ECONOMIC VIABILITY AND CONTRIBUTION OF DAIRY GOATS TO INCOME OF HOUSEHOLDS SUPPORTED BY HEIFER PROJECT INTERNATIONAL, KENYA

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A Thesis submitted to the Graduate School in partial fulfillment of the requirements for the Master of Science degree in Agricultural Economics of Egerton University.

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DECLARATION AND RECOMMENDATION

DECLARATION

This thesis is my original work and has not, wholly or in part, been presented for an award of a degree or diploma in any other university.

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RECOMMENDATION

This thesis is the candidate's original work and has been prepared with our guidance and assistance; it is submitted with our approval as the official University supervisors.

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DEDICATION

This thesis is dedicated to my mother Margaret Aoro Ogola, my late father Patrick Clement Wanjiri Ogola my wife Doughty as well as my daughters Kxkye and Kaden for their support and sacrifice which made this possible.

ACKNOWLEDGEMENTS

I greatly appreciate the opportunity to pursue my Masters degree at Egerton University. Many thanks go to the staff and students of the Department of Agricultural Economics for providing a supportive and academically stimulating environment. Sincere thanks are expressed to Dr.W.Nguyo and Dr.I.S. Kosgey. for their guidance, encouragement intellectual feedback as well as for giving me the freedom to do independent research throughout the entire process. They both represent everything a student can ask for in an mentor. Dr.B.O.Bebe and Dr.S.Shivairo for their support, encouragement and providing useful technical suggestions at various stages. I would like to greatly appreciate Heifer Project International, Kenya for financial support and opportunity to access its sites in collecting primary data for this thesis. I would also like to recognize the contributions of my fellow students P. O. Mungayo,, Hilary, Bett, O. Sikei,, J. Olwande, Auma Onam, T. Chuchu , for their support and encouragement during the development and data analysis of this thesisand also for their friendship and for creation of a pleasant working environment. The Lodiaga family and Mr Ogunde thank you for your support and understanding. I greatly thank my late godparents Jerim and Salome Othieno, I truly miss you guys and wish you were here. I will always be indebted to all of you.

Finally, I would like to express my heartfelt thanks, deepest gratitude and appreciation to my late father and my mother to whom I dedicate this thesis. Without their love and unconditional support it would have been impossible for me to get where I am today. My heartfelt thanks go to Caroline, Kxkye, Dr. Wanjiri, Geoffrey and Beatrice for their countless personal sacrifices and emotional support. Lastly, Our Heavenly Father, The Almighty God, Thank you!

ABSTRACT

Dairy goat farming is increasingly being promoted by many development organizations and policy makers as an alternative enterprise in Kenya to augment the incomes of farmers and, consequently, improve their livelihoods. The objective of the present study was, therefore, to gain a better understanding of the potentials and constraints of dairy goat farming based on the realities and the viability of a dairy goat unit, taken as an enterprise in three different agro-ecological zones where dairy goats were distributed as a strategy to improve livelihoods by Heifer Project International, Kenya. The study was designed to describe farmer practices, support services, production in the selected project sites; the gross and net margins from dairy goat farming as an indicator of economic viability; the contribution of the enterprise to household income and to determine the main socioeconomic factors that affect a dairy goat enterprise economic viability or non-viability. A survey covering 107 farmers was carried out in the Rift Valley, the Coast and Nyanza provinces in Kenya using a set of pre-tested structured and semi-structured questionnaires. The performance of the dairy goat enterprise was established using gross and net margins, and farms separated into viable or non-viable enterprises. A logit model based on the dependent variable of a farm being viable or unviable was used to determine farm characteristics (socioeconomic factors), leading to farm viability. Results showed that, on average, the dairy goat enterprise was viable and made a contribution of 15.2% to the total livestock income. Cost and revenues did not differ much across the different agro-ecological zones. Differences in gross and net margins were attributed to milk prices across agro-ecological zones. A comparison between those who obtained negative and positive margins showed that the latter had better milk and stock sales. The model results indicated that older producers, a higher education level and longer distance to the market had a negative impact on economic viability while a large family size, longer distance to veterinary centre and hired labour had a positive impact. Additionally, it revealed that where gender was concerned, female recipients tended to perform better than their male counterparts. Farmers intimated that the main reason for keeping dairy goats was income generation and milk. Constraints were more to do with purchasing power rather than lack of information. Strategies for implementation of dairy goat programmes should ensure that for their success labour, markets and nearness to the market, pricing, linking activity to gender, good husbandry practices, and type of animals are some of the factors that need to be addressed. Promotion of opportunities towards poverty alleviation should be commensurate with the farmer's capacity to ensure success.

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TABLE OF CONTENTS

DECLARATION AND RECOMMENDATION.....ii
COPYRIGHT.....iii
DEDICATION.....iv
ACKNOWLEDGEMENTS.....v
ABSTRACT.....vi
TABLE OF CONTENTS.....vii
LIST OF TABLES.....x
LIST OF FIGURES.....xii
LIST OF ABBREVIATIONS/ ACRONYMS.....xiii
DEFINITION OF TERMS.....xiv
CHAPTER ONE.....1
INTRODUCTION.....1
1.1. Background information.....1
1.2.Statement of the problem.....3
1.3.Objectives of the study.....4
1.4.Research hypotheses.....4
1.5.Justification of the study.....4
1.6.Scope and limitations of the study.....5
CHAPTER TWO.....6
LITERATURE REVIEW.....6
2.1.Dairy goats: global and local perspectives.....6
2.2.Development efforts.....6
2.3 Measuring economic viability and contribution of the dairy goat to household income.....8
2.4.Theoretical framework for the study.....17
2.5.Conceptual framework and model for the study.....18
CHAPTER THREE.....20
MATERIALS AND METHODOLOGY.....20
3.1. Areas of study and sample selection.....20
3.2. Research instruments and data collection.....26
3.3 The models used for the study.....26
3.3.1. The contribution of the dairy goat to household income model.....26
3.3.2. Gross and net margin model.....27

