generated by the cattle enterprise	74,661	
Quasi-rent earned per animal	21.66	[18]
Quasi-rent earned per average size herd	161.58	
Quasi-rent earned per animal unit	21.66	
Return to capital investment	8.3%	

Notes to Cattle Enterprise Budget:

[1] Survey results indicated livestock inventories and transactions in animals of unknown sex. In each case these were categorized into sexes by the proportions of animals of known sex.

[2] Average milk production per cow taken from management survey administered to stockowners in Sehlabathebe Grazing Association (see Lawry 1986).

[3] Oxen span days are days spent working fields with a span of cattle. Spans vary from 2 to 8 animals and are usually accompanied by two drivers. The number of days reported here include days spent working own fields and days spent working others' fields.

[4] It is assumed that those households which report milk sales milk the average number of cows, collect the average amount of milk per cow, and sell half of the milk collected per cow.

[5] While it is known that many of the households in the sample rented draught services to neighbouring farmers, it is not possible from the survey results to easily ascertain the amounts of those rentals or the charge per rental.

[6] The estimate of average yearly amount of kraal dung (lisu and maphoroa) consumed per household of 833 kilograms is taken from Best (1979) and multiplied by 462 to generate total amount of kraal dung consumed. Dung dropped outside of the kraals (khapane and bokoluba) is generally available to all households so is not valued as a benefit to the household.

[7] Own milk consumed in household only includes cows' milk collected at the household site. It does not include milk collected by the shepherds from cattle, sheep and goats at the cattle posts.

[8] Livestock Products Marketing Service (LPMS) average price for cattle sold at rural auction sales held between July 1984 and June 1985 (see Swallow, Mokitimi and Brokken 1986).

[9] LPMS average sales price is primarily a male cattle sales price as very few females are sold at those auctions. To adjust for a female sales price, the average sales price is multiplied by the ratio of average female sales price to average male sales price (312/443) reported in the survey.

[10] Average sales price is multiplied by a factor of 0.75 to adjust adult prices to average values for the herd.

[11] Average price for kraal dung is calculated from information contained in Gay and Khoboko (1982) who report that in the mountain areas kraal dung sold for M2.50 per 30 kilogram bag.

[12] Average hide value is taken from Brokken (1986) for sundried, 3rd grade hide.

[13] The surveyed households indicated that the average rental price for an oxen-span day was M15.93. As this usually includes the labour of two persons, it is reduced by M8.00 to M7.93. This is consistent with Lawry's (1986) estimate of M6.50 per day.

[14] Average kraal value supplied by Carvalho (1987), draft livestock budgets.

[15] Detailed production costs are given in table 3.4 since they were simultaneously calculated for cattle, sheep and goats.

[16] Information was collected during the survey to establish the number of fallen animals from which some products were consumed. However, no information was collected to ascertain the carcass weights or percentage of the animals consumed. To account for lower carcass weights and lower utilization of products an adjustment factor of 0.75 was used to establish a value.

[17] The average value of fallen animals of unknown sex was assumed to be the mean of male and female fallen animal values.

[18] The value of changes in the capital stock are calculated as: (calves survived + purchases - deaths - slaughter - sales - lost or stolen) * Average inventory price per animal. this assumes that no change in the herd age structure occurs. No allowance is made for animals given or received under bohali as it is not clear how these transactions should be valued.

[19] Because profits are generated by the fixity of the number of animals available, it is correctly labelled as quasi-rent.

Table 3.2 Enterprise Budget for the Production of Sheep by 250 Sheep Owning Households in Lesotho

Production and Inventory Conditions	
Total households in sample	537
Sheep owners in sample	250
Average sheep per all livestock holding	25.4
Average sheep per sheep holding	54.6
Inventory -- rams	585
-- wethers	4,255
-- females	8,814
-- total sheep	13,654
Disposition -- males lost or stolen	236
-- females lost or stolen	252
-- males died	108
-- females died	221
-- males marketed	271
-- females marketed	269
-- males slaughtered	416
-- females slaughtered	162
Acquisition -- lambs surviving	2,106
-- males recruited	49
-- females recruited	151
Sheep clipped	9,739
Wool sold per sheep clipped	2.08 kg/sheep [1]
Production of Cash Products	
Males marketed	271
Females marketed	269
Skins marketed	99
Total wool sales	20.257 kg
Production of Non-cash Products	
Males slaughtered	416
Females slaughtered	162
Skins used in household	497
Fallen males consumed	95
Fallen females consumed	194
Product Price or Imputed Prices	
Sheep sale price	M 55 [2]
Sheep purchase price	68.75 [3]
Sheep inventory value	41.75
Skins sale price	2.00 [4]
Skin value used in home	1.00 [5]
Kraal and cattle post value	200 [6]
Wool value per kilogram	2.31 [7]

Table 3.2 (Continued)

Investment, Costs and Returns

Investment	
Kraals and cattle posts	50,000
Sheep -- males	202,070
-- females	367,985
Total investment	620,055
Cash Costs	
Hired labour	18,561
Veterinary supplies and medicine	4,915
Salt	6,008
Purchased fodder	437
Other supplemental feeds	283
Purchased herd recruits	13,750
Total cash costs	43,954
Non-cash Costs	
Family herding labour	45,907
Own feeds	1,748
Total non-cash costs	47,655
Total costs of the sheep enterprise	91,609
Total costs per animal	6.71
Total costs per average herd (54.6 head)	366.37
Gross Cash Income	
Male animal sale	14,905
Female animal sale	14,795
Sale of skins	198
Wool sale	46,794
Total value of cash products	76,692
Gross Non-cash Income	
Products from -- slaughtered males	22,880
-- slaughtered females	8,910
-- fallen males	3,919
-- fallen females	8,003
Skins used in household	497
Total value of non-cash products	44,209
Value of Net Change in Capital Assets	
Male animals	2,964
Female animals	12,525
Net change in value of capital assets	15,489

Table 3.2 (Continued)

Summary Financial Statistics

Total cash, non-cash and capital stock income	136,390
Cash, non-cash and capital stock income per animal	9.99
Cash, non-cash and capital stock income per average sized herd	545.40
Total quasi-rent generated by the sheep enterprises	44.781
Quasi-rent earned per animal	3.28
Quasi-rent earned per average size herd	179.07
Quasi-rent earned per animal unit	16.40
Return to capital investment	7.2%

Notes to Sheep Enterprise Budget:

[1] It was not possible to calculate the average wool production per sheep or average mohair production per goat from the survey data. The national average wool and mohair production for 1984/85 was assumed to be representative of this sample and was supplied by the Bureau of Statistics.

[2] Average producer prices for sheep and goats were only available for 1983/84 from the Bureau of Statistics and were assumed valid for 1984/85.

[3] The average sale price was multiplied by 1.25 to arrive at the average purchase price.

[4] The average skin sales prices are for low grade, sun-dried skins.

[5] The skin sales price was divided in half to arrive at the average value of the skins in the home.

[6] The average value of M400 per kraal and cattle post was divided in half because sheep and goats are kraaled together.

[7] The average national price of wool and mohair for 1984/85 was assumed. Wool prices were multiplied by the arithmetic mean of 64.8 percent and 66.3 percent to obtain as estimate of the amount received by farmers. Mohair prices were multiplied by the mean of 77.8 percent and 80.8 percent. These percentages were calculated by Hunter (1987, p. 165) as net farmer shares of wool and mohair revenues for farmers selling to private traders and government woolsheds respectively.

Table 3.3 Enterprise Budget for the Production of Goats by 235 goat-owing Households in Lesotho

Production and Inventory Conditions	
Total households in sample	537
Goat owners in sample	235
Average goats per all livestock holding	16.4
Average goats per goat holding	37.5
Inventory -- billies	784
-- wethers	2,168
-- females	5,856
-- total goats	8,088
Disposition -- males lost or stolen	76
-- females lost or stolen	45
-- males died	135
-- females died	137
-- males marketed	94
-- females marketed	92
-- males slaughtered	181
-- females slaughtered	76
Acquisition -- kids surviving	1,074
-- males recruited	10
-- females recruited	87
Goat clipped	6,327
Mohair sold per goat clipped	0.76 kg/goat
Production of Cash Products	
Males marketed	94
Females marketed	92
Skins marketed	56
Total mohair sales	4,809 kg
Production of Non-cash Products	
Males slaughtered	181
Females slaughtered	76
Skins used in household	404
Fallen males consumed	113
Fallen females consumed	113
Product Prices or Imputed Prices	
Goat sale price	M 44
Goat purchase price	55
Goat inventory value	41.75
Skins sale price	1.50
Skin value used in home	1.00
Kraal and cattle post value	200
Mohair value per kilogram	10.97

Table 3.3 (Continued)

Investment, Costs and Returns

Investment

Kraals and cattle posts	47,000
Goats -- males	123,246
-- females	244,488
Total investment	414,734

Cash Costs

Hired labour	11,031
Veterinary supplies and medicine	2,912
Salt	3,559
Purchased fodder	393
Other supplemental feeds	254
Purchased herd recruits	5,335
Total cash costs	23,484

Non-cash Costs

Family herding labour	27,282
Own feeds	1,572
Total non-cash costs	28,854

Total costs of the goat enterprise	52,338
Total costs per animal	6.47
Total costs per average herd (37.5 head)	242.63

Gross Cash income

Male animal sale	4,136
Female animal sale	4,048
Sale of skins	84
Mohair sale	52,755
Total value of cash products	61,023

Gross non-cash income

Products from -- slaughtered males	7,964
-- slaughtered females	3,344
-- fallen males	3,729
-- fallen females	3,729
Skins used in household	404
Total value of non-cash products	19,170

Value of net change in capital assets

Male animals	2,547
Female animals	11,440
Net change in value of capital assets	13,987

Table 3.3 (Continued)

Summary Financial Statistics

Total cash, non-cash and capital stock income	94,180
Cash, non-cash and capital stock income per animal	11.64
Cash, non-cash and capital stock income per average sized herd	436.67
Total quasi-rent generated by the goat enterprises	41,842
Quasi-rent earned per animal	5.17
Quasi-rent earned per average size herd	194.00
Quasi-rent earned per animal unit	38.80
Return to capital investment	10.1%

Table 3.4 Detailed Calculation of Production Costs for Cattle, Sheep and Goat Enterprises in Lesotho

Animal units in herd

Animal units in total herd	number	% of total herd
-- cattle	3,447	44.2
-- sheep (13,654/5)	2,731	35.0
-- goats (8,088/5)	1,618	20.8
Total	7,796	100.0

Herding labour

Number of herders involved in herding the cattle, sheep and goats	-- full-time	532
	-- part-time	105
	-- related to head or head	506
	-- not related to head	131
Total cash and in-kind herding cost	-- food	12,120.00
	-- clothing	3,400.00
	-- cattle	5,789.79
	-- sheep	29,851.25
	-- goats	167.00
	-- cash	1,704.00
Total cost for hired labour		53,032.04
Average cost per hired herder (non-relative)		404.82

Table 3.4 (Continued)

Imputed cost for 401 full-time family members	
- children	46,351.89
- adults	69,629.04
Imputed cost for 101 part-time family members	
- children	6,072.60
- adults	9,108.45
Total imputed cost for family labour	131,161.98

Herding cost by species (assume equal cost per AU)

Species	Cash cost	Imputed cost
Cattle	23,440	57,974
Sheep	18,561	45,907
Goats	11,031	27,282

Fodder

Animal units fed fodder

Species	Number fed	% fed
Cattle	1636	81
Sheep	211	10
Goats	172	9
Total	2019	100

Purchased feeds per household at Sehlabathebe Management Sample equals M6.21 per household in total sample multiplied by 34 households equals M211.14 or M0.56/animal unit. This is according to the above proportions. Own fodder is assumed to be four times the value of purchased feeds.

Fodder cost by species

Species	Purchased feeds	Own fodder
Cattle	3,536	14,544
Sheep	437	1,748
Goats	393	1,572

Supplement Feeds

Supplement	Households feeding	M per household	Total cost
bone meal	4	20	80
Molasses	1	5	5
dairy meal	9	20	180
bran	62	20	1,240
other	66	20	1,320
total			2,825

Feed supplement cost by species -- cattle	2,288
-- sheep	283
-- goats	254

Table 3.4 (Continued)

Veterinary supplies, medicine and salt

Veterinary supplies and medicine at Sehlabathebe was M675.86 for all households in management survey or M1.79 per cattle, M0.36 per sheep, and M0.36 per goat assuming equal costs per animal unit. Similarily salt costs at Sehlabathebe were M833.55 or M2.20 per cattle, M0.44 per sheep, and M0.44 per goat.

Veterinary supplies and medicine -- cattle	6,170
-- sheep	4,915
-- goats	2,912
Salt -- cattle	7,583
-- sheep	6,008
-- goats	3,559

3.2 ATTITUDES TOWARDS LIVESTOCK OWNERSHIP

During the 1985 Livestock Holders Survey, respondants were asked questions regarding the most important reasons for owning livestock (cattle, sheep, goats, horses and donkeys). Given that all livestock in Lesotho serve a variety of purposes depending (among other things) on their type and sex, the respondants were asked to rank up to four reasons for owning each species of animal. Cattle were separated into cows, bulls and oxen. The responses are presented in tables 3.5 to 3.10. (The tables are also presented in A Survey of the Production, Utilization and Marketing of Livestock and Livestock Products in Lesotho as tables 20.8 to 20.12.

The overwhelming majority of reasons given owning all types of livestock were economic. For cows the two most important reasons appear to be increasing the herd size through production of progeny and milk production. Following in order of importance are draught, sale, beef, and bohali. Of a total of 1403 reasons given by 508 households, only forty could be described as social reasons. Reasons stated for owning oxen were also primarily economic, though a few more households mentioned bohali, 'traditional practices', and ceremonial slaughter. Draught, sale, and beef were the three most frequently mentioned reasons. The ordering was smimilar for bulls, but with breeding mentioned most frequently.

Reasons stated for owning sheep and goats were dominated by three: wool (or mohair), mutton (or goat meat), and sale. People owned horses and donkeys for haulage of goods, and transportation of people.

