

**AN ANALYSIS OF THE ECONOMIC VALUE OF CATTLE IN
SMALLHOLDER LIVESTOCK PRODUCTION SYSTEMS IN
WESTERN KENYA**

(CASE OF KISII AND RACHUONYO DISTRICTS)

By

OUMA EMILY AWUOR

A Thesis submitted to the Graduate School in partial fulfilment of the requirements of the
Master of Science Degree in Agricultural Economics of Egerton University.

EGERTON UNIVERSITY

August, 2003

DECLARATION

I declare that this is my original work and to the best of my knowledge, has not been presented in this or any other university for any degree.

Signed: **Ouma Emily Awuor** _____ Date: ___/___/2003

RECOMMENDATION BY SUPERVISORS

This thesis has been prepared under our supervision and is being submitted with our approval as supervisors:

Dr. G. A. Obare (PhD)

Department of Agricultural Economics

Egerton University.

Date: ___/___/2003

Dr. S. J. Staal (PhD)

International Livestock Research Institute

Nairobi.

Date: ___/___/2003

ABSTRACT

In developing countries, financial markets function poorly and opportunities for risk management through formal insurance generally absent. To cope with this, cattle have tended to assume non – market, socio – economic roles. Analyses of cattle systems, production patterns and producer decisions more often focus on market variables, resulting in possible inconsistent results. This is particularly so, when estimating the total contribution of livestock. The non – market functions are often ignored since they are difficult to value, yet they may contribute to a better understanding of existing livestock production systems. The purpose of the study was to estimate the value of non – market contribution of cattle and determine its contribution to the competitiveness and survival of smallholder cattle systems. The study used primary data collected through questionnaire interviews with two hundred and fifty sample farmers in Kisii and Rachuonyo districts. Four analytical methods were used in this study; the contingent valuation method, the Tobit model, the multiple regression model and complete budget analysis for the cattle enterprise. The results indicate that non – market benefits are highly valued by cattle keepers and comprise 18%, 15% and 14% of the animal's total perceived value in extensive, semi – zero grazing and zero grazing systems respectively. The budget analysis results indicate that smallholder cattle production systems are profitable and competitive when market and non – market contributions are taken into consideration. The latter contribute significantly to the survival of smallholder systems. The non – market benefits influence producers to hold cows after milk production has declined. Infrastructural development is noted as an important policy issue that needs to be addressed so as to minimize transaction costs faced by cattle producers. In addition, there may be need to integrate female headed households into financial and insurance markets since they have limited alternative sources of income to buffer risks.

ACKNOWLEDGEMENTS

I would like to express sincere appreciation to all individuals and institutions that have contributed towards the completion of this study. Thanks are due to my university supervisor, Dr. Gideon Obare, who provided guidance, encouragement, and constructive criticism in a most friendly, organised and timely manner, and my field supervisor, Dr Steve Staal of ILRI for his guidance, encouragement and support throughout the study.

Funding support by the Smallholder Dairy (R&D) Project (SDP) of the Kenya Ministry of Agriculture and Rural Development, Kenya Agricultural Research Institute and International Livestock Research Institute, through the UK Department for International Development (DFID) is gratefully acknowledged.

I am greatly indebted to Drs Isabelle Baltenweck and Michael Waithaka for assistance at the developmental stage of the work particularly with regard to the econometric models and the Analytic Hierarchy Process methodology. I owe special thanks to Mr. Julius Nyangaga of ILRI and Mrs Angela Wokabi of the Ministry of Agriculture and Rural Development (Nairobi) for helping with the logistics of data collection. The staff at the Ministry of Agriculture and Rural Development in Rachuonyo and Kisii districts are too many to mention in person but particular thanks go to the Dairy Officers; Mrs Alice Manoti and Mr. William Nyambaga; the DALEO of Rachuonyo district, Mr. Matoke; the DLPO's and the extension staff; Mrs Edith Kiche, Mr. Wilson Owino, Mr. Bernard Muthini, Mr. Leonard Omariba and Mr. Arthur Ahona. Thanks for making my fieldwork memorable, enjoyable and painless. Sincere appreciation goes to the farmers who spared their precious time to be interviewed.

The help extended to me by Mr. Patrick Wanjohi in data management skills and help by Messrs Philip Ongili and Edmund Githoro in data entry is greatly appreciated. Not forgetting

Mrs Pamela Mulaku for the beautiful maps prepared. Special thanks also go to the rest of the Smallholder Dairy Project team for the cordial relationship and enabling environment created, making my stay in ILRI productive. Particular thanks are extended to Drs. William Thorpe, Amos Omore and Mr. Hezekiah Muriuki, the project manager for the keen interest expressed in the study.

Finally, I would like to thank my family, friends and relatives for their unfailing support, love, patience and encouragement. To all of you and many I have not mentioned by name, thanks and may the almighty God bless you abundantly.

DEDICATION

With love and appreciation,

I dedicate this thesis to dad and mum,

Mr. Simon Ouma

and

Mrs. Theodora Ouma

TABLE OF CONTENTS

DECLARATION	I
ABSTRACT.....	II
ACKNOWLEDGEMENTS.....	III
DEDICATION.....	V
TABLE OF CONTENTS.....	VI
LIST OF FIGURES	X
LIST OF ACRONYMS AND ABBREVIATIONS	XI
PRE - FACE.....	XIII
CHAPTER ONE	1
1. INTRODUCTION	1
1.1 Background.....	1
1.2 Problem Statement.....	4
1.3 Objectives	5
1.4 Hypotheses.....	5
1.5 Significance of the Study.....	6
1.6 Study Area	6
1.6.1 Kisii District.....	7
1.6.2 Rachuonyo District.....	10
CHAPTER TWO	13
2. LITERATURE REVIEW	13
2.1 Introduction.....	13
2.2 Functions of Cattle in Smallholder Agriculture; Wealth, Saving, Financing and Insurance Functions of Cattle	13
2.3 Cattle as a Source of Fertilizer, Soil Conditioner and Fuel	20
2.4 Cattle as a Source of Draught Power.....	21
2.5 Cattle Production Systems in Kenya.....	22
2.6 Conclusion	25