3.3.3. Logit model 28
3.4. Data analysis 30
CHAPTER FOUR 31
RESULTS AND DISCUSSION 31
4.1.SOCIO-ECONOMIC CONDITIONS AND PRODUCTION SYSTEMS OF DAIRY GOAT FARMING 31
4.1.1.Household characteristics and farming systems 31
Socioeconomic profile of survey respondents 31
Education 33
Land size 33
Occupation 35
Reasons for keeping dairy goats 36
Dairy goat farming experience 37
4.1.2. Production practices of dairy goat farmers 39
Flock structure 39
Housing 40
Record Keeping 41
Feeds used 42
Waste destination 45
Health management 46
Labour 47
Milk production 48
Marketing 49
4.1.3. Indicators of output efficiency 51
4.1.4. Livestock credit programme 52
4.2 ECONOMIC VIABILITY OF DAIRY GOAT ENTERPRISES 53
4.2.1 Enterprise viability 53
4.2.2Enterprise costs 57
Feed costs 57
Veterinary costs 59
Labour costs 60
Variable costs 60
4.2.3 Enterprise revenue 60
Milk revenue 61
Revenue from stock sales 61
Manure 61
Total revenue 62
4.2.4.Enterprise viability indicators 62
4.2.6.Income contribution of small ruminants 66
4.3. FACTORS INFLUENCING VIABILITY OF A GOAT ENTERPRISE 68
4.3.1. Descriptive statistics of dependent and explanatory variables 68
4.3.2.Determinants of viability at the gross margin level 69
4.3.3.Determinants of economic viability at the net margin level 72
CHAPTER FIVE 75
CONCLUSIONS, RECOMMENDATIONS AND RESEARCH ISSUES 75
5.1. Conclusions 75

5.2. Recommendations 76
5.3. Research issues 78
REFERENCES 79

APPENDIX 85

Questionnaire - dairy goat project 85

Dairy goat production practices in Kenya: Implications for a breeding programme 99

Economic contribution and viability of dairy goats: implications for a breeding programme 101

LIST OF TABLES

Table 2.1. Goat populations, total milk and meat produced in Kenya for the period 2000-2005 6

Table 2.2. Goat research (R) and development (D) projects in Eastern Africa 7

Table 3.1. Characteristics of the research areas 20

Table 3.2. Variable description and measurement 29

Table 4.1. Household demographics of farmers who benefited from dairy goats 32

Table 4.2. Level of education attainment of the respondents 33

Table 4.3. Land use and average acre allocated in all the three provinces 34

Table 4.4. Occupation of the respondents in all the three provinces combined 35

Table 4.5. How respondents learnt about the dairy goat enterprise 36

Table 4.6. Farming experience of the respondents on dairy goats in all the three provinces 37

Table 4.7. Dairy goat flock structure 39

Table 4.8. Average dairy goats per farmer in all the three provinces 39

Table 4.9. Average stall costs per province 41

Table 4.10. Area under pasture in the three provinces 42

Table 4.11. Dairy goat feeding practice 44

Table 4.12. Waste management and effect on purchase of inorganic fertilizer 45

Table 4.13. Stock sales for all the three provinces 50

Table 4.14 Kidding and pre-weaning mortality rate 52

Table 4.15 Average economic dairy goat performance in the three provinces 54

Table 4.16 Average economic dairy goat performance as segregated by positive and negative gross margins 56

Table 4.17 Level of production to cost of feeding 57

Table 4.18 Dairy goat enterprise viability indicators (Kshs) across the three provinces 63

Table 4.19 Dairy goat enterprise viability indicators (Kshs) as segregated by

positive and negative gross margins..... 63
Table 4.20 The milk price analysis per litre at gross margin level for the three provinces..... 64
Table 4.21 The milk price analysis per litre at gross margin between those who got positive and negative gross margins provinces..... 65
Table 4.22 Percentage contribution of livestock, crop and off-farm income to total income (Kshs) 66
Table 4.23 Percentage contribution of livestock income by type across the three provinces (Kshs) 67
Table 4.24 Percentage contribution of dairy goat income to total income household across the three provinces (Kshs) 68
Table 4.25 Descriptive statistics of dependent variables 68
Table 4.26 Descriptive statistics of independent variables 69
Table 4.27 Frequencies of actual and predicted outcomes of the logit regression model at the gross margin level..... 70
Table 4.28 Logit model estimates for the probability of an economic viability at the gross margin level..... 71
Table 4.29 Frequencies of actual and predicted outcomes of the logit regression at the net margin level..... 73
Table 4.30 Logit model estimates for the probability of an economic viability at the net margin level..... 74

LIST OF FIGURES

Figure 1.	Conceptual model for the study	19
Figure 2.	Location of site visited in Rift Valley province	22
Figure 3.	Location of sites visited in Nyanza province	23
Figure 4.	Location of site visited in Coast province	24
Figure 5	Provinces and sub-provinces of Kenya	25

LIST OF ABBREVIATIONS/ ACRONYMS

AI	Artificial insemination
DPG	*Dual purpose Goats*
FAO	Food and Agricultural Organization of the United Nations
FARM–Africa	Food and Agriculture Research Management – Africa
GDP	*Gross domestic product*
GM(s)	Gross margin(s)
GoK	Government of Kenya
GTZ	Deutsche Gesellschaft fur Technische Zusammenarbeit (i.e., German Technical Co-operation)
HPI/ HPIK	Heifer Project International/ Kenya
ICIPE	International Centre for Insect Physiology and Ecology
KDPG	Kenya Dual Purpose goat
Kshs	Kenya Shillings
LIMDEP	*Limited Dependent Variable Software Package by Green Bill 1998.*
LPM	Linear Probability Model
MALD/ MLFD	Ministry of Agriculture and Livestock Development / Ministry of *Livestock and Fisheries Development*
MLE	Maximum Likelihood Estimation
NM(s)	Net margin(s)
OLS	Ordinary least squares
SPSS	Statistical Package for Social Scientists
SR-CRSP	Small Ruminant Collaborative Research Support Programme
TVC	*Total variable cost*
UNDP	United Nations Development Programme