Table 3.5 Reasons Stated for Owning Cows

Number of Households Reporting

Reason	Most important reason	2nd Most important reason	3rd Most important reason	4th Most important reason	All Responses
Increased herd size	267	142	22	6	437
Milk	228	221	21	4	474
Draught	9	62	112	29	212
Sale	1	26	45	31	103
Beef	2	12	39	31	84
Traditional practices	-	1	4	5	10
Payment of shepherds	-	-	-	1	1
Funerals	-	1	2	-	3
Transport	-	-	1	-	1
Bohali	-	3	20	7	30
Because I have them	1	-	-	-	1
Hides	-	-	1	2	3
Easy to feed	-	1	-	-	1
No need for shepherds	-	-	1	-	1
No interference with kids education	-	-	-	1	1
Making butter	-	1	-	-	1
Dung	-	-	15	25	40
Total	508	470	283	142	1403

Table 3.6 Reasons Stated for Owning Oxen

Number of Households Reporting

Reason	Most important reason	2nd Most important reason	3rd Most important reason	4th Most important reason	All responses
Draught	439	25	7	1	472
Sale	26	199	33	10	268
Beef	4	33	46	10	93
Transport	3	29	8	3	43
Hides	1	1	2	4	8
Traditional practices	-	12	35	8	55
Dung/manure	-	16	11	6	33
Bohali	-	13	18	9	40
Funerals	-	8	4	1	13
Balimo	-	4	2	2	8
Bohali & funerals	-	-	-	-	-
Rentals	-	1	-	-	1
Total	473	341	166	54	1034

Table 3.7 Reasons Stated for Owning Bulls

Number of Households Reporting

Reason	Most important reason	2nd Most important reason	3rd Most important reason	4th Most important reason	All responses
Breeding	358	21	4	-	383
Traditional/ceremonies		2	2	3	- 7
Draught	50	59	11	-	120
Sale	7	43	-	1	51
Beef	3	31	24	6	64
Rental for breeding	3	4	-	-	7
Transport	1	-	-	-	1
Hides	-	-	1	4	5
Dung/fuel/manure	1	10	3	2	16
Bohali	7	3	29	5	44
Initiation	2	5	1	-	8
Funerals	1	4	-	-	5
Bohali/hides/situation		-	-	1	- 1
Payment of traditional healers	-	-	1	-	1
Total	435	182	78	18	713

Table 3.8 Reasons Stated for Owning Sheep

Number of Households Reporting

Reason	Most important reason	2nd Most important reason	3rd Most important reason	4th Most important reason	All responses
Increase herd size	21	9	5	-	35
Wool	291	77	28	5	401
Mutton	83	206	73	9	371
Traditional rites	20	16	12	7	55
Sale	25	86	97	14	222
Bohali	-	1	8	13	22
Milk	-	3	1	1	5
Balimo	1	2	2	-	5
Dung/manure	-	1	2	-	3
Skins	1	2	2	2	7
Initiation	-	1	1	2	4
Traditional healing	3	1	3	-	7
Payment of shepherds	-	-	1	-	1
Total	445	405	235	53	1138

Table 3.9 Reasons Stated for Owning Goats

Number of Households Reporting

Reason	Most important reason	2nd Most important reason	3rd Most important reason	4th Most important reason	All responses
Increase herd size	16	10	2	2	30
Mohair	294	74	22	2	392
Mutton	78	186	68	4	336
Traditional rites	13	11	11	5	40
Sale	16	90	87	10	203
Bohali	-	1	10	10	21
Milk	1	5	1	1	8
Balimo	-	-	2	-	2
Dung/manure	1	1	2	1	5
Skins	1	2	5	-	8
Initiation	-	-	1	-	1
Traditional healing	1	-	1	1	3
Total	421	380	212	36	1049

Table 3.10 Reasons Stated for Owning Horses and Donkeys

Number of Households Reporting

Reason	Most important reason	2nd Most important reason	3rd Most important reason	4th Most important reason	All responses
Haulage	211	161	11	3	386
Transport - people	197	133	13	3	346
Draft	24	21	12	2	59
Sale	6	30	12	2	50
Increase herd	4	1	1	-	6
Dung	2	1	1	1	5
Bohali	-	3	7	-	10
Meat	-	10	8	-	18
Horse racing	-	-	1	-	1
Total	444	360	66	11	881

4. AN INTEGRATED MODEL OF THE LIVESTOCK/RANGE COMPLEX

The preceeding analysis has shown that Basotho livestock owners are primarily motivated by economic variables, and regard their livestock as capital assets. In this chapter that principle is used as the basis for an integrated model of the Lesotho livestock/range complex. Once the conceptual groundwork is laid, the model is specified for Lesotho conditions. In chapter 5 the model is used as a basis for examining a number of livestock development and range utilization issues.

4.1 A MODEL OF OPTIMAL SHORT-TERM STOCKING RATES [1]

A well-documented finding of range science is the nature of the short-term relationship between the stocking rate and animal productivity. Two basic physical relationships relate stocking rate to output per animal, and output per unit land area.

The forage available to each animal grazing on a fixed area of land and the corresponding output per animal are dependent, everything else equal, upon the number of animals grazed. At relatively low stocking rates each animal may consume as much as it wants and will produce at its maximum rate [2]. As more animals are added, they begin to compete for forage, their average consumption declines, and their average annual production is reduced. Eventually, a stocking rate is reached where positive energy balances of some animals are offset by negative energy balances of others, so that average weight gain is zero [3].

Figure 4.1a depicts output per animal unit in relation to stocking rates, while figure 4.1b depicts output per unit of land. Figure 4.1a shows that a yearly maximum output per animal unit can be maintained up to a stocking rate of N1 animal units. Thereafter, average output per animal unit declines linearly to zero at N2 animal units. More realistically, the decline in output per animal unit would be more gradual at first and then decline more rapidly to form a non-linear pattern. However, the linear

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[1] This model draws heavily on the conceptual work of Lovell Jarvis, particularly his 1984 paper entitled: "Overgrazing and Range Degradation: The Need for and Scope of Government Policies to Control Livestock Numbers". Jarvis' other work, particularly Jarivs (1982), is also important for understanding producer decisions within their portfolio of livestock assets. Here, however, we are more interested in overall interactions between livestock and the range.

[2] This ignores problems associated with understocking, principally brush encroachment, which may result in increasing output per animal unit as additional animals are added to a lowly stocked range.

[3] Energy balance = net metabolizable energy - maintainence energy requirement.

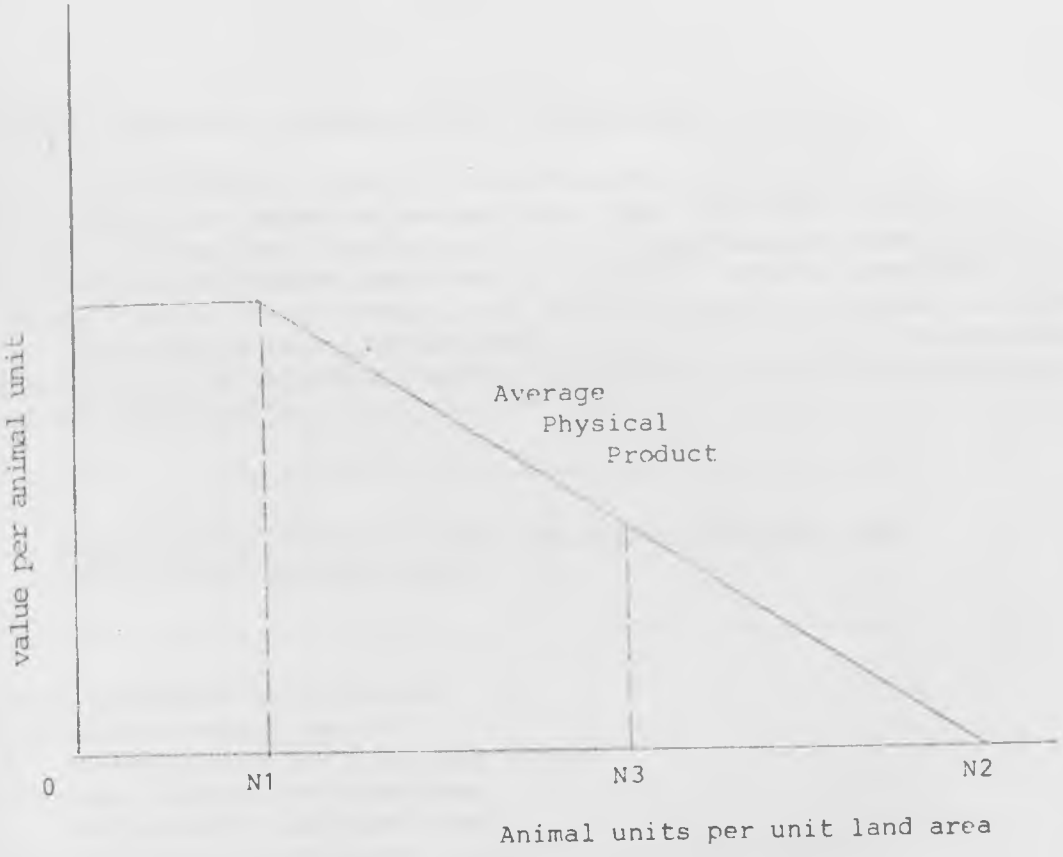

Figure 4.1a

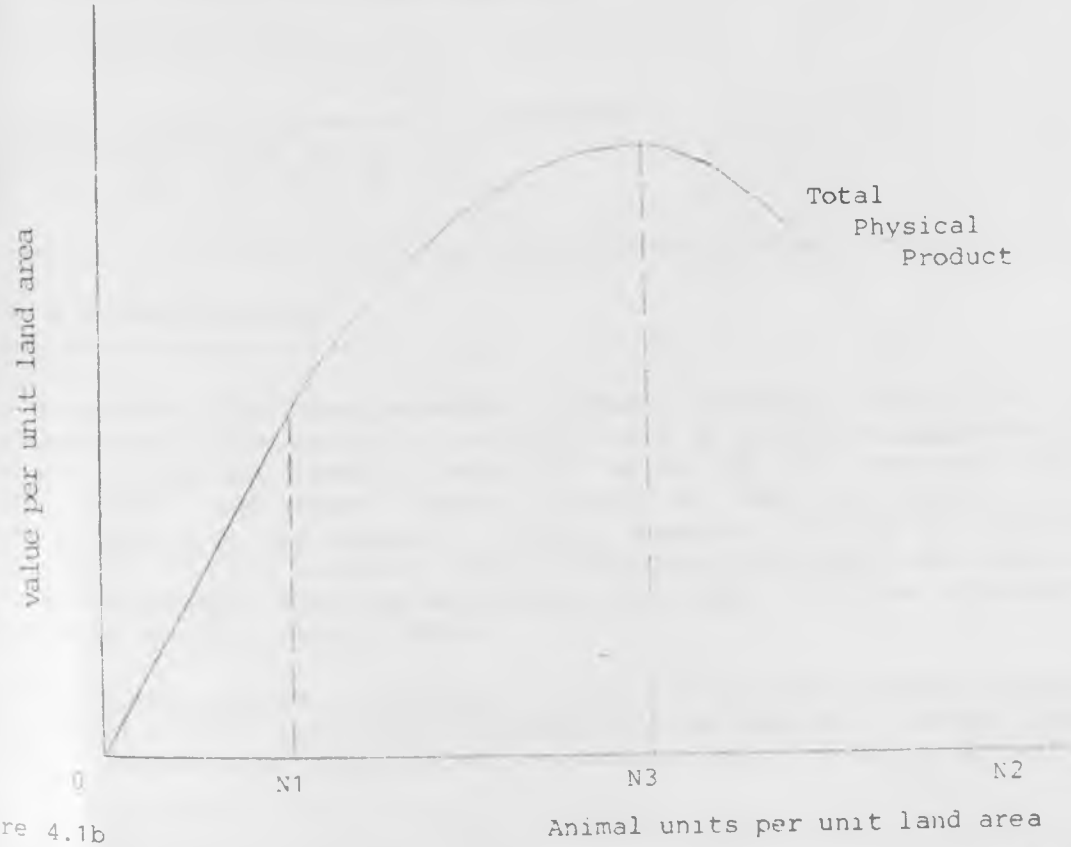

Figure 4.1b

Figure 4.1 Relationships between Average Physical Product, Total Physical Product, and the Stocking Rate

approximation used here is adequate for the analyses which follow.

Figure 4.1b is derived directly from figure 4.1a by multiplying output per animal unit by the number of animal units per land area to obtain the total physical output per land area. It is important to note in figure 4.1b that total annual output continues to increase after a stocking rate of N1 animal units even though the average output per animal unit is declining. The maximum total output from the unit of land area is obtained at a stocking rate of N3 animal units. Thereafter, total output declines to zero at N2 animal units.

Table 4.1 Equations for Average Output per Animal Unit (AU) and Total Output per Land Area

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Variable and parameter definitions:

Y = average output per AU
X = stocking rate per land area in AU
XY = total output per land area
= (output/AU) * (AU/land area)
A = intercept of horizontal segment of average physical product function
a = intercept of sloping segment of average product function
b = slope of average product function

Average physical product or output per AU:

(1) Y = A for X <= N1 AU
(2) Y = a + bX for X >= N1 AU

Total physical product or output per land area:

(3) XY = AX for x <= N1 AU
(4) XY = aX + bX for X >= N1 AU

Short-term Economic Optima

To determine short-term economic optimum stocking rates, both the revenue generated from products and the costs of producing them must be considered. Production costs include the value of all non-land inputs (capital, labour and other inputs) valued at what they could earn if employed elsewhere in the economy. Capital expenses include the interest on the value of all capital assets: buildings, equipment and animals. Livestock are capital; they can be sold and the funds invested elsewhere, normally at a positive rate of return.

The physical outputs of figures 4.1a and 4.1b are converted to revenue by multiplying a price per unit of output by the number of output units produced. Figure 4.2a shows value per animal unit, or value of average

product, and cost per animal unit, or average cost of input. Figure 4.2b shows total revenue and total cost [4].

The vertical distance between the total cost and total revenue curves in figure 4.2b represents total profit (or rent) for the unit land area. Profit (or rent) is maximized at N4 animal units. This distance represents the maximum rent that could be paid for the fixed land resource and still cover all other production and opportunity costs. Under the physical productivity, product prices, and costs assumed, any other stocking rate results in lower rent generated from the fixed land resource [5].

If all other production and opportunity costs had equalled zero, then the stocking rate which generated maximum value -- N3 animal units -- would also be the rate which generated maximum rent. However, in this example costs are not zero so the rate which generates maximum rent -- N4 animal units -- is less than the rate which generates maximum revenue. In the next section it will be proven that the rate which generates maximum rent is consistent with individual access to the range resource.

Total revenue equals total costs at N5 animal units per unit land area. Livestock owners receive opportunity returns to their capital and labour and generate zero rent from the fixed land resource. Further expansion is discouraged because total revenue can no longer cover the costs of the herd inputs. Jarvis (1984) called this zero rent point the open access equilibrium, and defined the difference between the maximum rent equilibrium and the open access equilibrium as the rate of overstocking.

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[4] Average cost of input (alternatively defined as average expense of input or average outlay) for a single variable production function is equal to total variable cost divided by the quantity of the variable input. In this case we assume that there are no fixed costs (because no rent is paid for the land) and that animal units are the only variable input, so average cost of input equals total cost divided by the number of animal units. Average cost of input is distinct from average cost which to total cost divided by the quantity of output. In this example average cost of input is constant while average cost increases at stocking rates greater than N1.

Value of average product is equal to total revenue divided by the quantity of the variable input. This is distinct from average revenue which is total revenue divided by the quantity of output. In this example average revenue is constant while value of average product decreases at stocking rates greater than N1.

[5] For an individual stockowner the differrence between total revenue and total cost is viewed as profit. If this profit is generated due to a conscious decision to limit the number of animals on the unit of land area it is correctly defined as rent to the fixed factor of production -- in this case the land. However, if the profit is generated due to some external limit in a temporary fixed factor -- in this case the number of animal units -- then it is correctly defined as quasi-rent.