CHAPTER THREE.....	26
3. CONCEPTUAL FRAMEWORK.....	26
3.1 Utility Maximisation and the Cattle Enterprise	26
3.2 Non – Market Goods Demand and the Stated Preference	29
CHAPTER FOUR.....	32
4. METHODOLOGY	32
4.1 Survey Design	32
4.1.1 <i>Sample Selection</i>	33
4.2 Data Collection	36
4.2.1 <i>Elicitation of Willingness to Pay</i>	36
4.3 Analytical Methods	38
4.3.1 <i>The Tobit Model and Willingness to Pay Function</i>	38
4.3.2 <i>Budget Analysis</i>	48
4.3.2.1 Recurrent cash and in-kind production	49
4.3.2.2 Recurrent purchased inputs.....	50
4.3.2.3 Annual cost of capital items.....	50
4.3.2.4 Socio-economic value of cattle.....	51
4.3.3 <i>Relative Weights of Cattle Keeping Objectives</i>	51
4.3.3.1 Pairwise Comparisons.....	52
4.3.3.2 Computing the relative weights	52
4.3.4 <i>Optimal Livestock Sales Age</i>	53
4.4 Scope and Limitations.....	55
CHAPTER FIVE	57
5. RESULTS AND DISCUSSION	57
5.1 Descriptive Analyses	57
5.1.1 <i>Household Characteristics</i>	57
5.1.2 <i>Cattle Production Systems Characteristics</i>	60
5.1.3 <i>Socio – Economic Roles of Cattle keeping</i>	62
5.2 Econometric Analyses	67
5.2.1 <i>Econometric Results on Socio – Economic Non – Market Valuation</i>	67
5.2.2 <i>Influence of Non – Market Benefits on the Optimal Sales Age of Cows</i>	74

5.2.2.1 Econometric Results on Factors that Influence the Decision to Keep Cows Beyond the Optimal Sales Age with Marketed Output	77
5.3 Relative Competitiveness of Cattle Production Systems.....	81
5.3.1 Extensive (<i>Open – grazing</i>) system.....	81
5.3.2 Semi – intensive (<i>Semi – zero</i>) system.....	81
5.3.3 Intensive (<i>Zero – grazing</i>) system.....	82
5.3.4 Benefits from cattle keeping.....	82
CHAPTER SIX	88
6. CONCLUSIONS AND POLICY IMPLICATIONS.....	88
6.1 Summary	88
6.2 Conclusions.....	90
6.3 Policy Implications	92
6.4 Suggestions for Further Research	94
REFERENCES.....	95
APPENDICES.....	100
Appendix 1: Budget Analysis for Cattle Production Systems.....	100
Appendix 2: Field Questionnaire	103

LIST OF TABLES

Table 1: Value of livestock and livestock products in selected African countries, 1988	1
Table 2: Cattle grazing systems in the survey area.....	34
Table 3: Description of variables specified	43
Table 4: Scale of comparative importance.....	52
Table 5: Household related characteristics, by cattle production system.....	58
Table 6: Household head characteristics.....	59
Table 7: Characteristics of cattle production systems in Rachuonyo and Kisii districts	61
Table 8: Relative importance of keeping cows, by system type.....	64
Table 9: Type of cattle sold to finance expected and unexpected expenditures.....	66
Table 10: Estimated Tobit model for factors influencing the share of socio – economic value of cattle.....	69
Table 11: Estimated Multiple Regression Model using OLS for factors influencing the decision to hold cows beyond the optimal age	77
Table 12: Predicted values of length of holding cows above optimal age.....	80
Table 13: Average annual income parameters (US\$) per household and percent contributions (in parenthesis), by cattle production systems	84

LIST OF FIGURES

Figure 1: Relative contributions of livestock products to total value of livestock production in East Africa	2
Figure 2: Map of Kenya showing districts on which the study is based.....	7
Figure 3: Map of Kisii district, Kenya.....	8
Figure 4: Map of Rachuonyo district, Kenya.....	11
Figure 5: Conceptual framework of utility maximisation from cattle enterprise	26
Figure 6: Clusters of similar sub – locations in Western and Nyanza provinces	33
Figure 7: Dairy cattle density (per Sq. Km) in Western and Nyanza provinces.....	35
Figure 8: Cattle density (both zebu and dairy) in Western and Nyanza provinces.....	35
Figure 9: Objectives of cattle keeping, by cattle production systems.....	63
Figure 10: Relative importance of keeping bulls, by system type.....	63
Figure 11: Relative importance of keeping heifers, by system type.....	65
Figure 12: Relative importance of keeping immature males, by system type	65
Figure 13: Reasons for not obtaining credit.....	67
Figure 14: Annual milk production versus cow age	75
Figure 15: Annual milk revenue and costs versus cow age, for improved breeds.....	76
Figure 16: Annual milk revenue and costs versus cow age, for local breeds	76
Figure 17: Comparison of Revenue, Costs and Profit with and without non – market benefits	86