DEFINITION OF TERMS

Agistment	The use of pasture for which the farmer has no rights, e.g., on common property resource.
Buck	Male goat.
Does	Female goats.
Economic viability	Refers to the ability of an enterprise to cover its costs. If the costs covered are only the variable costs, then viability is identified as short-term, which is normally measured by GM. If the enterprise can cover some, if not all of the fixed costs, the model for analysis is the NM
Economic efficiency	A broad term that implies a specify in which every resource is optimally allocated while minimizing waste and inefficiency. In terms of production, goods are produced at their lowest possible cost, as are the variable inputs of production.
Farmer Field school	Schools set up by farmers for purposes of learning aspects of farming.
Fittos	Sticks used for constructing the wall and floor of the dairy goat shed
In-kid	When a goat is pregnant.
Kid	Offspring of the goat.

CHAPTER ONE

INTRODUCTION

1.1. Background information

Kenya straddles the equator from latitude 4° north and south, and longitude 34° to 41° west. It covers an area of 584,000 km^2. The human population as at the year 2005 was estimated at 34.3 million with an average population growth rate of 2.3% and a life expectancy estimated at 48 years (World Bank Group, 2006). Agriculture is the backbone of the national economy, directly contributing 27.4% of the GDP (World Bank Group, 2006). About 80% of the population lives in the rural areas and derive its livelihood largely from agriculture (GoK, 2004). Livestock farming contributes significantly (42-45%) to the agriculture GDP. Cattle are the most popular with farmers followed by poultry, goats, sheep and then pigs (MLFD, 2005).

Dairy goat farming is increasingly being promoted by many development organizations and policy makers as an alternative enterprise in Kenya to augment the incomes and nutrition of farmers and, therefore, improve their livelihoods. The increased human population pressure, land demarcation and changing weather patterns may be stimulants to this focus. Previously, developmental efforts on the part of Africa over the years showed a pronounced bias towards large ruminants while ignoring the small ruminants. This was because cattle represented a more concentrated and obvious target than the small ruminants, and cow's milk and beef constituted a larger share of consumption for most countries (Josserand, 1984). Factors that have put goats as a viable alternative for use by development agencies for livelihood improvement emanate from the fact that goats generally thrive well across agro-ecological zones, which is reflected by the degree of their adaptation (survival under various environmental stresses, diseases, parasites and high temperatures), functional contribution (meat, milk, fibre and skin) and socio-economic relevance (security and income generation) (Livestock in Development, 1999; Devendra, 2001; Peacock, 2005). Other attributes of goats are multiparity, faster multiplicity, higher digestive efficiency, lower investment (Thirunavukkarasu and Prabaharan, 1996) and feed requirements as compared to cattle (a doe is 0.17 LSU,

raising one mature dairy cow is equivalent to raising five to six mature goats) (de Jong *et al.*, 1994; Braker *et al.*, 2002). The major breeds of dairy goats found in Kenya are the Saanen, Toggenburg, Anglo Nubian, British Alpine and their crosses. Crossbreds or pure exotic dairy goats are promoted on the basis that animals and technologies from industrialized countries offer great opportunities to increase animal production of small-scale producers so that project beneficiaries may realize increased economic returns or improved diet quality.

Dairy goats were first introduced in Kenya in the 1950's by British settler farmers. They spread to the adjoining African farms, mainly through buck purchases that were used to upgrade the indigenous goats. Major development projects to improve the productivity of goat milk and meat characteristics began in the 1970's and lasted to the 1980's. These initiatives were station-based and aimed at multiplying improved stock for farmers (Mwandotto *et al.*, 1990). Due to financial constraints, the objectives were not achieved (Rewe *et al.*, 2002). In the early to mid 1990's, the GTZ and FARM-Africa adopted community-based and farmer-led approaches in which genetic improvements. The dairy goat population rose significantly in the community-based compared to the station-based programmes (Ahuya *et al.*, 2005). The success of the community-based as opposed to the station-based approaches and the increasing popularity of the dairy goat may be attributed to several factors but it was assumed that the economic factor were paramount. Clearly, interventions aimed at farmers must be financially viable to be successful (Kosgey *et al.*, 2004). Low gross return was a factor in the declining numbers for a particular goat species in Turkey as observed by Gursoy (2006). Although gains have been made by community-based approaches as opposed to the station-based approaches in expanding the dairy goat population in Kenya, their popularity is still low compared to that of dairy cows. Lack of information on performance, profitability and income contribution to the household was assumed to be some of the principal reasons. Such knowledge is important to identify parts of the system that could affect the adoption of the dairy goats and impact on their numbers increasing or decreasing.

Heifer Project International Kenya (HPIK) implemented a community-based strategy since the year 1994 using high value exotic dairy goats. Goats were introduced in response to requests by communities to support them with dairy goats so as to change the family livelihood through improved nutrition and income. This was to be achieved through the utilization of dairy goat products of milk, manure and offsprings. Its strategy involves the use of pure bred dairy goats and a "pass-on" model that has helped to spread the goats to other farmers. No *ex-post* study has been done to evaluate the performance of the dairy goats provided by HPIK at farm level. There is no information on the production patterns and principal determinants of viability of dairy goat farming. Particularly, there are limited studies on the economic feasibility, performance and impact of the dairy goat enterprise in the country in general.