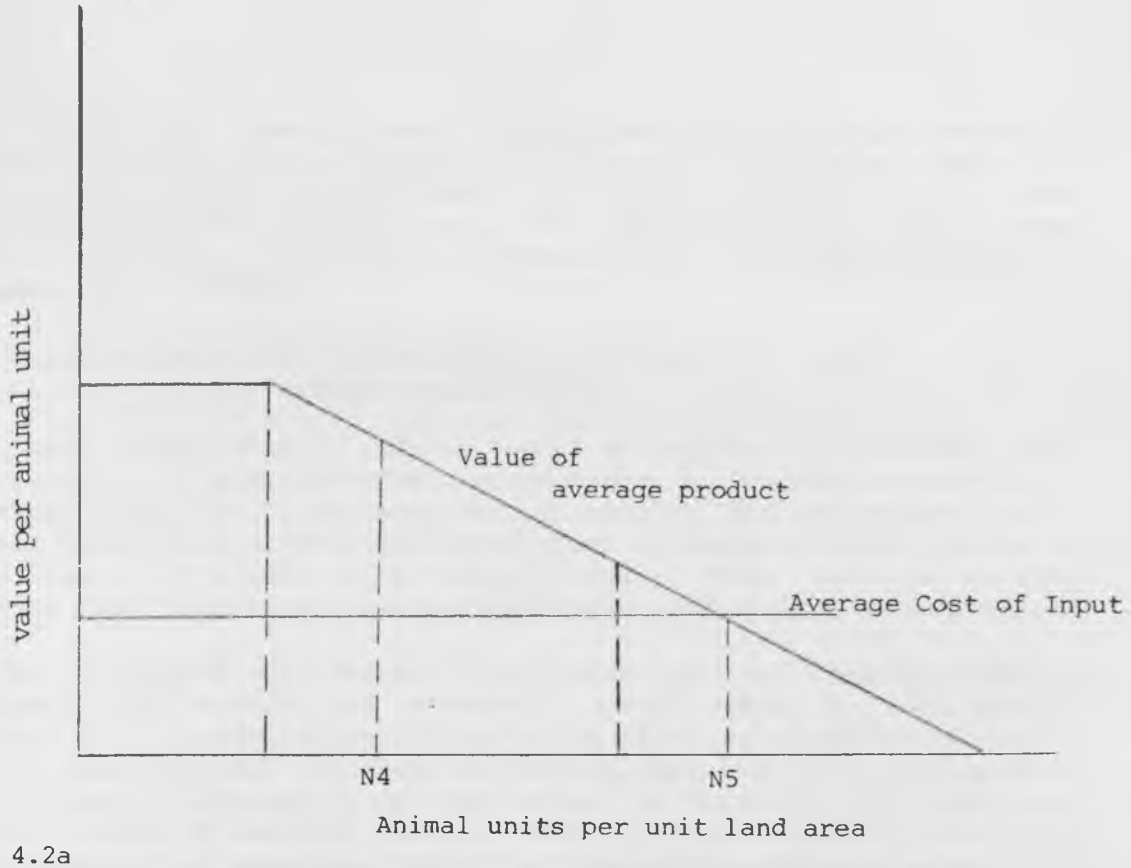

Figure 4.2a

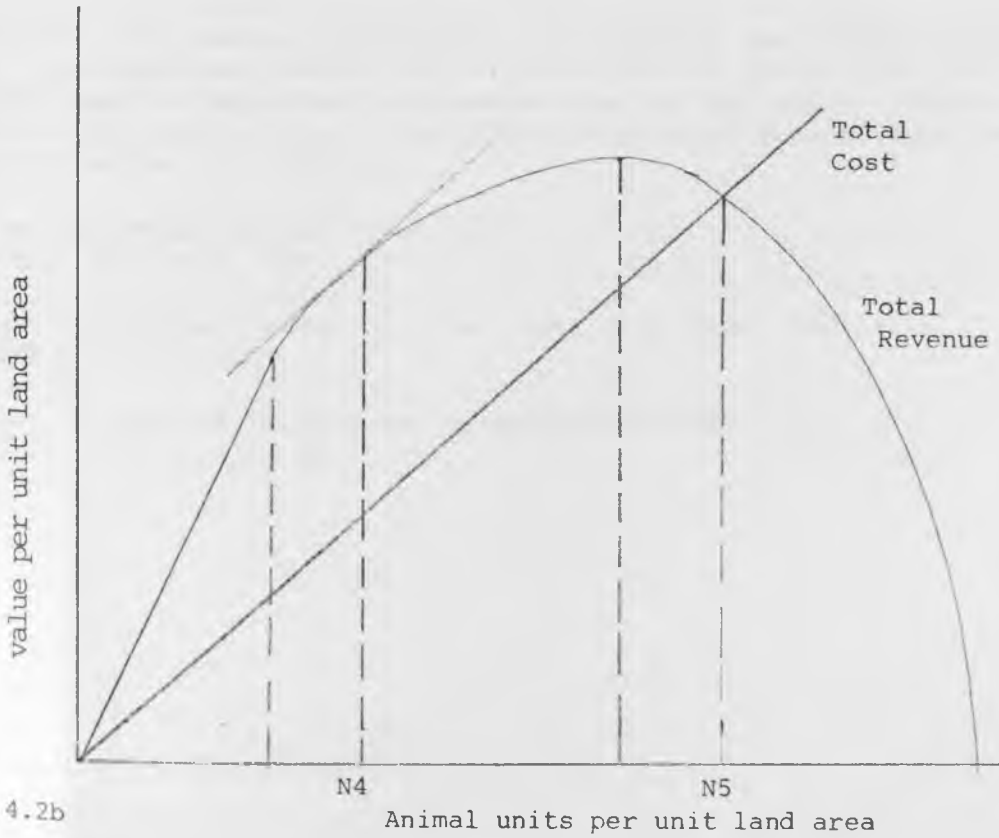

Figure 4.2b

Figure 4.2 Relationships between Revenues, Input Costs and the Stocking Rate

The proof that open access equilibrium with a large number of independent profit maximizing stockowners occurs at the point where land rent is zero is shown in the following subsection. It is also shown that as the number of herders becomes fewer, and their individual herds become larger in proportion to the total communal herd, the equilibrium size of the communal herd declines.

Stocking Rates and Varying Numbers of Independent Profit Maximizing Producers

How many herders does it take to create an overstocking problem? Does the overstocking problem increase as the number of herders increases? To answer these questions it is necessary to examine how independent profit maximizing individuals adjust their herd sizes to maximize their profits as the total number of animals on the range varies. To do this the concepts of marginal cost of input and value of marginal product must be introduced.

If an individual may add one more animal unit and realize a gain in total revenue that exceeds his increase in total costs, he will benefit from doing so. In other words, if the value of the marginal product of an additional animal exceeds the marginal cost of input, it is in the interest of an individual stockowner to add that animal to his herd. The individual stockowner's value of marginal product (VMPi) is the change in his total revenue (positive or negative) resulting from adding one more animal unit to his herd; his marginal cost of input (MCI) is the addition to his total cost resulting from adding one more animal unit to his herd. Thus if his VMPi from an additional animal unit exceeds his MCI, his profits will be increased by the additional unit. Maximum profits are achieved by the number of animal units that equate VMPi and MCI.

In table 4.2, general expressions are derived for average physical product, total physical product and marginal physical product for the range as a whole, and for individual stockowners sharing the range. Expressions for revenue are derived by multiplying the physical product functions by the price of output, P. That is:

Value of average product (VAP) is:

(5) $VAP = PY = P(a + bX)$

Value of marginal product for the range as a whole (VMP) is:

(6) $VMP = P(a + 2bX)$

Value of marginal product for an individual (VMPi) is:

(7) $VMPi = P(a + bX + bXi)$

Table 4.2 Derivation of the General Expression for Marginal Physical Product of an Individual Herder Sharing a Communal Range Resource

Notation:

X = total number of animal units (AU) grazing the fixed land area of a communal range

Xi = number of AU owned by individual i; i = 1,2,. . ., n

Y = output per AU or average physical product (APP)

General Derivation of Marginal Physical Product:

(8) $Y = f(x)$ where $f'(X) \geq 0$ for all $X \geq N2$, $f''(X) \leq 0$

(9) $X = \sum Xi \qquad i = 1,2,\ldots,n$

XY = Total physical product (TPP) of the range as a whole:

(10) $XY = X\,f(X)$

XiY = Total physical product (TPPi) for individual i:

(11) $XiY = Xi\,f(X)$

Marginal physical product (MPP) for the range as a whole:

(12) $MPP = XY / X$

Marginal physical product (MPPi) for an individual i:

(13) $MPPi = XiY / Xi$

(14) $MPPi = Y\,(Xi/Xi) * Xi\,(Y/Xi)$

Derivation for linear case:

(15) $APP = APPi = Y = a + bX$

(16) $TPP = XY = aX + bX$

(17) $MPP = a + 2bX$

(18) $TPPi = XiY = aXi + bXXi$

(19) $MPPi = a + bX + bXi$

Let $Xi = piX$ or $pi = Xi/X$ where pi is the proportion of AU owned by individual i, and

(20) $MPPi = a + bX + bpiX$

(21) $MPPi = a + (1 + pi)\,bx$

To determine the number of animal units which the ith herder will stock to maximize his profits -- if he acts independently of other herders -- we set VMPi = MCI and solve for Xi:

(22) $MC = P\,[a + 2bXi + b\,(X1+X2+ \ldots +Xi-1 + Xi+1 + \ldots Xn)]$

(23) $Xi = [MCI/P - a - b(X1+X2+ \ldots + Xi-1 + Xi+1 + \ldots Xn)] / 2b$

Thus the number of animals which herder i would have to maximize his profit depends on:
(a) marginal cost of input, MCI;
(b) product price, P;
(c) parameters in the average product function, a and b; and
(d) the number of animal units held by all other herders (X1 + X2 + ... + Xi-1 + Xi+1 + ... Xn).

If all other herders have no animals, then Xi = X and VMPi in equation (7) becomes the same as VMP in equation (6) which is the value of marginal product for the range as a whole.

If all other herders have very large numbers of animal units, then Xi becomes very small relative to the total number of animal units and value of marginal product for herder i becomes close to average revenue for the range as a whole. This may be seen more easily if we define pi as the proportion of all animals on the range that herder i holds, where pi = Xi/X. VMPi, as derived from equation (21) becomes:

(24) $VMPi = P [a + b (1 + pi) X]$

If herder i owns one percent of the animals on the range then pi = 0.01. Substituting this value in equation (24) we obtain:

(25) $VMPi = P (a + 1.01 bX)$

This is approximately the same as value of average product shown in equation (5). Thus, when there are very many stockowners each of whom owns a small proportion of the animal units on the range, the values of their individual value of marginal product functions asymptotically approach the values of the value of average product function. In the case where average costs are constant per animal unit, as assumed in figures 4.2a and 4.2b, average cost of input equals marginal cost of input. Therefore when the proportion of all animal units on the range owned by an individual is very small, the condition of equating value of marginal products with marginal costs is the same as equating average revenue with average cost for the range as a whole. When average revenue equals average cost, total value equals total cost and rent is zero.

Figure 4.3 indicates the over-investment in livestock which would occur when more than one independent profit-maximizing producer has access to the range. The MCI line intersects: (1) VMP at N4 animal units; (2) VMP* at N* animal units; (3) VMP** at N** animal units; and (3) AR at N5 animal units. These represent profit maximizing stocking rates, respectively, for:
(1) one individual stockowner with 100 percent of the group animal units;
(2) two independently competitive individuals each with 50 percent of the group animal units;
(3) 20 independently competitive individuals each with 5 percent of the group animal units;
(4) a very large number of independently competitive individuals so that

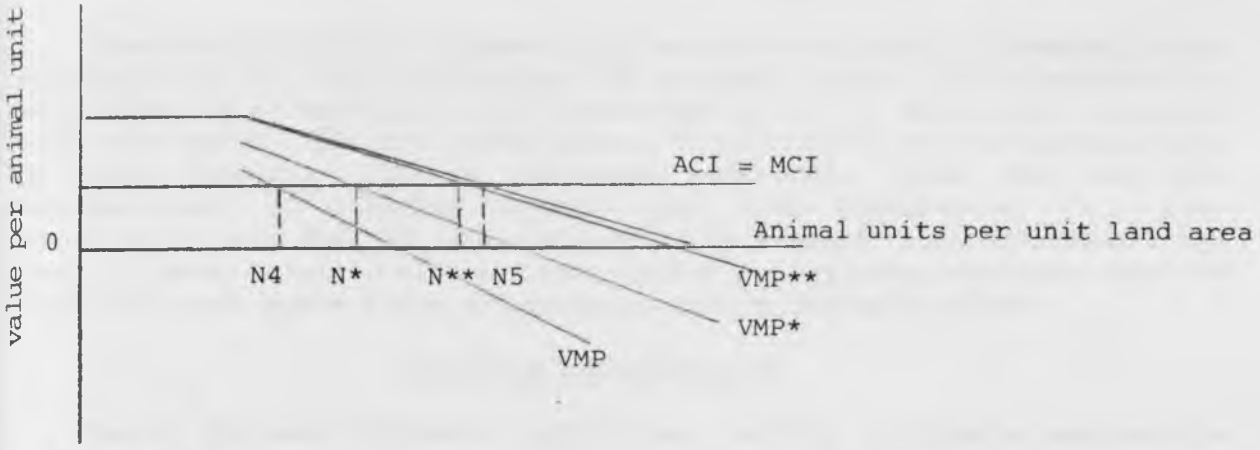

Figure 4.3a

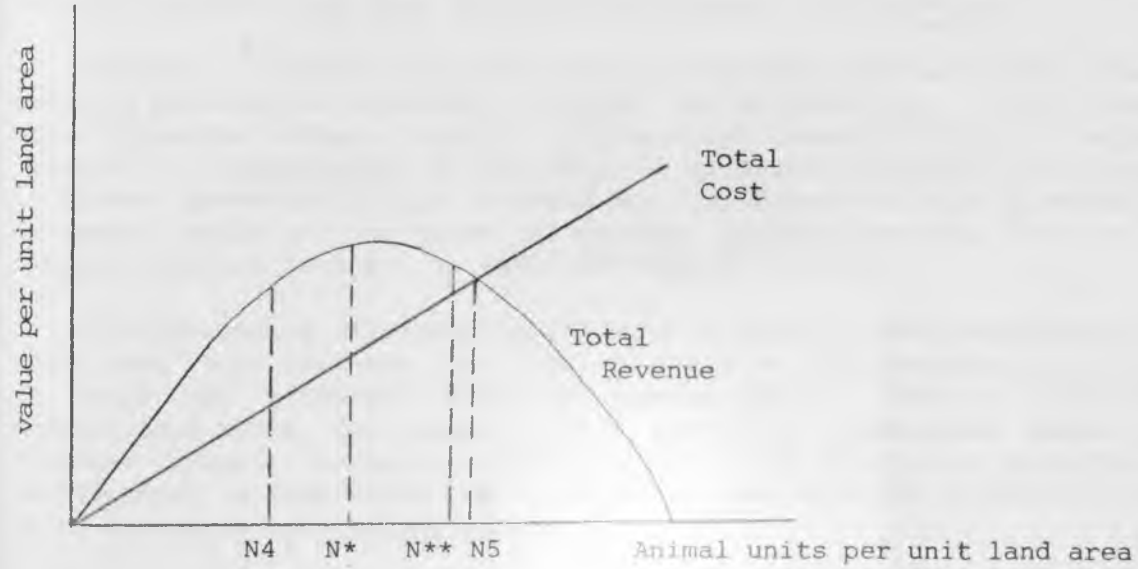

Figure 4.3b

Figure 4.3 Revenue and Cost Functions for Varying Numbers of Independent Profit-Maximizing Producers

each holds one percent or less of the group's animal units. This is equivalent to Jarvis' open access equilibrium.

Jarvis calls this fourth optimum the open access optimum, which is the economically attractive stocking rate that a large group of stockowners would attain if they ignored, or were unaware of, their interdependence.

From this analysis it appears that unrestricted use of communal range may result in a total dissipation of economic rent. It is important to note that this definition of overstocking is a short-term economic definition which does not take account of the effect of the stocking rate on range quality. It is divorced completely from the long-term considerations of carrying capacity and range degradation. It is also important to note that in this analysis it is assumed that stockowners can stock as many animal units as they desire. Long-term considerations and limits on stock numbers are addressed in the following sections.

Long-term Considerations

One of the most important implications of the preceeding analysis is that overstocking can occur whether or not range degradation results. What has not been established are the relationships between the level and types of livestock and the soil and foilage environment. It is these relationships which most concern rangeland ecologists.