LIST OF ACRONYMS and ABBREVIATIONS

CVM – Contingent Valuation Method

R&D – Research and Development

SDP – Smallholder Dairy (R&D) Project

ILRI – International Livestock Research Institute

KARI – Kenya Agricultural Research Institute

MoARD – Ministry of Agriculture and Rural Development

WTP – Willingness to Pay

WTA – Willingness to Accept

Sq. – Square

Km – Kilometre

Lt. - Litres

CFCRS – Cow From Cow Rotation Scheme

LDP – Livestock Development Project

K-REP – Kenya Rural Enterprise Programme

KWFT – Kenya Women Finance Trust

SACCO – Savings and Credit Co – operative Societies

OIP – Oyugis Intergrated Programme

HPI – Heifer Project International

PPE - Precipitation over Potential Evapo-transpiration

DM - Dry Matter

AI – Artificial Insemination

TLU – Tropical Livestock Units

RoK – Republic of Kenya

AHP – Analytic Hierarchy Process

DALEO – District Agricultural and Livestock Extension Officer

DLPO – District Livestock Production Officer

GIS – Geographic Information Systems

PRE - FACE

This thesis is divided into six chapters. In the first chapter, a background to the study is presented. Further, the problem under investigation is presented with the objectives and hypotheses to be tested, including the area of study. Relevant literature articles are reviewed in the second chapter including an outline of the agricultural production systems in Kenya. In the third chapter, the conceptual framework of the study is presented. The methodologies and analytical techniques used are discussed in the fourth chapter. The results obtained from the econometric estimations as well as the descriptive statistics are presented in the fifth chapter. In the final chapter, the conclusions, policy implications arising from the study as well as suggested areas for further research are discussed.

CHAPTER ONE

1. INTRODUCTION

1.1 Background

Livestock production is a major component of the agricultural economy of developing countries and goes well beyond direct food production. The roles cattle play in these economies are manifold though their contribution to agricultural and overall development has not been adequately evaluated and is likely to be underestimated. For example, Ogle (1996) estimate livestock contributing 38 and 88 percent of agricultural production in Kenya and Botswana respectively in 1988 (Table 1), without the inclusion of manure and animal traction.

Table 1: Value of livestock and livestock products in selected African countries, 1988

Country	Climate	Livestock Value (\$ Mn)	Livestock share of agricultural output (%)
Botswana	Arid	107	88
Mauritania	Arid	158	84
Kenya	Semi – arid	826	38
Uganda	Sub – humid	404	14
Zaire	Humid	143	5

Source: Adapted from Ogle, 1996

In East Africa, manure and animal traction is more valued than meat (Figure 1). These valuations are based on the additional returns from crop production by manuring crop fields and use of livestock for ploughing. In addition to traction and manure, livestock in many systems feature as living “savings” that can be converted into cash when need arises and as security assets influencing access to informal credits and loans. It is also an important source of income for the rural poor in developing countries, enabling poor and landless farmers to earn income through using public, common-property resources such as open rangelands.

Poor women in particular often rely on the cash income from livestock products kept in the household.

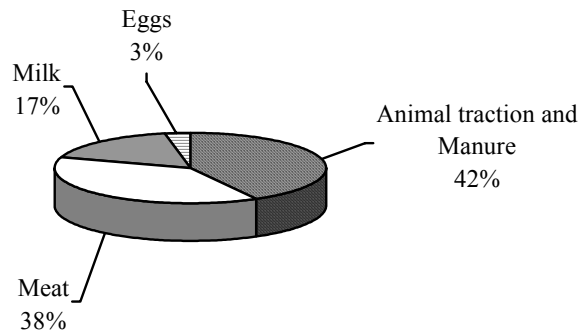


Figure 1: Relative contributions of livestock products to total value of livestock production in East Africa

Source: Adapted from Ogle, 1996

Livestock products are important contributors to total food production. Protein and micronutrient deficiencies are mainly wide spread in developing countries because people subsist on diets that are almost entirely made up of starchy staples. The addition of milk and meat provides protein, calcium, vitamins, and other nutrients that go lacking in diets that are exclusively made up of staples such as cereals. Besides providing food, the driving force behind increased livestock production; livestock remain an important form of non-human power available to poor farmers in much of the developing world. The poor, in particular use organic fertilizer from livestock operations, especially when rising petroleum prices make chemical fertilizers unaffordable. Livestock also store value and provide insurance for people who have no other financial markets available to them.

Livestock are also closely linked to the social and cultural lives of millions of resource poor farmers for whom animal ownership ensures varying degrees of sustainable farming and economic stability. These values vary from society to society and largely determine the

strategies, interventions, and demand and development opportunities for livestock. Owning livestock gives social status (leadership) and economic status (access to informal credits and loans) to the households. They are also considered a common means of demonstrating wealth, cementing relationships through bride price payments and as social links, important in crises. Animals are slaughtered at funerals, name giving days, and at other social or religious events to honour the person or god concerned. They are used in settling local disputes, whereby fines are paid in numbers.

Livestock research policies and measures aimed at improving livestock production are generally focused on physical production and productivity, where productivity of systems are measured according to a single criterion; milk production for dairy animals and beef output for beef animals. The focus is useful especially to the technical staff, though it has to be realized that farmers have multiple goals.

Farmers on one-hand, and researchers and technical staff on the other hand do not share the concepts of production and productivity resulting in assumptions about inefficiency and low productivity especially of traditional production systems. The intermediate (manure, draught power) and the intangible non – marketed benefits from cattle in the form of financing, insurance and status display roles are very much neglected, while all these benefits support human welfare and is probably what motivates farmers to care for their animals. This may explain productivity differentials as envisaged by farmers, researchers and technical staff. Bosman *et. al.* (1997) reveals that farmers in South Western Nigeria are willing to keep goats even though the financial returns per unit of labour is far below that of other enterprises such as cocoa or even cassava. However, the goats enable farming households to meet unexpected expenditures, through their insurance and financing roles. The selling of animals if and when required enables one or two animals to be disposed off if there are urgent obligations.