The present study was, therefore, intended to carry out an economic analysis of the dairy goat enterprise in order to shed light on their economic viability, contribution to household income, and levels of performance that have been achieved as well as the extent of variation in productive resources in order to know how these levels compare with the potential for the particular system. This may assist in the identification of paths for development or intervention in the case of HPIK in anticipation of further expansion and possible replication by other organizations.

1.2. Statement of the problem

Many families received dairy goats for use to augment incomes and nutrition under HPIK. These were heterogeneous households in environments having diverse farming systems, social, economic and technological levels, stemming from differences in agro-ecological conditions, population densities and economic opportunities. Varying levels of managerial abilities and input use could be expected. It has not been establishedwhether the dairy goat enterprise is viable at the farm level, It is also not certain what socio-economic factors affect viability. Furthermore, information on income contribution, ability of farmers to manage the enterprise is scarce.

1.3. Objectives of the study

The broad objective of this study was to investigate the economic potential and constraints of dairy goat farming based on the realities and the viability of a dairy goat unit taken as an enterprise. The specific objectives were to:

(i) Describe farmer practices and production in the selected project sites.

(ii) Determine the gross (GM) and net margins (NM) from the dairy goat farming enterprise.

(iii) Determine the contribution the dairy goat makes to the total household income across agro-climatic zones in Kenyan shillings.

(iv) Determine socio-economic factors that may be responsible for the dairy goat's enterprise viability or non-viability.

1.4. Research hypotheses

(i) There is no significant difference between regions in gross margin and net margin of a dairy goat enterprise across the agro-climatic zone.

(ii) There were no significant differences in the costs and revenues between those with positive and negative GM.

(iii) Viability of a dairy goat enterprise was not influenced by socioeconomic factors.

1.5. Justification of the study

Livestock projects in developing countries have had a low reputation among development institutions for failure. Therefore, finding one that successfully contributes towards rural livelihoods improvement is a fundamental concern for policy makers and planners. Many development agencies are now scaling up their support to Kenyan farmers using exotic dairy goats as an option that backs rural livelihoods. Previous attempts to develop the dairy goat industry through donor funded initiatives did not achieve much. The performance of the exotic dairy goats in the country and at the farm level, and the factors that may influence production, whether at subsistence or commercial level, are unknown because few studies have been carried out. Consequently, no meaningful decisions can be

made on how to improve the systems currently in operation or change to alternative strategies. It would therefore be useful to take up an empirical study of the dairy goat programme. The results of this study can be useful in redirecting, improving and strengthening existing dairy goat programs and research by contributing to knowledge for future use by researchers or development agencies and other stakeholders.

1.6. Scope and limitations of the study

This study represents a partial response to the need for information towards a better understanding of the economic viability and contribution of dairy goats for improvement of livelihoods of rural households. It is significant in terms of its contribution to both theory and practice. The study limited itself to dairy goats from the HPIK project and therefore the findings will apply to it directly and generalizations will be extended to other organizations with caution. The study covered Kwale and Taita Taveta districts both in the Coast province; Nyanza province, Homabay, Migori, Nyando, Siaya and Suba districts and in Rift Valley province, Bomet district. The selection of these areas was purposive with availability of the dairy goats central to the choice. Time and budgetary constraints limited the coverage of the study to a period covering one year.

CHAPTER TWO

LITERATURE REVIEW

2.1. Dairy goats: global and local perspectives

Globally, there are about 1.4 billion goats. By the year 2003, 96% of these were kept in the developing countries (FAO, 2003). Worldwide trends of the evolution of the goat population and products between 1969 and 2003 show a continuous and rapid increase relative to either cattle or sheep, especially in the developing countries. This indicates that these animals might provide a tool required to meet some of the needs accompanying continuous increase of the human population in developing countries (Boyazoglu *et al.*, 2005). In Kenya, the population of dairy goats by the end of 2006 (see Table 2.1) was estimated at 153,300 (MLFD, 2006). The major breeds found in the country are the indigenous Small East African and the Galla. The latter is dual purpose while the Small East African is purely for meat. For dairy goats, exotic breeds, i.e., the Saanen, Toggenburg, Anglo-Nubian, British Alpine, German Alpine and their crosses are dominant.

Table 2.1. Goat populations, total milk and meat produced in Kenya for the period 2000–2005

	Year			
	2003	2004	2005	2006
Total population	11,945,500	13,390,500	13,882,600	10,210,500
Dairy goats	118,400	111,600	253,300	153,200
Meat goats	11,827,100	13,278,900	13,629,300	10,057,300
Meat (metric tones)	56,000,000	21,860,000	NA	NA
Milk (litres)	107,230	118,500	129,000	6,400,000

Source:MALD/ MLFD (2006). NA - not available.

2.2. Development efforts

Goat improvement projects have normally been on research or development (Table 2.2). In Kenya, serious attempts to development and research of goats, however, began in the 1970's with financial and technical backing from the UNDP and FAO, respectively

(Ahuya *et al.*, 2005). The projects were characterized strictly by station-based research and multiplication of breeding stock, focusing on the indigenous Small East African and the Galla, and the exotic Boer for improved meat characteristics. The males were sold to farmers to upgrade the local genotypes. From the 1970's to 1980's, dairy goats were introduced on government farms and agricultural institutions such as the then Egerton College (now Egerton University), Wambugu Farmers Training Centre (Nyeri, Central province) and Embu Institute of Agriculture (Embu, Eastern province) from where the animals were sold to farmers. These projects were then followed by the SR-CRSP that ran from 1980 to 1997. The latter was largely concerned with synthesizing the KDPG from two indigenous goats, the Galla and the Small East African, and two exotic goats, the Toggenburg and Anglo-Nubian, as part of the global SR-CRSP research network. The overall objective of the programme was to increase milk and meat supplies, and raise incomes of small-scale farmers (Mwandotto *et al.*, 1990).