Continual stocking of Lesotho's rangeland beyond its carrying capacity has reportedly resulted in an encroachment of unpalatable forage species and a degradation of the soil base through desertification, soil erosion, or exposure of rock. This degradation of the range will reduce future forage production, and thus future production of animal products. Such a reduction in future potential production is modelled as a downward shifts of the value of average product function and the total revenue function from VAP to VAP!, and from TR to TR! in figures 4.4a and 4.4b.

However, a reduction in the current stocking rate to a rate less than carrying capacity is expected to result in regeneration of the range as more palatable forage species increase and desertification is halted or reversed. A regeneration of the range is expected to result in an increase in future potential forage production. In figure 4.4 this is modelled as an upward shift in the value of average product function and the total revenue function from VAP to VAP#, and from TR to TR#.

The destocking depicted in figure 4.4 suggests that production in the short term would decrease, but then increase as improvements are achieved in range and potential livestock productivity. However, once this is accomplished there are even greater potential short-term gains to be obtained through increased stocking rates. Such short-term potential will always offer a temptation to stockowners and resource managers alike to allow increases in stocking rates.

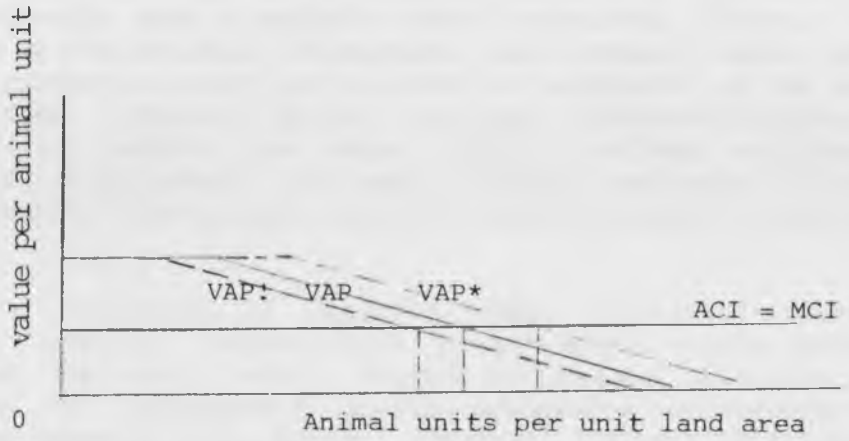

Figure 4.4a

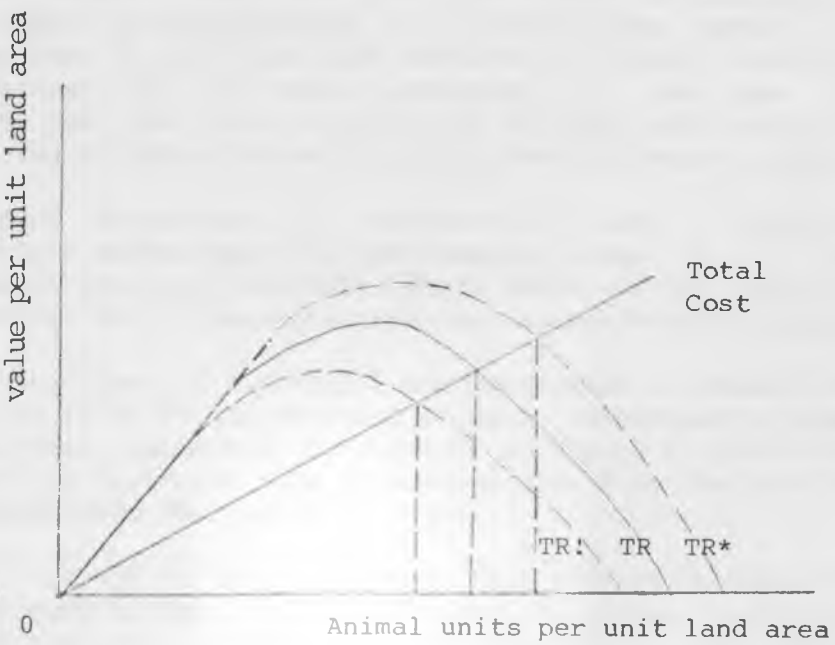

Figure 4.4b

Figure 4.4 Revenue and Cost Functions for Range Degradation and Range Improvement

Limits on Stock Numbers

One of the conclusions of the previous analysis was that unrestricted use of a communal range may result in a total dissipation of economic rent as independent stockowners seek to maximize their individual profits. This conclusion is based on the implicit assumption that animal units are a variable factor of production which may be added or subtracted on the basis of stockowner decisions. However, given that many livestock systems are effectively closed to imports and hence totally reliant on internal production for herd recruitments, it may be more realistic to treat livestock as temporarily fixed inputs which can only be varied in the long term.

In figure 4.5 a situation is depicted where there is a maximum attainable stocking rate, N+, beyond which no increases in the stocking rate are possible in the short term. Because N+ is less than the open access equilibrium, N5, independent profit- maximizing stockowners will seek to increase the sizes of their herds. However, because animal units are temporarily restricted to a maximum of N+, quasi-rents are earned by the owners of the animal units. The amount of the quasi-rent is equal to the difference between total revenue and total cost in figure 4.5b, which is equivalent to value of average product less average cost of input multiplied by N+ animal units in figure 4.5a.

It is important to note that the rents depicted in figure 4 are due to the scarcity value of the fixed factor of production, the land, and that the quasi-rents depicted in figure 4.5 are due to the scarcity value of the temporarily fixed factor of production, the animal units.

Conclusions

The economic model of optimal short-term stocking rates developed in this section of the report illustrates that open access utilization of a communal range may result in overstocking in a short-term sense to the point where economic rent to the fixed land resource is totally dissipated. However, the extensions of the model contained in the last three subsections indicate that the total equilibrium stocking rate may be less than the open-access equilibrium for no less than four different reasons:

(1) If an individual stockowner (or stockowners) have a significant proportion of the total animal units on the communal range, it is in their own short-term economic interest to limit their share of the animals so that the total stocking rate is less than the open-access stocking rate.

(2) The production functions of individual stockowners on a communal range are inter-dependent so it is in the interest of each stockowner to promote institutions which will stimulate cooperative solutions to the stocking problem. Runge (1981) illustrated this interdependence from the cost side, here it was illustrated from the production side.

(3) If stockowners recognize the long-term costs of high stocking rates they may internalize some of those costs or attempt to foster institutions which will encourage the group of stockowners to internalize those costs in the stocking decisions.

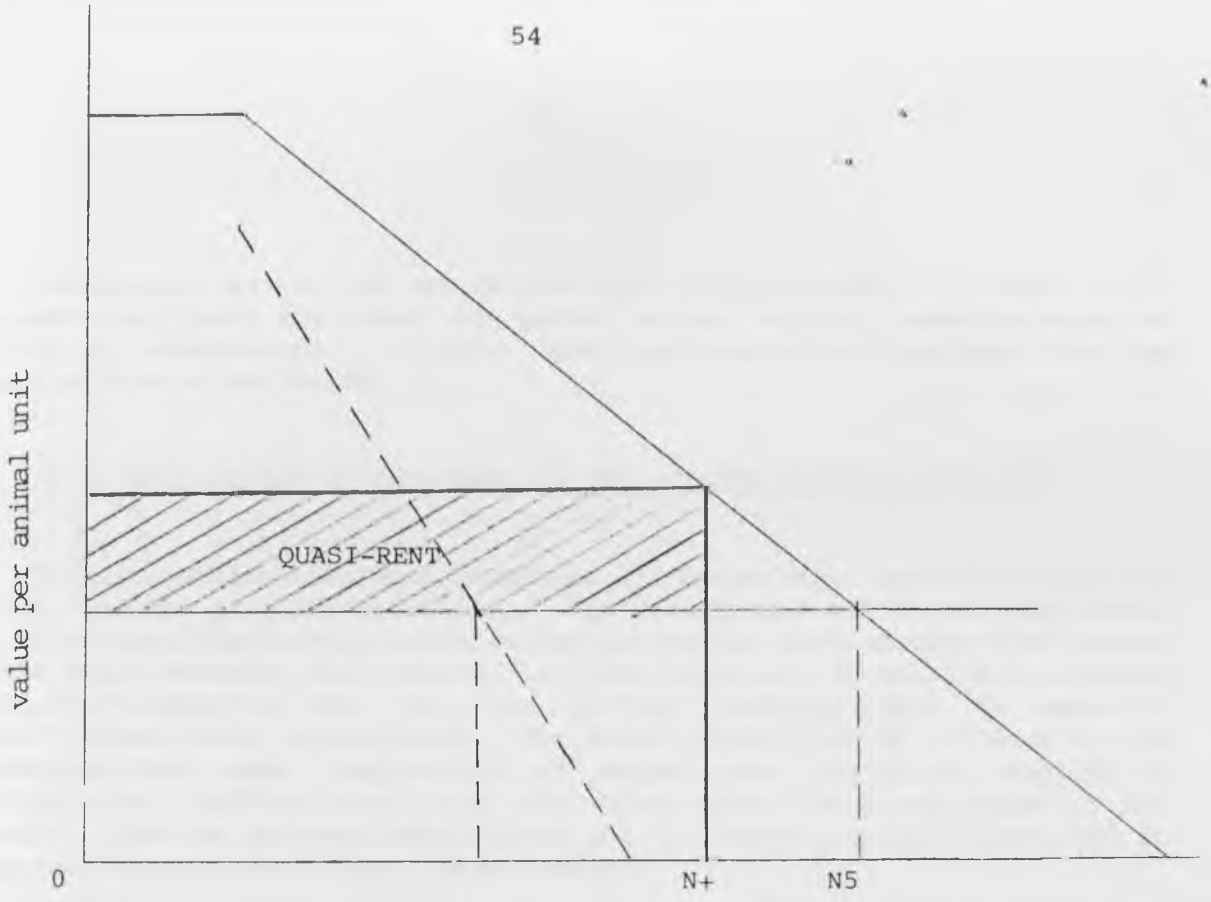

Figure 4.5a

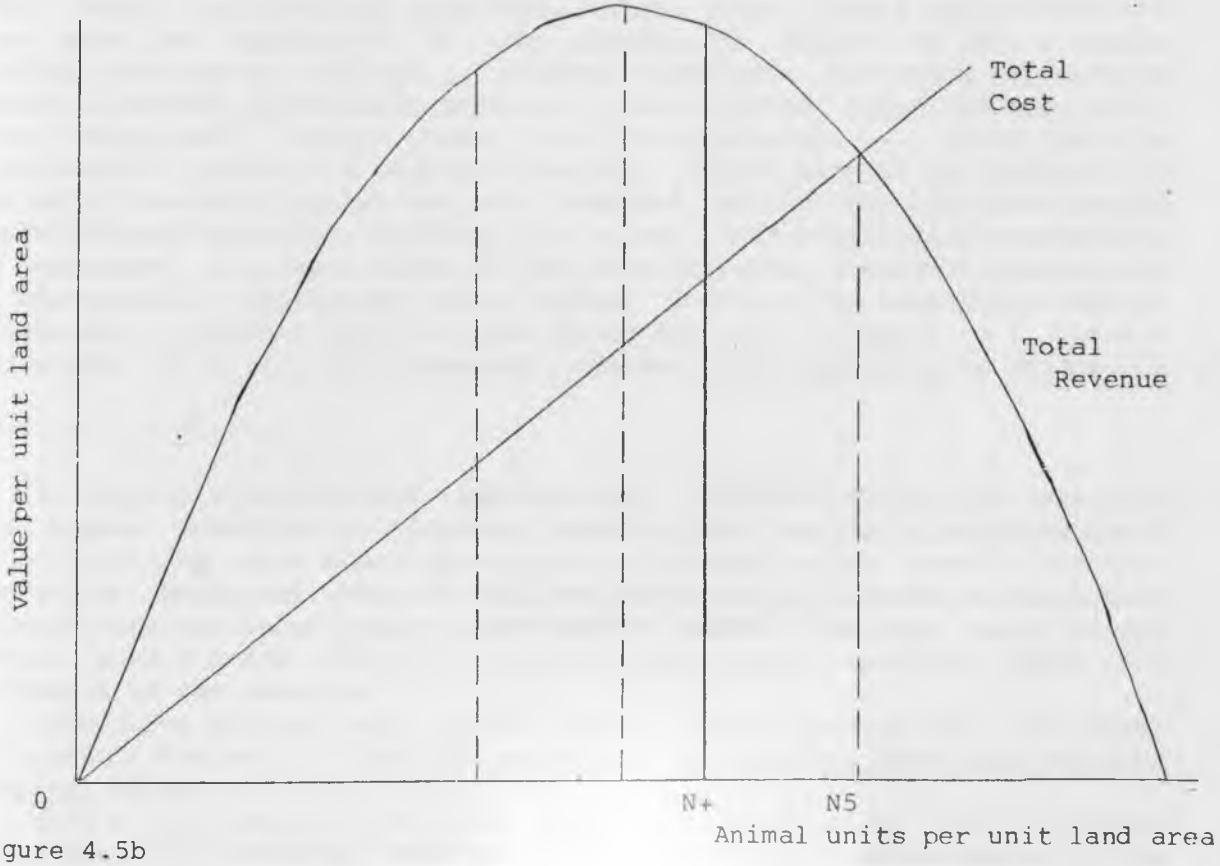

Figure 4.5b

Figure 4.5 Revenue and Cost Functions with a Biological Stock Limit

(4) Biological and/or market restrictions on the number of animal units available may limit the number of animal units, even if more animals are desired by stockowners. In this case quasi-rents are generated for the owners of the animal units.

4.2 APPLICATION OF THE MODEL TO THE LESOTHO PROBLEM SITUATION

In this section the model developed in the previous section is applied to the Lesotho problem situation. Two alternative models are specified. The first specification is based on the assumption that unrestricted access to the range resource has resulted in a stocking rate at which all economic rents are dissipated, that is, the current stocking rate is equal to Jarvis' open-access equilibrium. The second specification is based on the assumption that some combination of market and biological constraints restrict the stocking rate to a point where quasi-rents are earned by the animals. Data on the herd populations and the budget analysis contained in chapter 3 support the latter specification.

Three basic problems arise in empirical specification of the model. First, Lesotho is populated by cattle, sheep, goats, horses and donkeys and these must be aggregated in some meaningful manner so that a single stocking rate may be defined. Second, Lesotho's livestock populations produce a variety of valuable products -- meat, hides, skins, offals, wool, mohair, dung, milk, draught power and transportation -- which must be aggregated to generate a composite output. Third, many of the products of Lesotho's livestock populations are consumed within the livestock-owning households and are thus difficult to value. Four simplifying assumptions are necessary: (1) populations of the five different livestock species can be meaningfully aggregated into animal units -- the conversion factors assumed are: 1 animal unit = 1 (450 kilogram) cow = 5 goats = 1 horse = 1.25 donkey [6]; (2) all livestock species react similarly to changes in

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[6] In chapter 2 substantial evidence was presented which indicate that this linear substitution between species may seriously under-estimate optimal stocking rates under mixed-species grazing as we have in Lesotho. However, no empirical research has been conducted in Lesotho on which more realistic species substitution rates may be based. In this model linear species substitution will be assumed, but readers cautioned about this limitation of the results.

Conversion factors are taken from: Land Conservation and Range Development Project, The Determination of Stocking Rates and Carrying Capacity. 1986.