1.2 Problem Statement

In order to understand the overall contribution of cattle in developing economies, it is important to have an understanding of the different livestock production systems, which exist in the country and the producers' cattle keeping objectives. Official statistics maybe underestimating the total contribution of livestock, by placing emphasis on the physical marketed production and disregarding the non – marketed socio – economic functions which cattle also assume. This is because the functions are difficult to value.

Whereas production and income from livestock raising have been extensively studied, quantified and modeled, so far very little has been done to get a conceptually better underpinned and more quantitative grasp of the importance of the socio – economic functions that would explain why livestock keepers are willing to keep low productive animals in the herd as perceived by the technical staff. Apart from the works of Moll *et. al.* (2001) which has attempted to value the finance and insurance roles of cattle based on the costs saved, by considering costs of alternative ways of financing or insurance other than livestock, review of existing literature so far does not indicate any study that has attempted to quantify these benefits and their effect on the competitiveness of the smallholder dairy systems and farmer circumstances. This study aims to fill this gap by focusing on valuation of these socio-economic functions and its contribution to the economic valuation of the cattle production systems.

1.3 Objectives

The overall objective is to assess the economic value of smallholder cattle production systems in light of the marketable and non - marketable outputs derived from cattle.

Specifically, the study seeks;

1. To estimate the value of tangible and intangible products derived from the smallholder cattle enterprise for intensive, semi – intensive and extensive livestock production systems.
2. To determine the relative competitiveness of smallholder cattle production systems on the basis of both tangible and intangible products derived from cattle.
3. To determine the differential in the length of time producers keep cattle, relative to the optimal animal production age and assess the factors influencing this differential.
4. To draw recommendations and policy implications on the basis of the study results.

1.4 Hypotheses

1. The stock of intangible, non – marketable livestock products are highly ranked and valued by livestock producers.
2. Smallholder extensive cattle production systems are profitable and relatively competitive when tangible and intangible, non – marketable products are taken into consideration.
3. Cattle keepers keep cattle beyond their optimal production period as long as utilities from intangible non – marketable function are derived and benefits still outweigh the costs.

1.5 Significance of the Study

It is recognised that Kenya now faces a scarcity of high and medium potential land and there is limited scope for increased agricultural expansion without causing serious environmental damage (Bilsborrow, 1999). The future of agricultural growth, therefore, must come from increased productivity. The definition of productivity must incorporate the livestock keepers as well as technical staff and policy makers' perception so as to have effective livestock policies. The differing viewpoints of stakeholders in terms of productivity results from the institutional environment which is characterised by absent or ill – functioning markets for products and production factors, meaning that the values of resources used for and products derived from livestock are not necessarily reflected in market prices, and that livestock attains roles in insurance, financing and display of status (Moll *et. al.*, 2001).

Analysing and determining the economic value of cattle would provide a better understanding of the contribution of the socio – economic, non – marketed functions to the survival of small scale mixed cattle producers. These socio – economic functions may also contribute much more to the understanding of livestock production systems than production of meat, milk, traction and provision of farm inputs. The information from this study is hoped to provide a better understanding of “appropriate” public and private policies benefiting both producers, technical staff, researchers and policy makers and also building up on the existing body of knowledge.

1.6 Study Area

Two districts are assessed in the study (Figure 2). These are Kisii and Rachuonyo districts in western Kenya, in which smallholder open grazing, semi – zero grazing and zero grazing systems are practised (Waithaka *et. al.*, 2002).

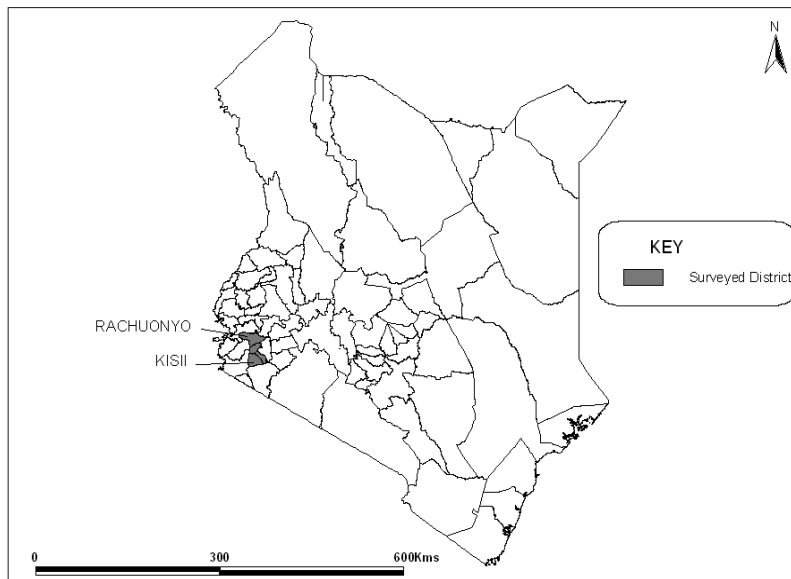


Figure 2: Map of Kenya showing districts on which the study is based

Source: ILRI Geographic Information Systems database

A brief background of these districts is presented in section 1.6.1 and 1.6.2. Smallholder dairy systems are defined as systems whose inputs are primarily derived from the household and whose outputs are meant to contribute mainly to subsistence needs and in some cases surplus sold to meet non – subsistence needs (McDermott *et. al*, 1999). This general description is used, as opposed to outlining the criteria based on livestock numbers and land size. Livestock numbers and land size of smallholdings are dependent on agro – ecological potential, demographic and other socio – economic factors. If uniform livestock numbers and land size criteria were applied, units that would be classified as a smallholding in arid and semi – arid lands would be large holdings in the highlands. In addition, a focus on household inputs provides a common indicator for understanding the decisions made in diverse circumstances faced by farmers.