Table 2.2. Goat research (R) and development (D) projects in Eastern and Southern Africa

Country	Location	Type	Technical specificities	Year of Commencement
Kenya	Maseno	R	Crossbreeding with Toggenburg to create a synthetic dual purpose breed and on-farm research	1981
Tanzania	Morogoro	R	Crossbreeding with Norwegian Landrace and on-farm research	1983
Malawi	Bunda	R & D	Crossbreeding with Boer and Alpine, and selection of Small East African goats	1983
Rwanda	Kigali	D	Crossbreeding with Alpine	1987
Burundi	Ngozi	D	,,	1980
Ethiopia	Harar	D	Crossbreeding with Anglo-Nubian	1989

Source: Wilson *et al.* (1990).

Due to technical, logistical and financial constraints, the station-based projects failed to meet their objectives or their desired impacts (Okeyo, 1997), and by 1996, despite huge financial investment in this effort, only a total of approximately 40,000 improved goats were available in Kenya. The farmers were not directly involved in this endeavor and genotype-by-environment interactions were not taken into account in designing and

executing the projects (Ahuya *et al.*, 2005). In the early to mid-1990, GTZ, using the German Alpine, and from 1996 to 2004, FARM-Africa using the Toggenburg, established on-farm dairy goat breeding programmes. The objective was to reduce household poverty through increased productivity of dairy goats from improved genetic improvement. Both programmes were community-based and farmer-led. Farmers were rigorously trained on breeding programme design, management and husbandry (including primary healthcare), and were facilitated to run their show with frontline technical support from the NGO's and the Government. In just seven years, the dairy goat population had risen to more than 90,000 head, double over the period (Ahuya *et al.*, 2005).

The on-going HPIK programme that began in 1994 but on a pilot basis before being fully adopted from 1998, is community-based and on-farm. The approach differs from the others in that farmers are provided with pure exotic dairy goat does, which at times were in-kid. A buck is provided to ensure that the genetic level remained exotic. Each beneficiary of the goat is expected to sign a "pass-on" contract. Fifty percent of the members of the farmers' self-help groups are initially provided with goats, and they in turn "pass-on" the first female offspring to the remaining 50% of the members of the group until all are supplied with the animals.

2.3. Measuring economic viability and contribution of the dairy goat to household income

The best method to measure performance and resource efficiency has always been a subject of debate in farm management and agricultural economics. The theory of the firm under production economics, has always considered profit maximization as the primary objective of the farm business and this is linked with sustainability. This is because an enterprise that is considered economically viable or profitable is also considered to be sustainable. Economic viability is probably the most important factor that affects the adoption of a particular practice. However, the approach of profit maximization as the primary objective assumes perfect competition. This has been criticized by many economists because knowledge about the future is imperfect, agriculture production decision making takes place in an environment of uncertainty. Upton (1996) noted that

uncertainty was caused by environmental and price variations and lack of information, all of which are significant in African agriculture. Game and decision theories were developed to explain decision making under uncertainty by making assumptions on risk situations by attaching probability to future outcomes. Use of probability makes game theory applicability in farm decision making difficult. However, the theories do not serve as the complete exposition of decision making unless combined with utility analysis as described by von Neumann and Morgenstein (2007). Decision theory, combined with utility analysis, forms the household objectives approach.

Where profit maximization and the household objectives approach have been applied to small-scale agriculture, the results have always been at odds with each other. Measures based on profit maximization normally lead to the conclusions that small-scale farmers allocate resources inefficiently while those based on household objectives tend to conclude efficient allocation of resources on the basis of the subjective judgment of the future outcomes. Gross margin, although not an absolute measure of profitability in the neoclassical sense, remains helpful as a quick measure of resource efficiency available in small–scale agriculture. A study by Shirima (2005) used gross margin to analyse the benefits from dual purpose goats introduced to small-scale peasant systems in Kondoa, Tanzania. Revenue was made up of sale of milk, live animals and manure while costs were made up of labour, cost of drugs, cost of feeding and repairing the shed. Goats were found to make a significant contribution to welfare. Fixed costs as per GM analysis methodology are ignored. The limitation to the use of GM is that comparison of enterprises with different fixed cost structures can be misleading, particularly when conventional variable costs have been substituted for fixed costs. Fixed costs are, however, unlikely to vary in relation to the size of the enterprise. Provided common costs stay constant, then any increase in whole farm GM will raise the profit by exactly the same amount (Johnson, 1990).

Statements to the effect that interventions must be financially viable to be adopted overlook complications with respect to measuring profitability. Given the nature of small-scale agriculture, and in consideration of such complications, many researchers have

resorted to the use of cost and returns instead of GM or profitability, as this is believed to provide a better forum to analyse subsistence agriculture. It gives leeway and flexibility to what can be included in the calculation to net returns. Baars (1999) studied cost and returns of camels, cattle and small ruminants in pastoral herds in eastern Ethiopia and found that the contribution to the total gross revenues for camels, cattle and small ruminants were (%) 58, 25 and 17, respectively. Milk production was the most important source of revenue. Sales of animals were also important with higher sales occurring in the dry season to compensate for low milk production. The costs considered were labour, cost of livestock purchase and drugs. The cost of livestock purchases and drugs were found to be insignificant.

Gihad and El-Bedawy (2000) studied the contribution of goats to Egyptian smallholder farmers' food and income. The model for analysis was money returns (i.e., net income minus cost). Milk and the offspring were considered as the benefits, and feeds as cost. The goats were found to contribute meat, milk and income. However, several sources of income or costs attributed to the goats were ignored.