With a 450 kilogram cow used as the standard animal unit, it would appear that the stocking rate has been consistently over-estimated in the many studies which have equated cattle numbers with animal units. Data from the LPMS auction sales contained in Swallow, Mokitimi and Brokken (1986) indicate that only mature oxen reach 450 kilograms. The average weight of mature cows may be as low as 300 to 350 kilograms. Clearly this issue requires further research.

nutritional levels resulting from increased or decreased competition for available forage; (3) livestock owners treat their animals as capital and act as portfolio managers to equate the returns to capital investment for each species; and (4) all of the products generated by the livestock may be given economic value regardless of whether they are sold or consumed in the household.

Current stocking rates in Lesotho average about 2.0 hectares per animal unit, or about 500 animal units per 1000 hectares [7]. It is thought that for much of Lesotho a stocking rate of approximately 10 hectares per animal unit, or 100 animal units per 1000 hectares would result in maximum production per animal unit under current management and allow significant range improvement under well-managed grazing [8]. The maximum output per animal could be sustained somewhat beyond 100 animal units, but allow less range improvement. Above 125 animal units per 1000 hectares, output per animal starts to decline in these examples.

From the cattle, sheep and goat budgets presented in the chapter 3, average revenues, costs and rents per animal unit can be calculated. The result of these calculations is that at the current stocking rate, cattle, sheep and goats in Lesotho cost an average of M39.36 per animal unit per year, generate revenues of M60.04 and earn quasi-rent of M20.68.

The Current Stocking Rate as the Open-access Equilibrium

Figure 4.6 depicts a situation in which the current Lesotho stocking rate is the rate at which the average cost of input (ACI) is equal to the value of average product (VAP) and thus rents are driven to zero. The average cost of input is assumed to be constant at M39.36 per animal unit, and thus equal to the marginal cost of input (MCI). The current stocking rate of 500 animal units per 1000 hectares is assumed to be the rate at which ACI=VAP. A function with a linear section from 0 to 125 animal units then fit through the equilibrium stocking rate point. In this example the following relationships are assumed to apply:

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[7] There are a total of 1,210,106 animal units on a total land base of 3,003,500 hectares for an average density of 2.48 animal units for every hectare in Lesotho. However, there are only 2,092,558 hectares of rangeland (table 2.3), indicating a density of 1.73 animal units per hectare of rangeland. Since many animals are grazed on crop residue left on cultivated land, an average of 2 animal units per hectare is assumed for this application of the model.

[8] The assumption of 2 animal units per hectare equates to a usable grazing area of 2,420,212 hectares. Applying the lower carrying capacity estimate of 147,182 animal units, this equates to one animal unit per 16.44 hectares. Applying the higher estimate of 255,116 animal units, the estimate is one animal unit per 10.54 hectares. Given that the estimation procedure did not account for the grazing habits of the different livestock species, a slightly higher 1 animal unit per 10 hectares is used here.

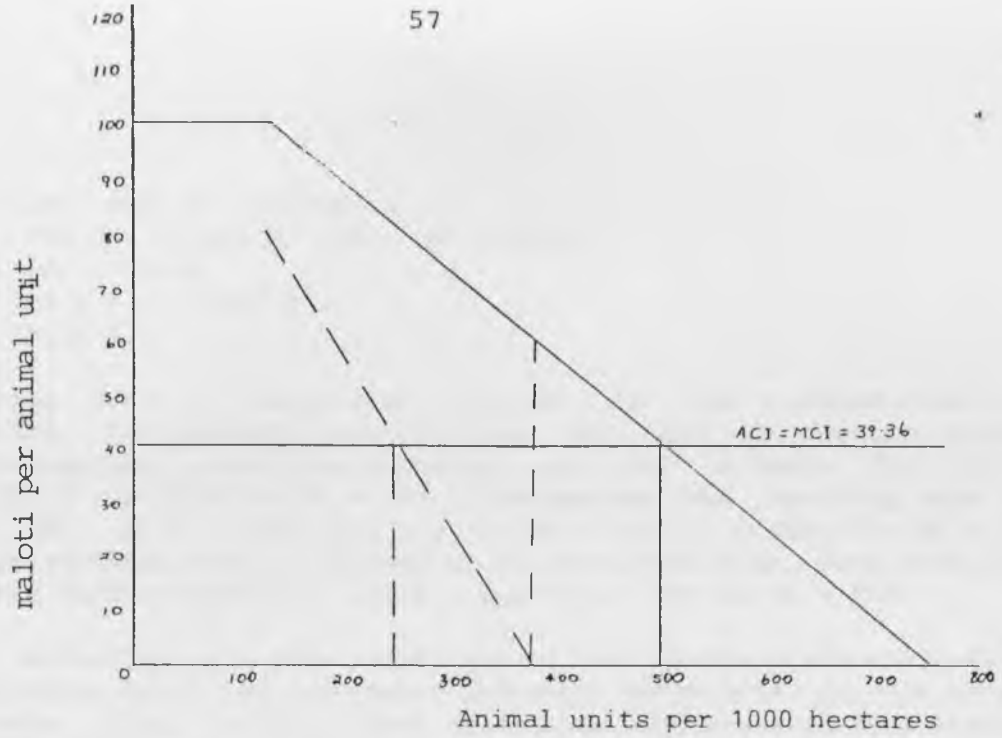

Figure 4.6a

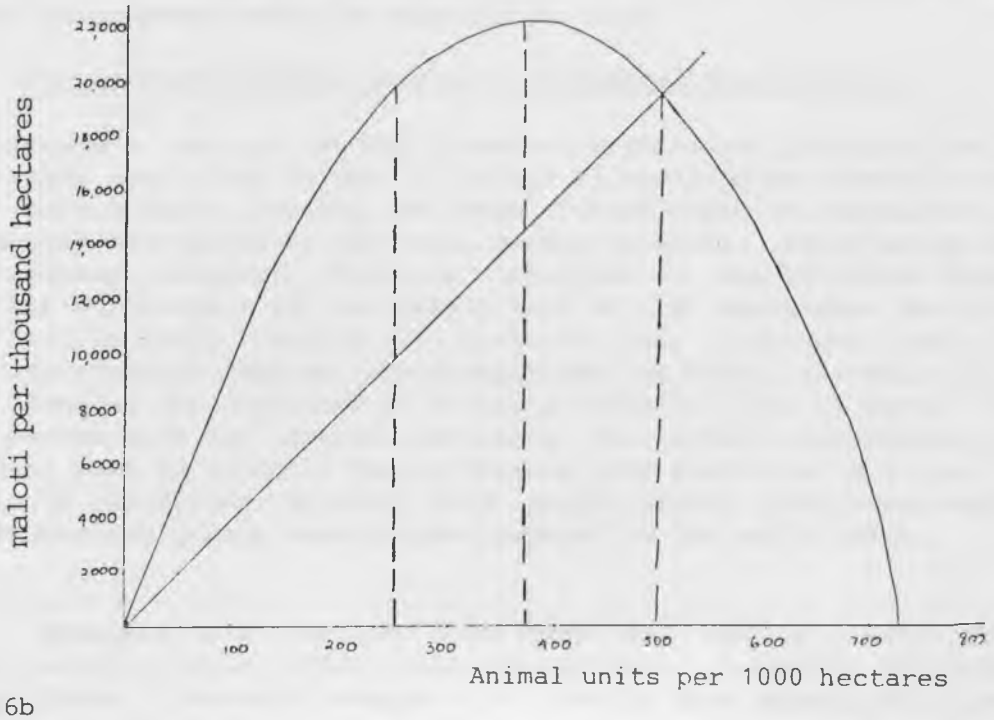

Figure 4.6b

Figure 4.6 Revenue and Cost Functions for the Lesotho Livestock System Modelled as an 'Open-Access' Equilibrium

VAP = 100 for X < 125 AU
VAP = 120.2 - 0.1617 X for X > 125 AU
MCI = ACI = 39.36
TR = 120.2 X - 0.1617 X
TC = 39.36 X

Stocking rate of particular interest are the maximum production stocking rate, the maximum rent stocking rate, and the current stocking rate. The maximum production stocking rate (N3) is where TR / X = 0, i.e. 0 = 120.2 - 0.3234 N3; N3 = 372. The maximum rent stocking rate (N4) is where TR/ X = TC/ X; i.e. 39.36 = 120.2 - 0.3234 N4; N4 = 250. The current stocking rate is assumed to be consistent with zero rents (N5) and is where TR/X = TC/X; i.e. 120.2 - 0.1617 X = 39.36; N5 = 500.

Thus according to this depiction of the Lesotho problem situation, total production could be increased through reductions in the current stocking rate of up to 128 animal units per 1000 hectares to a stocking rate of 372 animal units. Further reductions of up to 250 animal units would generate increases in total rent. It is interesting to note that this maximum rent stocking rate is 100 percent greater than the rate at which range degradation is assumed to stop. The implication is that large short-term losses would be foregone by a stocking rate of 100 animal units where range enhancement would be expected to occur.

The Current Stocking Rate as a Biological Equilibrium

The aggregate data on Lesotho livestock populations indicate that the total livestock population is near a biological equilibrium where the total number of animal units leaving the range through death and slaughter each year is roughly equivalent to the total number of animal units being added through surviving progeny. The data contained in the livestock budgets indicate that stockowners are now making most of the management decisions, which are within their control, to increase their individual herds [9]. Only old, unproductive females are slaughtered or sold, virtually all of the young females are retained as breeding animals. Thus it appears that livestock owners have few options available for further increasing total stock numbers even if economic forces provide them incentive to do so. The possibility of recruiting imports from South Africa has been severely hampered by Lesotho import restrictions imposed in the early 1980s.

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[9] Managers have cetain objectives and control over a set of management variables which affect those objectives. Compared to managers of private farms, livestock managers in Lesotho have access to a limited set of management variables. Individual Basotho stockowners have little control over range use or crop residue on harvested fields, and restricted ability to independently introduce improved breeding. Much more intensive management, and hence higher costs, would be necessary to bring many of the possible variables under individual control.

This combination of biological factors and market constraints may serve to constrain livestock numbers in Lesotho below the zero-rent equilibrium stocking rate to what is here termed as a biological equilibrium stocking rate. Further evidence in support of this hypothesis is provided by the results of the livestock budget analysis which indicates an average return to capital in raising cattle, sheep and goats of M20.68 per animal unit. In this sub-section a model is constructed which incorporates this biological equilibrium and models the returns as quasi-rents earned by the owners of the animals.

Figure 4.7 depicts a situation in which the current stocking rate of 500 animal units is at a point where the value of average product is equal to the average cost of input plus a quasi rent of M20.68 per animal unit. Again, the average cost of input is assumed to be constant at M39.36 per animal unit. A function with a linear section from 0 to 125 animal units was then fitted to intersect the biological equilibrium stocking rate where the value of average product function was deliberately chosen to be equal to the VAP function in figure 4.6. The following relationships are assumed:

$VAP = 120.68$ for $X < 125$ AU
$VAP = 140.88 - 0.1617\ X$ for $X > 125$ AU
$MCI = ACI = 28.44$
$TR = 140.88\ X - 0.1617\ X$
$TC = 39.36\ X$

In this model the maximum production stocking rate (N3) is where $TR / X = 0$; i.e. $0 = 140.88 - 0.3234\ N3$; $N3 = 436$. The maximum rent stocking rate (N4) is where $TR / X = TC / X$; i.e. $39.36 = 140.88 - 0.3234\ N4$; $N4 = 314$. The current stocking rate of 500 animal units is associated with quasi-rents per animal of M20.68. The zero-rent stocking rate (N5) is where $TR/X = TC/X$; i.e. $140.88 - 0.1617\ X = 39.36$; $N5 = 628$.

The results of this specification of the model contrast markedly with the results of the previous model. The current stocking rate is 128 animal units less than the open-access equilibrium and quasi-rents of M20.68 are earned per animal unit. The current stocking rate is only slightly (64 animal units) greater than the maximum production stocking rate of 436 animal units. The maximum rent stocking rate of 314 animal units is 186 less than the current rate. In this model maximum rent is generated at a stocking rate which is 150 percent greater than the rate recommended to stop range degradation. The short-term losses necessary to generate range enhancement are even greater than illustrated in the previous specification.

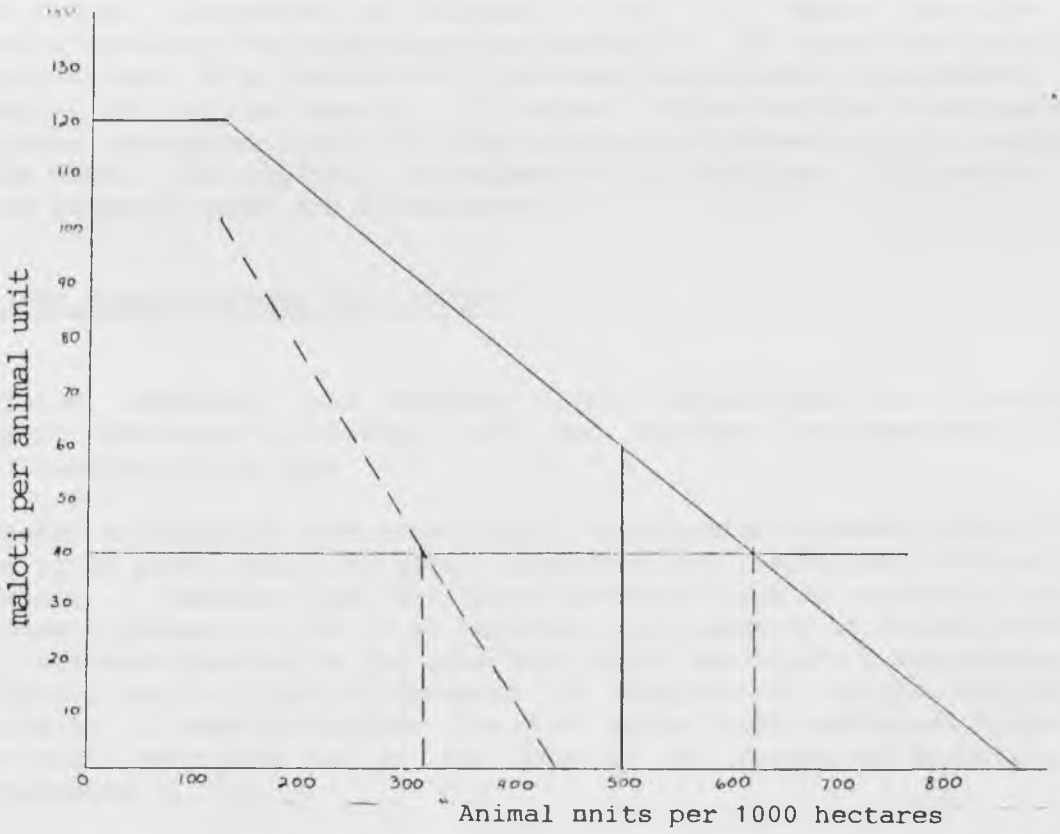

Figure 4.7a

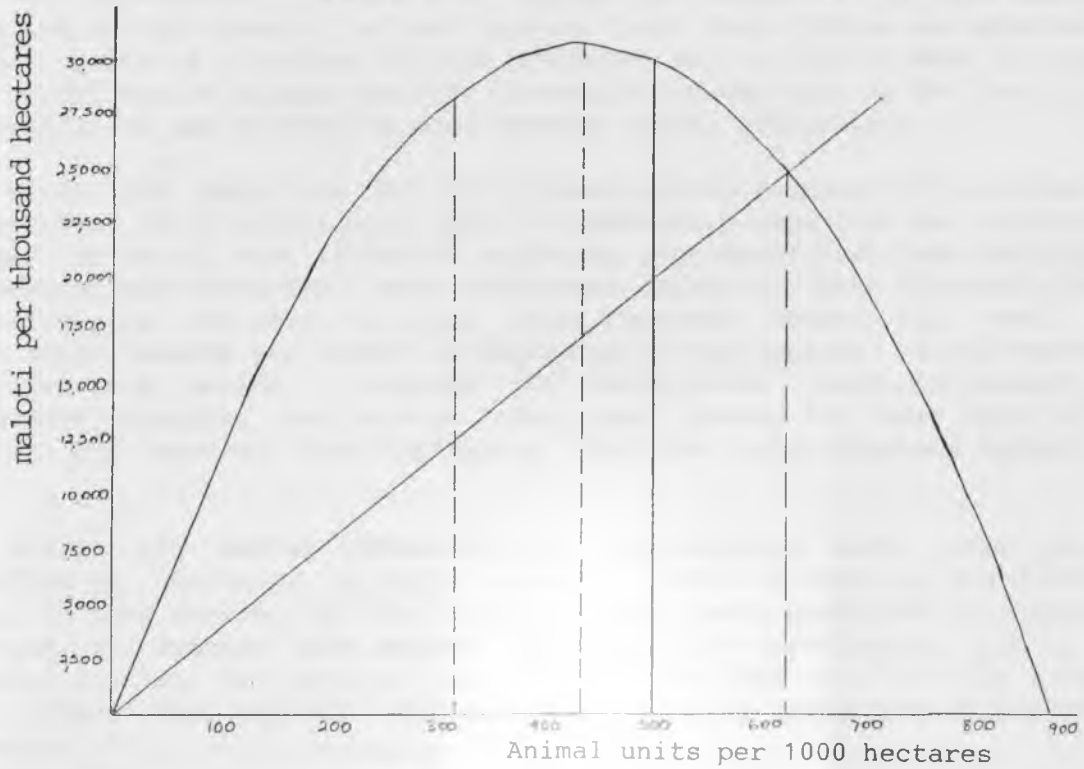

Figure 4.7b

Figure 4.7 Revenue and Cost Functions for the Lesotho Livestock System Modelled as a 'Biological' Equilibrium