1.6.1 Kisii District

Kisii (Figure 3) is one of the nine districts that form Nyanza Province. It lies between

Latitudes 0°30' and 0°58' South and Longitudes 34°42' and 35°05' East. The district is bordered by Homabay districts to the west, Migori, to the South West, Trans Mara to the South and Rachuonyo and Nyamira to the North and East respectively. It covers an area of about 1,302.1 sq. km and is subdivided into five administrative divisions (Ministry of Planning, 1997); Suneka, Mosocho, Marani, Masaba, and Irianyi.

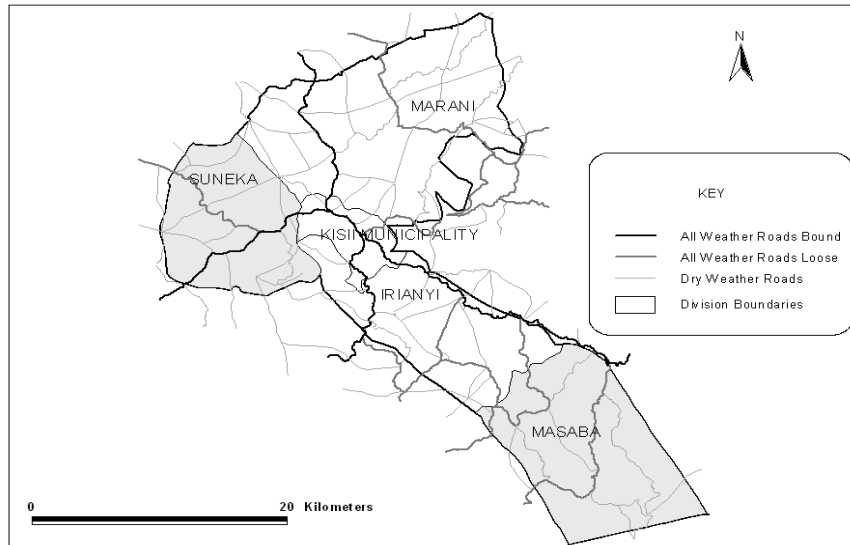


Figure 3: Map of Kisii district, Kenya

Source: ILRI Geographic Information Systems database

The 1989 population census shows that Kisii district has a population of 747,042 people with an annual population growth rate of 2.7 percent. The district is mostly hilly with several ridges in the eastern part. It can be divided into three topographical zones. The first zone covers the area below 1500 metres above sea level. It includes western and northern parts of Suneka and Marani divisions. The second zone covers the areas lying between 1500 metres and 1800 metres above sea level and includes part of Irianyi division especially the Kuja basin and parts of Marani division. The third zone covers areas above 1800 metres above sea level and includes most parts of Irianyi and Masaba divisions. The altitude has enabled the growth of tea and pyrethrum in areas lying above 1000 metres above sea level while at lower

altitudes, coffee, sugar – cane and bananas are grown.

The district has a highland equatorial climate. It receives an average of over 1500mm of rainfall per year, which is highly reliable. This falls in two seasons with the long rains occurring between March and June and the short rains between September and November. The high altitude of the district is expected to lower temperatures, however the proximity to the equator raises the temperature to a mean annual maximum of 27° C in the lowlands and minimum of 16° C (Ministry of Planning, 1997).

Most parts of the district have red volcanic soils (Nitosols). These soils are deep and rich in organic matter. The rest of the district has clay soils that are poorly drained (Phaeozems), red loams and sandy soils. There are also black cotton soils (Vertisols) and organic peat soils (Phanosols) in the bottoms of the valleys. The Phanosols are important in brick making, pottery and manufacture of tiles. The red volcanic soils support the growth of cash crops such as tea, coffee, pyrethrum and subsistence crops like maize, beans, potatoes and bananas. The district is divided into three agro – ecological zones comprising the upper midland (UM), lower highland (LH) and lower midland (LM). The UM zones are comparable to those found in Vihiga, Nandi, Kiambu, Kericho, some parts of Gucha, Kericho and Murang'a districts. The lower highland zones are comparable to those in Thika, Nyeri, Nyamira, Narok, some parts of Kiambu and Nandi districts while the lower midland zones are comparable to Busia, Bungoma, Homa Bay, Siaya, Migori and Kuria districts.

Farming is the main economic activity undertaken in Kisii district. The high and reliable rainfall coupled with moderate temperatures and good soils is suitable for growing both food and cash crops. Main crops include coffee, pyrethrum, bananas, maize, beans, sweet potatoes, finger millet and sugar cane. This also makes it possible to practice dairy farming in the district. Over 70 percent of farmers in the district are cattle keepers with cattle per

capita of 0.2 comparable with Kiambu and Embu districts. The main breeds kept include Friesian, Ayrshire, indigenous breeds and cross breeds. The total cattle population is 110,246 heads of which 57 percent are grade and 43 percent Zebu (MoARD, 2000a). Most of the improved breeds are imported from the Rift Valley province, particularly Kericho, Kitale, Uasin Gishu, Bomet and Nandi districts. Farm holdings in Kisii district are relatively small, ranging from 0.5 to 4.5 acres of land, comparable to the land holding sizes in intensive areas of Kiambu district. This is due to population pressure on land resulting in sub – divisions and fragmentations of the land holdings.

1.6.2 Rachuonyo District

Rachuonyo district (Figure 4) covers an area of 931 sq. km of which 835 sq. km is dry land and 96 sq. km is covered by Lake Victoria. 744 sq. km is arable land while 91 sq. km is marshy, rocky and badly eroded or too steep for cultivation (Ministry of Planning, 1997). It shares a common border with Kisumu to the north, Kisii and Nyamira to the south, Homa Bay to the west and Kericho to the east. The district is divided into four administrative divisions; Kasipul, Kabondo, East Karachuonyo and West Karachuonyo. According to the 1989 population census, the district has an estimated human population of 379,725 persons (MoARD, 2000b).