Hamadeh *et al.* (2001) studied the economic sustainability of small ruminant production in Lebanon. The objective was to assess the feasibility of four small ruminant production systems ranging from semi-nomadic to the settled. The study employed a cost-benefit analysis technique where revenue was made up of milk, sale of kid, manure, and costs consisted mainly of labour and feed. The result of that study was that all systems recorded negative returns apart from the settled system if labour was excluded. Feed was identified as a major constraint to profitability.

Ayalew *et al.* (2003) evaluated a dairy goat development project in Ethiopia that introduced Anglo Nubians x Indigenous goats using a net benefits approach calculated by subtracting, from net benefits, the cost of purchased external inputs. This approach has been applied primarily to explain subsistence agriculture, where keeping goats extends beyond the products; meat, milk, fibre and offspring to include manure, benefits in resource use, socio-economics like asset financing, security, employment, and socio-cultural functions like meeting social functions and fulfillment of cultural needs. This

method has been criticized on the grounds that it is difficult to assign a monetary value to some functions like socio-economic functions and security. It also ignored the use of costs for financing these benefits.

With the increasing economic pressure on agriculture in recent years, there has been greater emphasis on the use of the cost accounting technique, which results in NM to determine the economic viability of an enterprise. Net margin provides a longer-term, although static, assessment of enterprise viability than GM, which gives a short-term view of an enterprises economic viability. Net margin involves the allocation of easily allocatable costs to a particular enterprise to establish the NM. The reality, however, is that many of the fixed farm resources have very low opportunity costs. This presents a dilemma as to the choice of the degree to which the fixed input was charged (Taj-Uddin and Talukder, 1997). Panin (2000) used NM when analyzing smallholder cattle and small ruminant production systems in Botswana. The major component of revenue was identified as milk output and sales of live animals while labour was the major cost item. Other operating costs included in the calculation were medicines, water, dipping, replacement costs and feed. The cost of depreciation was also considered in the calculation. The goats were found to be economically viable.

In situations where allocating and obtaining cost information is not difficult, then profitability can be used. Panin and Mahabile (1997) used profitability to establish economic viability of goats and the possible contribution of small ruminants to small-scale farmers in Botswana. Returns were made up of sale of animals and milk, and milk consumed and given away while costs were made up of feeds, dipping, water, veterinary medicine and labour. That study found goats to be economically viable. This approach, unlike the others, allocates fixed costs and allows for establishment of the break-even level. The limitation of this method is that allocation of overhead costs is difficult with one resorting to arbitrary decisions. With respect to profitability, it is the element of time span that creates the greatest difficulty for the concept of economic viability (Tisdell, 1996).

Several studies suggest different methodologies and variables that relate to the determination of economic viability, contribution and competitiveness of the dairy goat enterprise. Each methodology has enumerated its advantages and disadvantages. Literature review, however, provides guidance that the contribution of dairy goats can be calculated by the difference of revenue minus costs, where revenue is made up of outputs from the enterprise such as milk sold, consumed or given out as a gift, manure, animals sold, and socio-economic and socio-cultural benefits. Cost is generally made up of inputs such as fodder, concentrates, mineral salt and water. The models used vary in methodologies, sophistication and assumptions. The difference in many scenarios is as a result of what is omitted in the benefits or costs. The current study will use the GM and NM approach to establish the economic viability and possible contribution of dairy goats to household income. Although GM and NM analysis is not a full analysis of the profitability of different enterprises, it provides an excellent opportunity to compare the income and variable costs of the dairy goat enterprise in a standard way leading to valid comparisons. Net and gross margins were, therefore, used in the current study to establish viable and non-viable groupings.

While many studies have carried out economic analysis of the dairy goat enterprise, none of the studies referred to made any attempt to find a set of characteristics that best allow one to predict the chances of an enterprise being viable or not. Failure prediction and financial distress models have been much discussed in the accounting and credit management literature from the late 1960's to the present day. The topic has developed to a major research domain in corporate finance since the first failure prediction models of Beaver (1967) and Altman (1968). Research in failure prediction in agriculture is, however, scarce (Argilés, 2001). Earlier studies tended to use discriminate models to assess farm loan repayment. Argilés (2001) observed that subsequent research involving prediction models could be classified into three, namely:-

(i) Binomial logit and simultaneous equation models,

(ii) Multinomial logit and ordered logit models, and

(iii) Multiresponse ordered model.

Logistic regression is frequently used in place of discriminant analysis as it usually involves fewer violations of assumptions (independent variables need not be normally distributed, linearly related, or have equal within-group variances), is robust, handles categorical as well as continuous variables, and has coefficients which many find easier to interpret. Logistic regression is preferred when data are not normally distributed or group sizes are very unequal. However, discriminant analysis is preferred when the assumptions of linear regression are met because it has more statistical power than logistic regression. Two kinds of variables are usually employed in predicting farm failure (Argilés, 1998), namely:-

(i) Financial ratios and any other variables taken from accounting information. On the one hand, accounting variables are usually difficult to obtain from farms because they require accounting procedures. As previously mentioned, the use of accounting in agriculture is generally limited.

(ii) Variables relating to characteristics of specific farms and farmers that do not meet accounting criteria, but are easily observed and usually reflect socioeconomic and fixed characteristics of each particular farm. These include factors like farm output, acreage, livestock units and age of the operator.

The current study will borrow from these earlier studies and use a binary model where the dependent variable is a qualitative variable, which is incorporated into the regression model as a dummy variable. The most commonly used approaches to estimating such models include LPM, logit model and probit model. However, a serious weakness of the LPMs when used in binary choice dependent variable is that they have a problem of generating predicted values which may fall outside 0,1 interval and heteroscedacity. The probit and logit models have been developed to overcome the problems associated with LPMs (Pindyck and Rubinfeld, 1991). The logit model is based on cumulative logistic probability function, which is quite similar in form to the cumulative normal function. The models use MLE procedures. Although OLS can be used to compute the estimates for the binary choice models, certain assumptions of the classical regression model are violated. These include non-normality of the disturbances, heteroscedastic variances of the disturbances and questionable value of R^2 as the measure of goodness of fit.