5. EVALUATION OF SPECIFIC DEVELOPMENT PROGRAMMES

The model presented in chapter 4 of this report provides an appropriate framework for analysing the production and short-term stocking rate implications of a variety of livestock development programmes. In this chapter the implications of: (1) market infrastructure developments; (2) improved management; and (3) range control programmes are all analyzed using the model. The analysis is augmented by additional discussion. A number of research needs are illuminated.

5.1 MARKET INFRASTRUCTURE DEVELOPMENT

Swallow, Mokitimi and Brokken (1986) categorized the livestock development literature in Lesotho into two distinct perspectives. The dominant perspective is that

> Basotho stockowners are traditional, subsistence-oriented peasants who place great value on their livestock for social and cultural reasons. Basotho own far more livestock than is reasonable on economic grounds ... so it is important that markets be established to introduce Basotho to the idea that their cattle are a marketable product, and to allow stockowners to dispose of surplus culled animals. A more productive livestock sector and a destocked range are thus purported to be the results of successful marketing programmes (p. 10).

The alternative perspective, which is supported by the analysis contained in this report, is that Basotho treat their cattle as investments which: generate a variety of flow products; may be sold to meet household cash needs; may be slaughtered for household consumption or for particular ceremonies; or may be used to meet certain social obligations.

Given the magnitude of the evidence which supports the alternative perspective, it is unfortunate that the dominant perspective has determined the way in which most livestock marketing programmes have been developed, implemented and evaluated. Many programmes appear to have focussed almost exclusively on the need to serve urban consumer demands for beef. Too often rural demands are viewed as obstacles to the rational development of the livestock sector. Somehow the traditional livestock demands for ceremonies, draught, and perhaps even rural demand for meat from culled animals, are seen as less legitimate than the urban consumer demand for meat.

Almost all market infrastructure developments have been partly justified on the basis of their supposed effects of reducing the stocking rate. In this section the short-term economic model developed in chapter 4 is used to examine how market infrastructure development such as the National Feedlot, the National Abattoir, and the LPMS rural auction network will affect the optimal stocking rate and the production of livestock products.

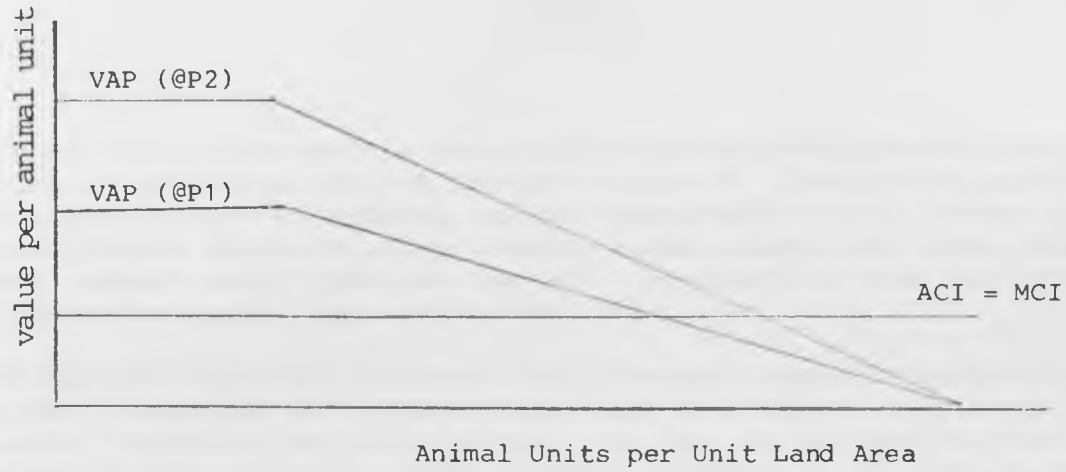

Figure 5.1a

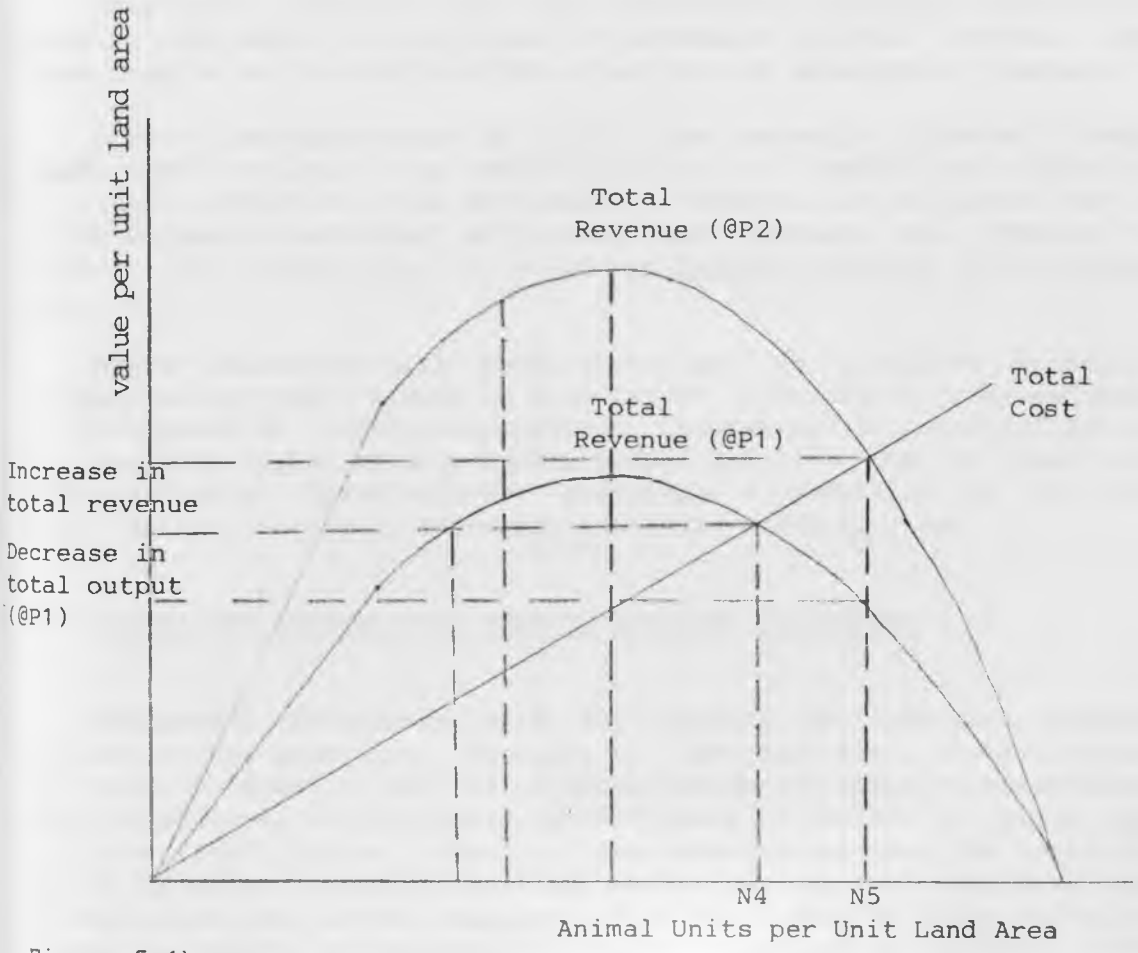

Figure 5.1b

Figure 5.1 Revenue and Cost Functions for Two Different Price Levels

In the short term each of these infrastructure developments offer the potential for increasing the net producer price of livestock by improving marketing efficiency or lowering market transactions costs. These allow the formal market buyers to offer slightly higher prices and thus, perhaps bid some animals away from other markets. Figures 5.1a shows the effects of a hypothetical price increase/decrease.[1]

In figures 5.1a and 5.1b, the lower revenue lines correspond to a lower price level and the upper revenue lines to a higher price level. In this model, increasing the price results in: (1) an increase in the open access equilibrium from N4 to N5; (2) an increase in the total revenue derived from the sale of livestock products; and (3) a decrease in total output.

Thus price increases (or cost decreases) encourage increases in the stocking rate which in turn result in decreases in total output. Both of these results are contrary to the objectives of development planners.

A very low percentage of cattle are currently marketed through the formal market outlets. The construction of the Feedlot and Abattoir have had little effect on this percentage. However, to the extent that these projects improve marketing efficiency and increase net returns to the farmers, the effect is to encourage greater stocking of the range, not less.

Market infrastructural development may be justified on efficiency grounds and may shift demand to some degree in favour of urban consumptions at the expense of rural consumptions. Increases in marketing efficiency may result in higher or more stable prices for livestock, or lower producer marketing costs. These will not encourage a reduction in the stocking rate. Rather, they will encourage increased stocking rates.

5.2 INCREASING PRODUCTIVITY THROUGH IMPROVED MANAGEMENT

Management interfaces with all aspects of livestock production, utilization and marketing. Managers of livestock have certain objectives and control over a set of variables which influence outcomes impacting these objectives. On privately owned farmers or ranches in North America, Europe or South Africa, managers have some control over the condition and use of the range, breeding, culling, marketing, use of veterinary supplies and medicines, and use of supplementary feeds. Many of these variables are beyond the control of individual livestock managers in Lesotho. Many of the improved livestock and rangeland management practices called for by foreign advisors are inconsistent with traditional institutions and communal use of rangeland. In this section only three management issues are examined: marketing animals at younger ages; improved culling; and

[1] No attempt has been made to quantify the likely effects of any of the programmes which are evaluated in this chapter. With further refinements the empirical model presented in chapter 4 may be appropriate for such analysis, but in its present form the model may give misleading results.

improved breeding. Decisions on these issues are made by livestock owners in their own interest. Thus the hypotheses that these are currently inefficient suggests that livestock owners could be better off it they changed their management practices. These hypotheses beg testing.

Marketing Animals at Younger Ages

It is suggested that livestock production could be made more efficient if animals were marketed at younger ages. However, this hypothesis has not been tested in Lesotho. Research in the United States indicates that cows should be culled at ages ranging from 6 to 12 years depending on the prevailing economic conditions (Trapp 1983). Arizo-Nino and Shapiro (1984) found optimal culling ages of 6 years for male cattle and 11 years for female cattle in the Sahel.

The Arizo-Nino and Shapiro model of optimum age of sale for cattle in the Sahel is appropriate to the issue here. The general decision rule used in their analysis is as follows:

> In each period, t, a pastoralist has the option of selling any animal or keeping it unitl the next period, t+1. . . . If the animal is kept, then in the next period the same decisions is faced regarding sale in t+1 or t+2 and so on. thus, the long run decision of when to sell an animal may be analyzed piece-wise as the decision of whether or not to keep an animal one more period.
>
> The decision to keep or sell an animal may be characterized as depending on a comparison of the gains from keeping the animal one more period versus the costs of doing so. By keeping the animal one more period, a pastoralist may benefit [depending on the circumstances, the benefits and costs discussed may be large, small, zero, or perhaps even negative], from (a) the increase of the animal's sale value due to its increased weight, and (b) the additional value flowing from the animal as a living resource. Such flow values may include milk, calves, security, power, liquidity, prestige, aesthetic pleasure, and so forth. The cost of keeping an animal one more period includes (a) the cost of herding, feeding, watering, maintaining good health, and the risk of mortality, and (b) the one-period gains foregone by not selling the animal and investing the proceeds in another (presumably younger) animal or some other asset or a bank.
>
> The animal will be sold if the cost of keeping it one more period outweighs the benefits of keeping it that additional period. This decision rule may be written as follows: Do not sell if Expected gains > Expected costs (Arizo-Nino and Shapiro 1984, p.318).

The authors developed a computer simulation model incorporating fertility ratios, growth ratios, mortality rates, flow products (milk and calves), costs and product prices. They examined the effects of changes in those variables on the optimal age of sale.

Programmes to promote marketing of younger animals in Lesotho should

be guided by results of economic analysis of optimal marketing ages under Lesotho conditions. The Arizo-Nino and Shapiro model may be deficient with respect to replacement cost and growth rates. Increasing reproductive efficiency and growth rates through improved nutrition should lead to greater offtake and perhaps lower age of marketing. However, the analyses of Trapp and Arizo-Nino and Shapiro provide a good starting point for analysis of the Lesotho situation.

Suppose the analyses show that farmers would be better off if they sold animals at younger ages. And suppose they are enlightened so that they do in fact sell animals at younger ages. Will this help destock the range? The key question is: if a stockowner changes his management so that he now makes more money than before, is he encouraged to raise more or fewer animals? The history of Basotho farmer response to market conditions dating back well into the early 19th century (see chapter 2) suggests that the likely response to greater livestock returns is to grow more livestock not less livestock. Thus, if marketing younger animals proved profitable one could expect farmers to adjust their herd composition and retain more breeding stock with the offspring marketed at earlier ages. The expected effect on the stocking rate is displayed graphically in figure 5.1.

Figure 5.1 depicts the effects of a general increase (decrease) in the value of output per animal unit. Value of output per animal unit could be changed by either: (1) a change in physical output per animal unit while price per unit output remains unchanged; or (2) a change in price per output while the physical output per animal unit could remain unchanged.

Figure 5.1a depicts the effects of an increased price or an increase in physical output per animal unit with a constant price. Figure 5.1b depicts the effects of the price or productivity increases on total revenue and total cost per unit land area in relation to stocking rate. In both cases the open access equilibrium is shifted from N4 animal units to N5 animal units. Thus, policy changes or development programmes to increases the value of output per animal unit will stimulate an increase in stocking rates.