The district can be divided into two main relief regions namely the lakeshore lowlands and the upland plateau. The lakeshore lowlands comprise a narrow stretch bordering Lake Victoria and cover mostly the north - western parts of the district. The upland plateau starts at 1,220 metres above sea level. It has undulating surface, which resulted from erosion of the ancient plain. The district has an inland equatorial climate, which is modified by the effect of altitude and the proximity to Lake Victoria, which makes local temperatures comparatively low. The temperature in the lower parts of the district (1,135 – 1,300 metres above sea level)

range from a minimum of 17° Centigrade to a mean maximum of about 20° Centigrade.

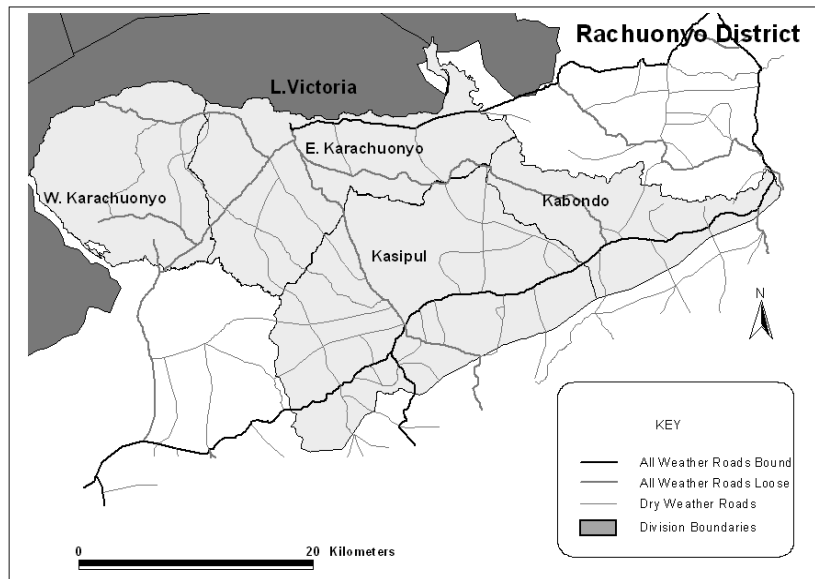


Figure 4: Map of Rachuonyo district, Kenya

Source: ILRI Geographic Information Systems database

In the higher eastern part (1,300 – 1,600 metres above sea level) the mean minimum and maximum temperatures vary between 14° Centigrade and 25° Centigrade. The district has two rainy seasons. The long rains occur from March to June and range from 500mm – 1000mm while the short rains start as early as August and continue to November, ranging from 250mm – 700mm. Kasipul and Kabondo divisions receive reliable rainfall while the rest of the district has varying and unreliable rainfall (Ministry of Planning, 1997).

Rachuonyo district has 74,300 hectares of arable land of which 95% are small scale holdings. The district is characterised by a variety of soils the dominant of which are alluvial, loamy and sandy soils. On the lakeshore lowlands, alluvial, sandy and loamy soils are found which support cotton, sunflower, maize, beans, green grams and cowpeas growing. Small - scale irrigation for horticultural crops is currently practised in the area. The eastern region of the district is highly productive and is characterised by well-drained loam and brown clay soils

mainly in the uplands of Kasipul and Kabondo divisions. In this area, the major crops grown include maize, coffee, finger millet, potatoes, tobacco and beans.

The district can be divided into five agro – ecological zones. The upper midland zone (UM1) covers south western parts of Kasipul and Kabondo divisions. It is suitable for tea and coffee production, however, coffee production is only on small – scale due to poor marketing organisation. The upper midland (UM 2 – 3) is the main coffee zone and occupies a small section of south – east Kabondo. This zone is comparable to that found in Machakos, Koibatek, Baringo, Samburu and West Pokot districts. The lower midland 2 zone (LM2) covers western parts of the district in Kasipul and Kabondo. Crops grown include maize, beans, groundnuts, pineapples, bananas, sunflower, sisal and groundnuts. The lower midland 3 zone (LM3) supports maize, sorghum, cotton, groundnuts, sweet potatoes, cassava, sunflower and beans while the lower midland 4 zone (LM4) is the marginal cotton zone. The lower midland zone is comparable to those in Migori, Homa Bay, Siaya, Busia and Meru district among others.

Livestock production is a major economic activity in the district complementing crop production. The predominant type of livestock kept includes zebu cattle, sheep, goats, poultry, donkeys and dairy cattle. Zebu cattle are common in the lowland arid zones of the district where there is enough grazing land and less competition from intensive agriculture. The zebus are the major sources of income as most families meet their financial obligations from the annual sale of these animals. In 1995, the district had cattle per capita of 0.5 including both zebu and dairy cattle (*ibid.*). This is comparable with cattle per capita in Kericho, Nyando and Bomet districts. Dairy cattle, mostly Ayrshires, Friesians and their crosses are kept in the high potential areas of Kasipul and Kabondo divisions, where zero grazing is practised.

CHAPTER TWO

2. LITERATURE REVIEW

2.1 Introduction

It has been estimated by the World Bank that around 10 percent of the population of Sub – Saharan Africa are primarily dependent on their animals, while another 58 percent depend on varying degrees of their livestock (Ogle, 1996). Cattle are important culturally in establishing the status of the farmer (Moll *et. al*, 2001); as a store of wealth (Doran *et. al.*, 1979); as a form of insurance (Slingerland, 2000); as providers of employment to the farm households, and in the recycling of waste products and residues from cropping or agro – industries (Sansoucy *et. al.*, 1995). Often, livestock keeping has considerable social and cultural significance, which may be the main reason for keeping animals in many societies. It is not always possible to attach monetary value to many of these roles due to the absence of functioning markets for these products (Moll *et. al*, 2001). Nevertheless, they cannot be ignored, since such animals when used for cultural, religious and socio - economic events may be highly valued.