The choice of model for this study was, therefore, the binary logistic model. Unlike earlier studies, it will assess an enterprise instead of the whole farm. Net and gross margins will be used to assign values for the dependent variable. The independent variables will be based on specific farm and farmers characteristics due to difficulty in obtaining accounting ratios. The observed economic viability of an enterprise (for example, dairy goat) can be hypothesized to be the end result of socio-economic characteristics of farmers, managerial and location factors. Several hypotheses can be derived on factors that affect economic viability.

Farmer's age may negatively influence both the decision to adopt and the extent of adoption of improved dairy goat breeds. It may be that older farmers are more risk averse and less likely to be flexible than younger farmers and, therefore, have a lesser likelihood of adopting new technologies. However, it could also be that older farmers have more experience in farming and are better able to assess the characteristics of modern technology than younger farmers, and, consequently, a higher probability of adopting the practice. The expected result of age is an empirical question. Age may, therefore, influence viability of an enterprise; the direction of the effect is generally location or technology specific and unknown. Family size, a proxy to labour availability, may influence the adoption of a dairy goat technology positively as its availability reduces the labour constraints faced in dairy goat production.

Literacy augments one's ability to receive, decode and understand information relevant to making innovative decisions. This creates an incentive to acquire more information. Farmers with more education should be aware of more sources of information, and be more efficient in evaluating and interpreting information about innovations than those with less education. It is hypothesized that an enterprise where the producer is more educated will more likely be viable than where farmers have less education. The decision to adopt any single innovation depends on the availability of interrelated inputs. This suggests that the viability of a current innovation may be conditional on the utilization of previously available complementary inputs. Provision of supplementary feed in the farm rather than letting the animals to scavenge, is considered as a complementary practice in

dairy goat production, and expected to influence viability of a dairy goat technology positively. Similarly, the availability of concentrate feed and health practices for the dairy goat may influence the viability of the exotic dairy goat positively. Agricultural extension may also enhance the efficiency of making dairy goat decisions. In the world of less than perfect information, the introduction of new technologies creates a demand for information useful in making adoption decisions. Of the many sources of information available to farmers, agricultural extension is the most important for analyzing the adoption decision. It is hypothesized that extension visits, by exposing farmers to new information and technical skills about disease control, housing and equipment, and feeding, have a positive effect on viability.

Market access factors, which refer to the existence of local markets offering good opportunities for sales and adequate transport facilities, are obvious prerequisites for dairy goat development. As most consumers with greater purchasing power live in cities, intensification of dairy goat production should be initiated, at least in areas having good road networks and transport facilities. The advantage of market opportunities is the incentives for the farmer to ensure that production is improved. Consequently, it is hypothesized that farmers' problems on market as a proxy for market access factor is negatively affected by the decision to adopt and the decision how much to adopt dairy goat breeds. Consequently, producers with larger numbers of marketed outputs derive expected benefit from being aware of technological advancements in inputs or techniques used in production and from adopting those improvements than producers with smaller expected benefits.

The number of years since adopting an exotic dairy goat breed is hypothesized in a way that those producers with more years of experience in the adoption of the dairy goat technology are more likely to have viable enterprises. Each work activity produces goods or services and provides work-related learning opportunities. Like education and other training, learning and perfecting skills on the job through experience makes an incentive for producers to be viable.

The current study used a case study approach. Some of the researchers who have used the case study approach include Francis and Sibanda (2001) in the analysis of the viability of smallholder dairy farming in Nharira-Lancashire, Zimbabwe, and Ngigi (2005) for smallholder dairying in Eastern Africa. Gall (1981) specifyd that for goats kept in family holdings for subsistence or as a side activity without cash input or opportunity cost, economic considerations have to be limited to contribution to the family nutrition and a possible net income. If economic analysis is carried out, especially for large operations: (i) comparisons with other possible users of means of production, mainly land and labour and (ii) the returns from investment in feeding, management and breeding should be carried out. Planning for improvement and development should be based on careful surveys of the pattern of goat production and the level of income under existing standards of management to reveal the relationships between costs and returns, and also provide ancillary information.

2.4. Theoretical framework for the study

A farm household provides the conceptual framework underlying the analysis to be undertaken. Unlike the pure neo-classical model that normally considers the production behaviour of the household; the household model considers not only the production but also the consumption behaviour of the household. This study presents a theoretical consistent model of production and consumption decision-making in the farm household. The household model assumes that to maximize utility (**μ**), small-scale agricultural households make decisions regarding the consumption of home produced agricultural products (**Ya**), market purchased goods ($\mathbf{X_m}$) and the use of time for leisure or production of **Q** goods (goods that gave utility and required time when consumed by the households). For a small-scale farmer, the agricultural household model may be specified for any production cycle as shown in equation 1; the household is assumed to maximize a utility function:

$$\mu = \mu (X_a, X_m, X_l) \quad (1)$$

where X_a is the agricultural stapple, X_m the market purchased good and X_l the time for leisure or production of Q goods. This is subject to the following constraints:

(i) *Budget constraint*: $P_m X_m = P_a (Q - Y_a) - W (L - F)$ (2)

where P_m is the price of market purchased good, P_a the price of stapple, Q the household production of stapple, Q–Ya=Xa the marketed surplus, W the market wage, L the total labour input and F the family labour input; if L–F is positive, hired labour is used, if negative, labour supply is off–farm. Family labour and hired labour are believed to substitute each other.