Improved Culling

The culling decisions of an individual livestock owner involve two seperate components: (1) the selection of animals to be removed from the herd; and (2) the decisions of how, when and where to dispose of selected animals. The selection of culls involves exactly the same decision process as the age of marketing decision, that is, livestock owners in each period compare the expected benefits from keeping each animal one more period with the expected costs. If the expected costs exceed the expected benefits the animal will be identified as a cull; if the expected benefits exceed the expected costs the animal will be retained. The decision not to cull is the complement of the decision to cull.

Once an animal has been identified as a cull, then the stockowner must make the decision on how, when and where to dispose of the animal. Marketing culls through the formal market is seldom the most attractive option facing stockowners. Often culled females would grade so low that they would fetch very low prices on the formal market. The location and

infrequency of auction sales also result in high transaction costs associated with the formal market. Rather, culled animals may be kept in the household and held for future household consumption.

External programmes to promote improved culling usually focus on the removal of old unproductive (in terms of reproduction and milk production) female cattle, and coloured goats and sheep. The removal of unproductive animals should result in greater per animal output by reducing the total maintenance requirement of the entire herd sharing the range. However, it appears that individual livestock owners find it in their own best self interests to retain many animals which appear to be unproductive. Economic analysis of the reasons for retaining these animals should be conducted. Such analysis would involve the comparison of expected benefits and expected returns from retention.

It has been proposed that programmes effective in enforcing modified culling practices would result in a reduction in the stocking rate. However, with the prevailing institutional environment, production practices and disposition patterns, two alternative outcomes appear likely from any enforced culling programme:
(1) A programme which forced the culling of a small proportion of individual herds would prompt the herd owners to slaughter or market those animals identified as culls and retain other animals. There would be little net effect on stock numbers.
(2) A programme which forced the culling of a large proportion of individual herds would also prompt the substitution referred to in (1), but may potentially result in a net reduction of stock numbers, in the short term. However, the reduction in in stock numbers would be expected to result in greater nutritional levels for each of the remaining animals, which in turn would cause greater output per animal, greater fertility, and lower mortality. These would all result in a longer-term increase in stock numbers offsetting the short-term reduction.

Weaving Animals at Younger Ages

Earlier weaning could reduce the energy demands on cows for milk production which in turn should be reflected in higher conception and calving rates. However, there are costs associated with earlier weaning. Among these costs may be one or more of the following: (1) reduced milk supply for the household; (2) reduced growth rate of the calf; (3) need for additional kraals to separate cow and calf; (4) increased cost of herding in order to keep calf separated from the cow (this cost could be mitigated by use of a weaning muzzle which permits grazing but not nursing).

The relative importance of both the benefit and costs from earlier weaning could vary from household to household and also by region or area of the country. The costs and benefits may also depend on the time of year of calving and weaning.

The potential net gains of earlier weaning need to be investigated under several different production situations. Such investigation will indicate situations where net benefits from earlier weaning are the greatest and guide extension officers toward the most effective extension efforts concerning earlier weaning. One would not expect this programme to

lead to destocking.

Improved Breeding

Many of the past livestock development programmes in Lesotho have attempted to improve cattle, sheep, goats and horses through the introduction of new breeds, and through the selection and castration within breeds. Since the 1930s the target in sheep breeding has been to develop purebred merino sheep and rid Lesotho flocks of the kempy, coloured wool of the carpet varieties of sheep. In the 1950s the small stock breeding effort was expanded to include goats. With goats the target has been to develop purebred angora goats and eliminate the coloured mohair of the boer goats (Hunter, 1987). The focus of small stock has almost been entirely on improving the quality of the wool and mohair. Little effort has been expended on improving the milk or meat production of small stock. Combs and Hunter (1987) have suggested that research on feasible meat and milk breeds may be warranted.

The Brown Swiss cattle variety was first recommended for Lesotho in the mid-1950s (Brossard 1955). Its large size and high milk production was supposed to make it a multi-purpose animal appropriate to the Lesotho conditions. While one project is still attempting to introduce the Brown Swiss (the Mphaki Project, See Dobb 1985, pp. 78-86), most of the current breeding programmes are emphasizing the South African Drakensburger and Afrikaans varieties for their meat production (the Sehlabathebe Project), or Friessens for their milk production (the Dairy Section of the Livestock Division). Given the variety of environmental, ecological and economic conditions facing Lesotho stockowners, it appears that no single cattle breed is appropriate for all of Lesotho. The same is likely true for small stock varieties.

Selection for the better quality females within herds is rendered almost impossible in Lesotho. Statistics indicate that current reproduction rates are so low that recent animal attrition through death and slaughter of cows two years and older exceeds the number of female calves born annually (Agricultural Situation Report, 1985 edition). These circumstances leave no room for selection among females as almost all females are currently kept to maintain the breeding herds. This is verified by data from the 1985 Livestock Holders Survey.

Castration of undesirable males within herds could also promote breed improvement. However, short term losses resulting from castration could substantially offset the long term benefits from breed improvement. Progress through within herd selection and selective castration is slow and potential gains are less than under the programmes using introduced sires and artificial insemination.

In the case of Lesotho, it may be appropriate to talk about more suitable breeds -- particularly in the case of sheep and goats. Wool merinos have higher nutrient requirements than a mutton breed, such as the Dorper; therefore, a mutton breed (or milk or dual purpose breed) may be more appropriate for the Lesotho environmental and management conditions. The Spanish or wool merino is not the typical, native, multiple purpose animal that is referred to in other countries. It is a breed raised nearly

exclusively for its wool and is an introduced breed to Lesotho. It is certainly possible that the stocking rate of sheep could be raised by the introduction of a more suitable breed. Much the same could be said of the Angora goat.

5.3 RANGE CONTROL PROGRAMMES

Most of the preceeding analysis is pessimistic about the future of livestock development and range utlization in Lesotho. Some of the more important results presented are:

(1) unrestricted use of communal range may result in a total dissipation of economic rent;

(2) the stocking rate becomes higher as the percentage of total animals held per individual declines;

(3) greater total output could be achieved if stocking rates were reduced;

(4) greater community and individual profits are possible if stocking rates are reduced;

(5) a reduction in the stocking rate would allow the full benefit of programmes designed to increase per animal output potential;

(6) Without reduction of livestock numbers, range productivity is expected to continue to decline;

(7) increases in market efficiency which result in higher or more stable prices or lower producer marketing costs will encourage increases in the stocking rate and hence decreases in total output; and

(8) any change in management practices which result in greater returns from livestock production will encourage an increase in the stocking rate. On the basis of these results it is apparent that many of the past initiatives which have been justified on the basis of their proposed impact on reducing the stocking rate have been misdirected.

While sections 5.1 and 5.2 focussed on the stocking rate effects of livestock development programmes, this section will focus on programmes aimed directly at the problems of reducing stocking rates. The following programmes will be addressed: (1) appealing to social conscience or patriotism; (2) educational programmes; (3) grazing fees or taxes; (4) grazing associations; and (5) grazing permits.

Appealing to Social Conscience

It was shown in chapter 4 that a group of stockowners sharing a communal range could be made better off if any or all of them would reduce their herds. The potential aggregate gain may be quite large. Each stockowner could be made better off as well if the gains from such a reduction were shared in proportion to individual reductions in stocking.

This provides a temptation for development officers to exhort stockowners to be 'responsible' and help destock the range by individually, voluntarily, reducing their herds. This reasoning is over-simplified and penalizes stockowners who succumb to the appeal if all other stockowners do not reduce their herds simultaneously.

However, an individual who voluntarily stints would not be better off, in fact, would be worse off, unless those who gained compensated him for his loss. Such compensation is unlikely. The individual suffers losses in the proportion of his reduction relative to the number of animals he originally held. The gains are distributed among all other herders in proportion to the reduction relative to all animals on the range.

Only if the society could mount such a successful campaign that all stockowners agreed to reduce their herds simultaneously could these programmes be successful. Such a campaign is unlikely to achieve such unaminous support, however, and some form of institution is likely to be likely to enforce compliance.

Educational Programmes

Solutions to Lesotho's overstocking problem will require education at a variety of levels. First, government policy makers must understand what can and what cannot contribute to increased range and livestock productivity, and what are the potential economic implications for society and for individual stockowners. Such understanding is not possible with current information and would require thorough economic analysis of the potential short-term and long-term benefits and costs of a programme of reducing livestock numbers.

Second, those in positions to implement programmes must have a clear understanding of these benefits and costs, and must be willing and able to exert their influence. This group of policy implementers ranges from local bureaucrats, to principal and village chiefs, to regulating agencies such as the police and courts, to local community leaders. Cooperation from each one of these groups is necessary.

Finally, and most importantly, individual stockowners and herders need to support a programme of stock reduction. Some equitable scheme of sharing benefits from reducing stock numbers is required. Individuals respond best to ideas that promote their own economic interests. If it can be shown that potential exists for increasing their livestock income, stockowners can be expected to listen.

Grazing Fees or Taxes

There is a simple justification for charging a per animal unit grazing fee or tax, quite apart from the possible effects on destocking. The range belongs to the public. It is scarce and valuable. Users should therefore pay the full value of the range use to the public owners. The full value is the maximum rent that would accrue to the range.

It is clear that per animal unit grazing fees or per year animal unit tax could decrease stocking rates. The effect of an increase in cost on

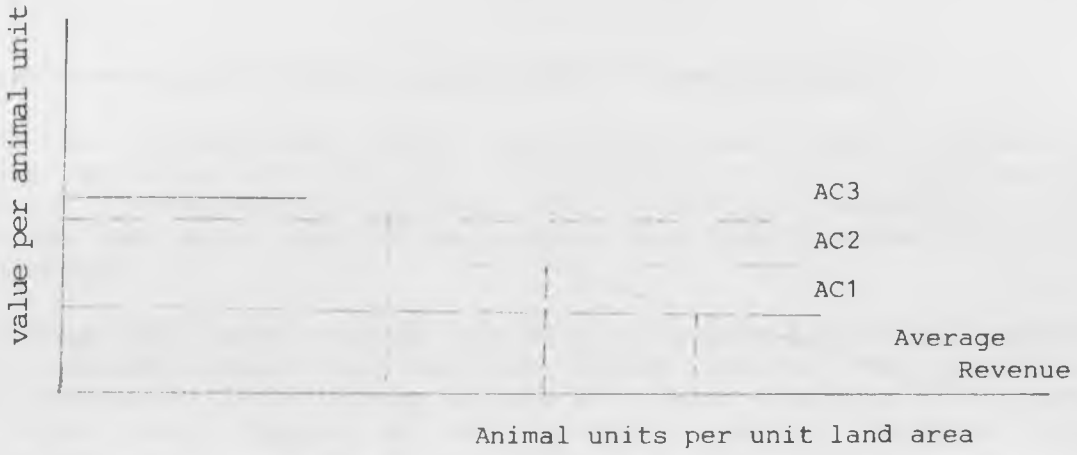

Figure 5.2a

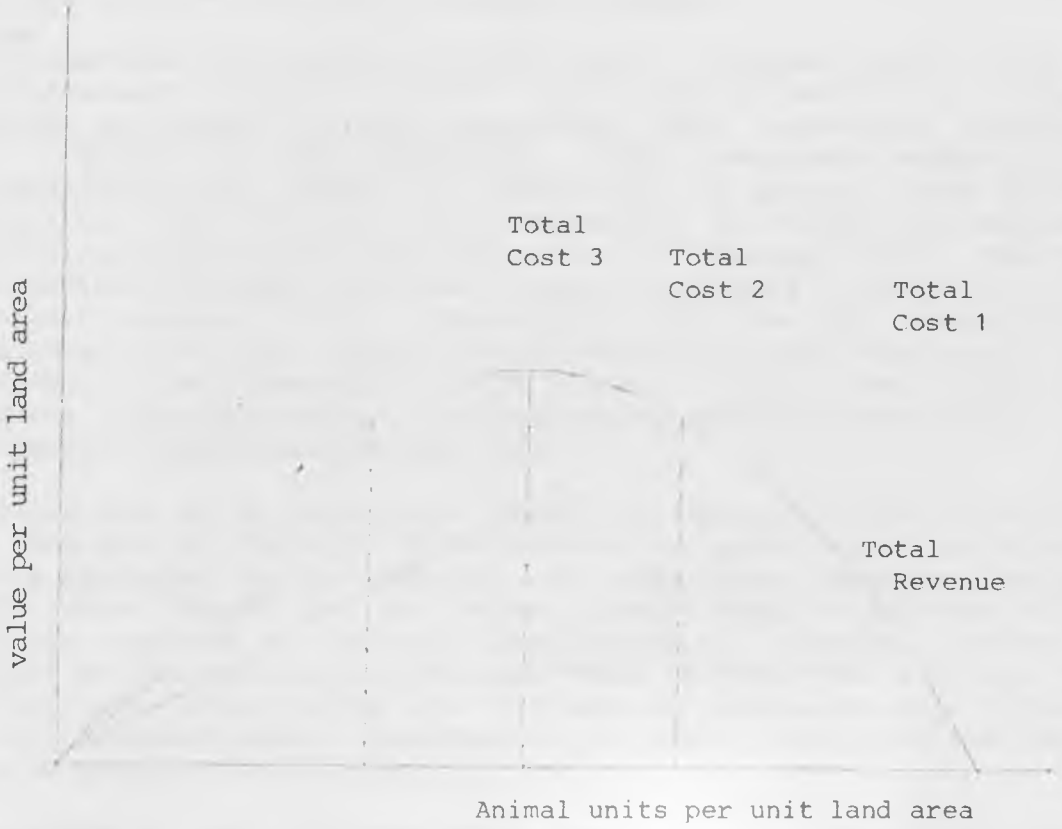

Figure 5.2b

Figure 5.2 Revenue and Cost Functions with Alternative Grazing Fees or Taxes

the open access equilibrium stocking rate is shown in figure 5.2.

In this hypothetical example open access equilibrium is initially at N1 animal units per unit land area. The addition of a per animal unit tax or grazing fee increases cost from ACI1 to ACI2 per animal unit. This shifts the open access equilibrium stocking rate from N1 animal units to N2 animal units.

Fixing the tax per animal unit would stimulate a shift in production toward livestock species that had the higher returns per animal unit. These adjustments would be more or less efficient, depending on the extent that animal unit figures do not properly reflect relative forage utilization among species and among types of animals within species. If, for example, two year old cattle were given the same animal unit factor as very old females, an equal tax per animal unit would favour keeping the younger, more productive, animals and culling the less productive animals. Per animal unit taxes or fees would stimulate a general interest in increasing pr animal unit productivity. However, these fees or taxes would be intensely unpopular. Collection would be difficult and expensive. Tax collectors would be subjected to bribes or threats.

As described in section 2.6 of the report, a grazing permit system was first introduced to Lesotho in 1973. This system was modified by the Range Management and Grazing Control Regulations 1980 (apparently amended in 1986). Under the 1980 Regulations, Chiefs were made responsible for administering grazing permits to regulate use of grazing lands in their jurisdictions, with village chiefs responsible for village grazing areas, and Principal Chiefs responsible for cattle post grazing areas. Employees of the Ministry of Agriculture are to supervise grazing in both village and cattle post grazing areas. Supervisory roles include, among others: determining the carrying capacity of the range each year; examining all the livestock; marking undesirable animals with an "X" until the stocking rate equals the carrying capacity; and instructing owners of undesirable stock to dispose of them within the next year.

Under this set of regulations, chiefs, including Principal Chiefs, are to be servants to the will of the Ministry of Agriculture. Agricultural Officers appointed by the Ministry of Agriculture determine how many animals there should be, and which animals should be disposed of; and chiefs are expected to enforce those rulings. "Advice, approval or decision" of the Agricultural Officers "shall be final" and any chief "who fails to comply within thirty days [or] take all reasonable steps to ensure that all persons finding themselves in his area comply with such advice should be guilty of an offence". (p. 139).