2.2 Functions of Cattle in Smallholder Agriculture; Wealth, Saving, Financing and Insurance Functions of Cattle

Doran *et. al.* (1979), defines wealth as the accumulation of assets, which confer among other things, security, prestige and status. It is distinct from income, which provides the means of attaining wealth and supporting current consumption. In many traditional societies, cattle directly perform both functions. As a source of both wealth and income, cattle provide satisfaction in terms of numbers as well as cash value. The cash value is important in so far as the current consumption needs, are concerned (*ibid*). Livestock assets are savings for future planned expected needs and perform financing roles in a context where banking is not

developed or households are not fully integrated into credit markets, they also perform insurance roles because the capital invested in the flock forms a guarantee for meeting future unexpected requirements.

Financing involves conversion of part of the flock into disposable income (and vice versa) to enable households meet lumpy expenditure needs, such as school fees payment. The benefit of financing is realised when the animals are sold: Insurance involves the maintenance of a capital stock embodied in livestock as a guarantee for offsetting shortfalls in earnings and unforeseen expenses in the future. These benefits of livestock keeping are of special importance in developing countries, where financial markets function poorly and opportunities for risk management through formal insurance are generally absent (Moll *et. al*, 2001). The absence or ill functioning of markets for finance and insurance in developing countries, especially in rural areas, has been widely documented by for example, Binswanger and Rosenzweig (1986) and Bosman (1995). The consequence of the restricted presence or absence of finance and insurance institutions is that to cope with the vagaries of life, people in rural areas search for alternatives such as owned assets within their sphere of command.

According to Slingerland (2000) assets used for financing and insurance in mixed farming systems require various qualities: liquidity, resistance to inflation, capacity for asset accumulation, capacity for production differentiation, accessibility and controllability. Liquidity relates to a households capacity to generate sufficient cash to meet its financial commitments as they become due, without disrupting its business operations. In mixed farming systems, livestock are the best resources to meet the liquidity criterion since the withdrawal of other assets such as land, equipment and housing would disrupt the farming business too much. In addition, if assets possess a capacity for value increase overtime, they become more attractive for financing and insurance. Livestock have this capacity, which is

embodied in the growth and reproduction of animals. Annual crop production does not share this feature. They attain their value only within the limits of one fixed period in the agricultural season that is, when the crop has reached maturity.

Raising livestock is often found to be superior to saving money on a bank account because livestock are resistant to inflation in the sense that its value increases with inflation. Furthermore, net annual returns from livestock may be higher than the interest rates in the bank that may even be negative due to inflation: Saving in the bank may be less attractive when transaction costs, and other obstacles farm households may experience in dealing with formal financial institutions are taken into account (Bosman *et. al.*, 1997; Slingerland, 2000). These qualities of livestock make them a relatively suitable means for financing and insurance for smallholders; compared to other assets, the capital can be kept safely without losing its value and its value can increase overtime. Livestock can also be sold easily to acquire funds for investment or consumption.

Other alternative forms of financing such as credit are limited and inaccessible especially for small-scale producers. The difference in the credit conditions faced by small and large farmers is the existence of a fixed cost of each lending and borrowing transaction, which is invariant with respect to the loan size. This makes it rather costly for small borrowers due to the larger transaction costs of small loans or in some cases an increased interest rate (Binswanger and Sillers, 1983). For goat keeping, Bosman *et. al.* (1997) identify the role of goat keeping in financing as being visible in both the outflow as well as the inflow. This observation can also be extended for the case of cattle. The inflow means investing capital (or saving), while the outflow means spending capital invested.

African rural households involved in rain fed farming are exposed to large income variations. A study by Valdivia *et. al.* (1996) in an Andean agro - pastoral community shows

that households are risk averse, and try to shield their consumption from these fluctuations. One option would be to rely on insurance arrangements. Unfortunately, past studies indicate that formal insurance services are generally absent in Africa's rural areas. In addition, geographic correlation makes weather related risks difficult to cover. The cost of dealing with asymmetric information problems and enforcement difficulties raise insurance premiums beyond levels that households are prepared to pay. Moreover, households may doubt the promise of the insurance company to cover losses if they arise (Binswanger and Rosenzweig, 1986). A study undertaken by Hoogeveen (2000) in Zimbabwe shows that informal arrangements do exist but are also cumbered with information problems and problems posed by aggregate or covariant risks. They are therefore limited to idiosyncratic risks, which only affect one out of many households.

One of the risk reducing strategies practiced by households to smooth consumption after an income shock is liquidation of assets. Evidence from household responses to drought indicates that loss management strategies occur in stages. Households first dispose assets held primarily as stores of value (self – insurance assets) then in later stages dispose of productive assets. Kinsey, *et. al.* (1998), identify drought as one of the major risks faced by households in Zimbabwe. The most important private coping mechanism by the households is the sale of livestock followed by the use of income from temporary local employment. In spite of the use of livestock for consumption smoothing, considerable accumulation of livestock wealth as a form of self – insurance also occurs implying that the accumulation of cattle by households provides them with greater flexibility in coping with drought. The observation that cattle are used to smooth consumption fluctuations have been made elsewhere by Swinton (1988) for Niger where livestock liquidation was a principal means by which households financed their cereal needs during the 1984 drought.

Bosman *et. al.* (1997) and Moll *et. al.* (2001) provide a way forward in determining the value livestock may have as a means of financing and insurance through a comprehensive appraisal of costs and benefits from the cattle enterprise. They propose two methods for valuing the special benefits from financing and from insurance respectively. For insurance, the capital embodied in the flock present on the farm, constitutes a potential to pay expenses, and can thus be seen as a form of security. They propose that the security value of livestock can be considered as equivalent to the insurance premium to be paid in situations where an insurance market exists. These insurance premiums provide cover to a specified limit for a determined period. Therefore the benefit of insurance from livestock for a year is the proportion of the average value of livestock over that year. To estimate this proportion, alternative insurance options are assessed. Bosman *et. al.* (1997), uses an informal life insurance system, with a premium of around 10 % as the reference. The insurance benefit is calculated thus;

$$B_i = b_i * (\text{averagestock} * P_{\text{meat}}) \quad (1)$$

Where; b_i is insurance benefit factor (10%) and P_{meat} is the price of meat.

This yields an insurance benefit of US\$ 149, 62, and 93 per herd for Western province Zambia, Coconut triangle Sri Lanka and Nakuru district, Kenya respectively, representing a continuum of extensive to relatively intensive systems.

They further calculate the benefit of financing through livestock by considering the costs or losses avoided through alternative ways of saving or obtaining credit other than through the outflow of livestock, such as costs of operating a savings account or the costs of informal credit. The studies consider the financing benefit as a proportion of the sales price, since the measurement function of financing focuses on sales of animals. Moll *et. al.* (2001), considers

a finance benefit factor of 10 %, 6 % and 6% for Zambia, Sri Lanka and Kenya and the finance benefit calculated thus;

$$B_f = b_f * (outflow * P_{meat}) \quad (2)$$

Where: b_f is financing benefit factor, P_{meat} is the price of meat and outflow is the part of the flock actually sold to meet the financial needs. This yields a finance benefit of US\$ 10, 5 and 10 for Western province Zambia, Coconut triangle Sri Lanka and Nakuru district, Kenya respectively.

Slingerland (2000) points out some of the weaknesses in these approaches. The idea of farmers saving money, by using their own resources instead of externally acquired resources may not be applicable and realistic. It may well be that the alternatives on the basis of which the extra benefits are calculated may not really be considered by farmers for various reasons. The alternatives may not exist, are not perceived by farmers or are rejected by farmers for other reasons other than their estimated costs. If an alternative is not seriously taken into consideration, it ceases to be an alternative and should not be treated as such. The question of what rates to apply then becomes irrelevant. Bosman *et. al.* (1997) and Moll *et. al.*, (2001) tend to treat the foregone costs of borrowing from the bank or taking out an insurance policy as benefits that can be added to the production value of livestock, yet foregone costs are real, since farmers take them into account in the decision process and hence does not entail attainable income.

Slingerland (*op. cit.*), adds that assessment of the benefits from financing and insurance on the basis of foregone costs alone is incomplete. Using livestock for financing and investment may also entail extra costs that farmers would not incur if the animals were kept for production only. She identifies these costs as liquidity costs, timing costs, market exchange costs and opportunity costs and includes the costs components both in the long and short

term in her model. For instance, farmers may incur loss of income or production when they liquidate assets such as livestock, for the purpose of financing or insurance. If the sales of animals reduces production of manure and hence crop production, then farmers may adjust to the new situation by buying manure.

Timing costs refer to the quality of asset accumulation. The costs are incurred when assets with this quality, such as livestock are used for insurance and finance, and not disposed off given constant market prices, at the moment coinciding with maximum production benefits. The income thus foregone represents timing costs. Market exchange costs accounts for losses due to changes in market prices and loss of real value. Livestock like many other commodities are subject to market price fluctuations and the terms of trade with staple crops may at times be unfavourable for livestock, particularly when crops are scarce due to crop failure. Security or storage costs may also be incurred, and they refer to costs of losses incurred by theft, insect or rodent damage and spoilage. She thus expresses the net financing benefit or cost in the short run as follows;

The net financing benefit or cost (F_l) of livestock (l) compared to another farm household asset (a) as;

$$F_l = (L_a + T_a) - (L_l + T_l) \quad (3)$$

Where; L is the liquidity cost and T timing costs.

The net financing benefit or cost (F_l) of livestock (l) compared to an external asset (such as credit, e) as;

$$F_l = (P_e + A_e) - (L_l + T_l) \quad (4)$$

Where; P is the interest payments and administration costs and A the transaction costs.

Both approaches are useful in providing a way forward for valuing the non – market benefits. However, some limitations are noted. First, operationalising the various cost components highlighted by Slingerland (2000) is not clear cut and may have to be solved arbitrarily. This can be minimised by estimating costs arising from keeping cattle for non – market benefits, by considering costs incurred from keeping cows longer than the optimal period. The optimal period is calculated by taking into account physical marketed production in the form of milk. Secondly, approaches used by Bosman *et. al.* (1997), Moll *et. al.* (2001) and Slingerland (2000) do not take into account the livestock keepers’ behavioural functions or other significant factors, their size and magnitude that may influence the non – market values farmers place on livestock. These factors may have significant policy implications for livestock keepers.

2.3 Cattle as a Source of Fertilizer, Soil Conditioner and Fuel

In many developing countries, manure is considered as important as milk, meat or draught power. Romney *et. al.* (1994), quote a study in Zimbabwe which recorded that farmers reduced grazing time by keeping cattle penned longer in order to collect more manure even though this meant a reduced feed intake thereby adversely affecting production. In the Kenyan highlands, use of inorganic fertilizers on smallholdings has been reducing steadily. With increasing cost of inorganic fertilizers, scientific interest has turned towards the evaluation of organic fertilizers based on locally available resources including green manures and mulches. The use of organic fertilizers particularly livestock manure has increased especially among the smallholder farmers due to its substitutability for inorganic fertilizer as the cost of the latter rises.

The rising costs are influenced by physical constraints such as roads infrastructure causing market distortions (Omamo *et. al.*, 2002; Obare, 2002). A study conducted in the Kenya