A glance at the aggregate data (see Bureau of Statistics, Annual Statistical Bulletin, various years) establishes that the Grazing Control Regulations, which could potentially restrict animal units to range carrying capacity, have failed. Both Dobb (1985) and Lawry (1986) found a long list of problems with the implementation of the regulations. Lawry stressed the lack of authority, administrative structure, and aptitude of the chiefs to enforce tough regulations on their people; Dobb stressed jurisdictional problems associated with a livestock system where cattle owners from one village have cattle posts scattered hetter-sketter across

the summer grazing areas. Lawry recommended that chiefs be given much greater support in administration of the system, and that the difficult enforcement function be transferred from the chiefs to the government and courts. Dobb recommended that cattle posts be reallocated so that residents of any village have exclusive use of contingent cattle post and village grazing areas. Such a reallocation should spawn local-level institutions of livestock owners interested in self-government of the grazing areas. One of the fundamental differences between the analyses of Dobb and Lawry is that, while Lawry recommends placing that control in the hands of some overall government range authority; Dobb recommends entrusting the bulk of range utilization control to groups of individual stockowners. One of the institutions possible for organizing stockowners is the grazing association.

Grazing Associations

Grazing associations provide an institutional framework for local level range management and regulation of range use which is based on very simple logic (consistent with the findings of chapter 2): individual livestock owners will recognise their interdependence and group together to seek collective decisions which are mutually advantageous to all members. Viewed this way, grazing associations have the theoretical potential to achieve long term conservation and range improvement.

Many important lessons have been learned since Lesotho's first grazing association was established in the Thaba-Tseka project area in 1975. Dobb (1985, pp 70-102) evaluated grazing associations at Thaba-Tseka, Ongeluk's Nek, Mphaki and Sehlabathebe. Lawry evaluated the Thaba-Tseka, Ongeluk's Nek, and Sehlabathebe grazing associations in a paper presented at the Workshop on Grazing Associations in Lesotho (Lawry 1986a, pp. 50-63), and presented a more complete description and evaluation of the Sehlabathebe Grazing Association in a larger report entitled: Livestock and Range Management in Sehlabethebe: A Study of Communal Resource Management. Another evaluation of the Sehlabathebe experience was completed as a USAID Evaluation Special Study by Warren, Honadle, Montsi and Walter (1985). Roeder (1985) conducted an evaluation of the Ongeluk's Nek Grazing Association and the Metseng Brown Swiss Breeders' Associations.

The Workshop on Grazing Associations in Lesotho provided an excellent forum for individuals with divergent interests and experiences to gather and thrash out some of the most important issues related to the successful establishment and operation of grazing associations. The published proceedings from that workshop will be important in guiding future development of grazing associations.

Some of the most important conclusions of these recent studies include the following:

(1) It is extremely important to understand the present system of range use. Some important insights are contained in Dobb (1985) and Lawry (1986), but these must be augmented by detailed analysis of cattle post usage and transhumance.

(2) The chiefdomship institution is important to the success of any

institution which affects range utilization, but chiefs must be given strong assistance in both management and enforcement of grazing regulations.

(3) "Government officers must exercise a strong leadership role, that may at times require more or less active management of association affairs" (Lawry 1986b, p. 157).

(4) There must be some reallocation of grazing land rights so that communities are assigned specific grazing land to use and manage (Lawry 1986a and 1986b; Dobb 1985; Weaver 1986).

(5) Membership of grazing associations should be community-based and should incorporate the interests of the heterogeneous group of livestock owners (Lawry 1986b; Weater 1986; Dobb 1985).

(6) the Sehlabathebe Range Management Area has a number of unique locational advantages which limit its replicability in other areas of Lesotho (Weaver 1986; Dobb 1985; Warren et. al. 1985).

(7) Grazing associations have a much greater probability of success if they incorporate elements of direct and immediate appeal to local stockowners such as animal improvement facilities (Weaver 1986).

(8) Grazing association executive committees should be provided with on-going technical assistance and training in cooperative management (Lawry 1986a).

(9) Grazing associations demand high levels of technical, financial and managerial support which make it difficult or impossible to institute a country-wide programme of associations. In the near future they can be hope to "serve as nuclei from which other farmers can also learn better ways of increasing production" (Motsamai 1986).

Despite the obvious successes of the Sehlabathebe Grazing Association, it has yet to effectively deal with the basic issue addressed in this section of the report: can stockowners be demonstrated the short-term and long-term benefits of reducing stock numbers and empower grazing associations with the authority to regulate stock numbers? Fertility appear to be very high in the area this year (Martin, unpublished data). Is it possible that association members will accept mandatory culling of older stock to keep total stock numbers close to the rent-maximizing levels? This, the ultimate test of the Grazing Association concept, should be tested.

5.4 A FRAMEWORK FOR EVALUATING LIVESTOCK DEVELOPMENT AND RANGE UTILIZATION PROGRAMME

In his study Dobb (1985) stated that an integrated approach is necessary for the evaluation of range policy and regulation. He suggested that the framework introduced by Clawson (1975) would be appropriate for evaluation of alternative solutions to Lesotho's livestock development and

range utilization problem. Clawson's framework consists of five evaluation criteria: "(1) physical and biological feasibility and consequences; (2) economic efficiency; (3) economic welfare and equity; (4) social or cultural acceptability; and (5) operational or administrative practicality" (Dobb 1985, p. 66). These criteria are used as a basis for the following matrix of alternative actions and subjective ratings for the various criteria.

It is not necessary to go through figure 5.3 in detail. Generally the ratings are subjective -- where possible they are based on the analysis contained in this paper, in some cases they are based on the results of other previous research, in other cases they are merely best guesses. However, some general conclusions can be drawn:

(1) The current system is characterized by low productivity and costs, high acceptability and practicality.

(2) Livestock development programmes instituted without any accompanying institutional changes are likely to result in reduced livestock and range productivity, and increases in the stocking rate. However, they are likely to be generally acceptable.

(3) Programmes which deal directly with the institutions which control range use have positive potential benefits, but are likely to be costly to implement and be poorly received by the affected groups.

The goals of livestock and range development require an integrated, comprehensive approach. The central focus of the development programmes should be on appropriate development and modification of the legal and institutional arrangements which govern range utilization. This should be accompanied by livestock development and market infrastructure programmes to enhance popular support, by a broad extension campaign, and by an integrated research programme.

ALTERNATIVE SOLUTIONS	PHYSICAL OR BIOLOGICAL FEASIBILITY AND CONSEQUENCES						ECONOMIC EFFICIENCY						ECONOMIC WELFARE AND EQUITY						SOCIAL OR CULTURAL ACCEPTABILITY						OPERATIONAL OR ADMINISTRATIVE PRACTICALITY	
	Range Production		Livestock Production		Stocking Rate		Capital Costs		Operations Costs		Mgt Costs		Stock-Owners		Society		Equity		Govern-ment		Chiefs		Stock-owners		Short-term	Long-term
	S	L	S	L	S	L	S	L	S	L	S	L	S	L	S	L	S	L	S	L	S	L	S	L		
1 Status Quo	0	-	0	-	0	-	l	l	l	l	l	l	0	-	0	-	+	+	h	h	h	h	h	m	h	h
Livestock Development																										
2 Markets	-	-	-	-	-	-	h	m	m	m	l	l	+	+	?	?	0	0	h	h	h	h	h	h	h	h
3 Culling	?	0	?	0	?	0	l	l	h	h	m	m	?	?	?	?	-	0	h	h	m	m	l	m	l	l
4 Breeding	?	?	+	?	-	-	l	l	m	m	m	m	?	?	?	?	-	0	h	h	h	h	h	h	h	h
Destocking Programmes																										
5 Social Conscience	0	?	-	0	?	?	l	l	m	m	l	l	0	?	?	?	-	-	h	h	m	m	l	m	h	h
6 Educational Programmes	0	?	0	?	0	?	l	l	m	m	l	l	0	?	0	?	0	0	h	h	h	h	m	m	h	h
7 Grazing Fees or taxes	+	+	+	+	+	+	m	m	h	h	h	h	-	+	0	+	-	-	m	m	l	l	ll	ll	ll	ll
8 Grazing Associations	+	+	+	+	+	+	h	h	h	h	h	h	?	+	-	+	-	-	h	h	m	m	m	m	l/m	l/m
9 Grazing Permits	+	+	+	+	+	+	m	m	h	h	h	h	?	+	0	+	-	-	h	h	m	m	l	m	l	l
10 Individual Tenure	+	+	+	+	+	+	m	m	h	h	h	h	?	+	-	+	-	-	l	m	ll	ll	l	m	ll	ll

Notes: S indicates short-term
L indicates long-term
0 indicates no change
- indicates negative or unfavourable change
l indicates low
h indicates high
m indicates moderate
+ indicates positive or favourable change
? indicates questionable change
ll indicates very low
l/m indicates low to moderate

6. CONCLUSIONS, RECOMMENDATIONS AND RESEARCH NEEDS

The Lesotho livestock system is comprised of institutions, households, persons, animals, grass and rangeland all linked together through a complex of economic, social, biological and ecological relationships. In chapter 2 of this report this complex system was depicted graphically as being comprised of four sub-systems: the livestock sybsystem; the household sysbsystem; the range subsystem; and the social subsystem. The interactions between these subsystems were described conceptually, historically and empirically. Attention was paid to the identification of government and social influence points and mechanisms.

6.1 HYPOTHESIS TESTING

In chapter 3 particular attention was paid to the economic motivations of livestock owners. Enterprise budgets showed relatively high rates of return to capital invested in livestock, an average of 8.5 percent, and remarkably similar rates of return from the cattle (8.3 percent), sheep (7.2 percent), and goat (10.1 percent) enterprises. On the basis of this evidence the second hypothesis that "Basotho view their livestock as capital assets, and as capital assets livestock generate returns competitive with other available investments" is accepted. The first hypothesis that "economic factors dominate social and cultural factors in determining how and why Basotho own and manage their livestock" is accepted on the basis of the budget analysis, the historical analysis, and the overwhelming economic emphasis of the responses to the 'why to you own livestock' questions (see chapter 3).

In chapter 4 a short-term economic model of the livestock / range complex was developed conceptually and specified for Lesotho conditions. Results of this model definately support acceptance of the third hypothesis that "the overstocking of Lesotho's rangeland is consistent with individual decision making based on economic criteria". Relatively ineffective range control institutions appear to be a primary factor contributing to the over utlization of the communal range. The three remaining hypotheses:
"mafisa and sharecropping are flexible institutions for allowing households to maximize their production of crop and livestock products";
"marketing channnels that link stockowners are more important than other more formal marketing channels"; and
"much of the meat and offal from the carcasses of fallen animals is consumed";
are all accepted on the basis of the survey information presented in Swallow et. al. (1987).

6.2 CONCLUSIONS

Economic factors continue to be very important motivations for Basotho stockowners despite current low rates of formal market sales. Growing human populations with increased income mean more demand for meat

within the rural livestock-owning and non-livestock-owning households. In this environment, rural Basotho find livestock enterprises to be relatively attractive investments; any marketing or production initiative which makes livestock more attractive will, everything else equal, motivate those individuals to invest more heavily in livestock, with the result that the overstocking problem may be further exacerbated. Thus the potential benefits of any marketing, breeding, culling or other livestock improvement programme must be carefully weighed against the costs of potential increases in the stocking rate.

Results of the short-term economic model of the livestock / range complex show that overstocking is consistent with open access to the range by economically-rational individual stockowners. The fact that severe overgrazing is occurring is thus consistent with evidence of poorly-functioning communal range control institutions (Dobb 1985; Lawry 1986). Specified for Lesotho conditions, the model indicates that more effective range control institutions which cause a reduction in the stocking rate will: (1) increase economic rent accruing to livestock owners; (2) increase output per animal; and (3) increase total output per unit land. Such reductions will also cause a slowing of the rate of range degradation. Elimination of range degradation and range improvement are almost impossible objectives if recent etimates of the level of overstocking are accurate. (See background information on carrying capacity presented in chapter 2 which indicates that all carrying capacity estimates should be viewed with extreme caution.)

6.3 RESEARCH NEEDS

At this time a number of information gaps hamper the implementation of an integrated livestock and range development programme. Research is needed on the following questions:

(1) What are the appropriate cattle, sheep, goat and horse breeds for Lesotho? It is likely that there are no one single breeds appropriate for all ecological, geological and economic conditions faced by Basotho stockonwers.

(2) How do animals of diffeent species, breeds, age and sex respond to changes in nutrition and general management practices?

(3) What are the grazing habits of the different species of livestock? How do these different grazing habits affect the optimal species mix?

(4) What is the most likely future path of range degradation if stocking rates are allowed to continue uncontrolled?

(5) What functions do the existing range use institutions play, and what potential do they have for strengthening and expanding their roles?

(6) What are the current patterns of range use rights and how would those be disrupted by alternative institutions?

(7) What are the legal barriers and requirements for alternative institutions?

(8) What are the costs and benefits attached to the alternative livestock and range development programmes?

6.4 RECOMMENDATIONS

On the basis of the analysis presented in this report, the following recommendations are made:

(1) Range utilization institutions must be the central focus of any livestock / range utilization development programme.

(2) Range and livestock subsystems must be seen as closedly integrated components of the livestock system. Livestock and Range Management Divisions of the Ministry of Agriculture should establish very close links, and if possible, operate under a common administrative structure sharing common facilities. Such an institutional arrangement should lead to greater understanding of the inter-relationships between livestock and range, and prevent simultaneous pursuit of contradictory objectives.

(3) Simple legislation such as the 1980 Grazing Control Regulations will not automatically bring stocking rates equal to carrying capacity. Careful consideration must be given to popular support, administration and enforcement of any programme.

(4) Economically rational stockowners will support any programme they see to be in their own self interest. To win their support for a particular development programme they must first be demonstrated the negative consequences of overstocking. Second, livestock development and marketing programmes should be initiated together with range control institutions so that there is some clear motivation for popular support of the institutions. Successful elements of the Wool Growers' Associations, the Sehlabathebe Range Management Association, and the requirements that grazing permits be shown at dip tanks are examples. Whenever possible stockowners should be encouraged to make group decisions. The new Cooperative College may provide training in management and simple record keeping for association executive and members.

(5) The system must be technically enforcable. Dobb's point is valid here. Some reallocation of grazing rights (cattle posts) may be necessary to clearly keep the land, livestock and people together. The amount of reallocation necessary could be minimized by using the Livestock Improvement Centre areas (as suggested by Phororo), rather than the smaller dip tank areas as the grazing control unit.

(6) Chiefs are unlikely to readily support an approach which makes them servants of the Ministry of Agriculture. If the approach has a minimum base of support from the people it affects than the chiefs could be key to the administration and enforcement of the system, working with, rather than for, the Ministry. If the system is generally unpopular amongst

stockowners, then more government bureaucracy will be necessary.

(7) The chiefs through some grazing permit system, livestock owners through grazing associations, and the government through a strong livestock and range development department will all be important components of a successful national livestock and range development programme. The relatve importance of each component will, and should, vary from location to location.

(8) An intensive research programme focussed on getting more value from the range, should be initiated in conjunction with a livestock / range development programme. The emphasis of such a programme should be on both those products which are sold -- wool and mohair -- and those products which are consumed within the household -- milk and draught power.

(9) The Government of Lesotho must take the lead in developing Lesotho's national livestock and range development programme. Donor agencies should be encouraged to support components of the programme (for example, the research component), or to support the programme in a particular area, but the overall management and guidance of the programme should be Basotho.

* * *

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