(ii) *Time constraint:* where $X_l + F = T$ (3)

where T is the total stock of household time. The household faces a time constraint and, therefore, cannot allocate more time to leisure (X_l), on-farm production, or off-farm employment (F) than the total time available to the household.

(iii) *Production constraint:* production technology that depicts the relationship between inputs and outputs. In this case, the production function is represented as shown in equation 4:

$$Q = Q (L, A) \quad (4)$$

where, A is the household's fixed quantity of land. Other variable inputs have been omitted and possibility of more than one product being produced is ignored. The household is assumed to be a price taker.

(iv) *Collapsing the three constraints into one:* production constraint becomes a cash income constraint, i.e., time and cash income constraints yield a single constraint of the form (equation 5):

$$P_mX_m + P_aX_a + WX_l = W_t + Л \quad (5)$$

where, $Л = P_aQ\ (L, A) - WL$ and is a measure of the farm profits. It, therefore, borrows from the consumer and production theory Singh *et al.*, 1986.

Assuming that farmers maximize utility, the choice whether a farm is economically viable or not in the short- or long-term is based on a comparison of expected practices of the farmer in the scenario where he/ she is viable or not. Suppose that there are two situations whereby an individual is economically viable, for a given vector of economic, social and physical factors (X) denoted by $U_n(X)$ or if the individual is not denoted by $U_o(X)$, then economic viability for both can be defined as a linear/ non-linear relationship as shown in equations 6 and 7:

$$U_n(X) = X\beta_n + E_n \quad (6)$$

$$U_o(X) = X\beta_o + E_o \quad (7)$$

and

$$U_n(X) = X\beta_n + E_n > U_o(X) = X\beta_o + E_o \quad (8)$$

where β_n, β_o and E_n, E_o are response coefficients associated with economic viability.

2.5. Conceptual framework and model for the study

Figure 1 below outlines the conceptual framework for the current study. In the recursive system, the net or gross margin is defined as the market value of products from the dairy goats less the cost of inputs. This is estimated as a function of productive resources and socio-economic factors. The productive resources are represented by factors affecting dairy goat production. These include input use, i.e., chemicals and dairy meal, area

cultivated for fodder, family labour and vaccination services. Other inputs and services should be available from the market at all times. These will contribute to keeping the dairy goat in production. The input use represents the intensity of resource use for production. Consequently, variation in input use may influence NM/ GM. Human capital in the form of labour applied to dairy goats is identified. It can be either hired or family labour. It is applied to contribute towards output. Linkages of total income arise from sale of livestock products, animals or household processed products or labour going off-farm or savings in-kind. The sale of resources and products generates income that permits the purchase of consumption goods, which include purchased inputs and labour or household items. These consumption items sustain the household as both a consumption and production unit. An enabling environment must contain institutional and policy space to provide the people involved opportunities to take the next step out of poverty by being able to establish a dairy goat enterprise, to minimize the risks and take the step to another enterprise. The comparative advantage of dairy goat keeping must be such that the cost of milk production must be low, and sales of animals and animal products high, and the price reasonable.

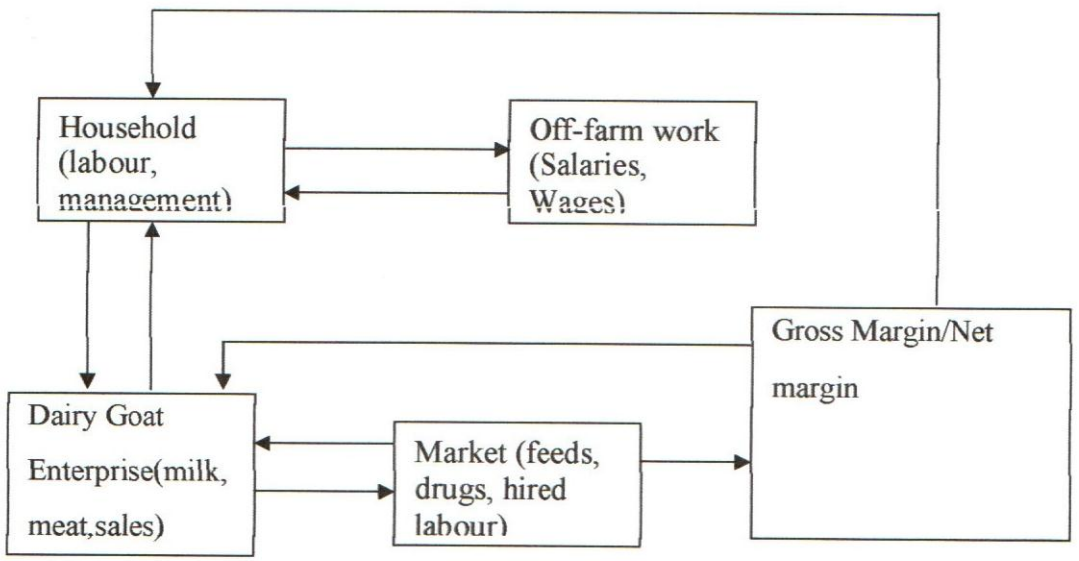


Figure 1. Conceptual model for the study

CHAPTER THREE

MATERIALS AND METHODOLOGY

This chapter presents information on the procedure adopted in eliciting data for the study. It provides information on the research design, sample information, research instrument and a description of the study location.

3.1. Areas of study and sample selection

The data for this study was collected through a survey from a population of beneficiaries who received goats from Heifer Project International kenya. The study was conducted in provinces selected purposively because they represented areas where HPIK had worked and placed the goats. These were: the Coast, Nyanza and the Rift Valley provinces. For Coast, the area of interest was Kwale district. In Nyanza, Homabay, Nyakach, Rongo, Siaya, Suba, and districts were surveyed. Finally for the Rift Valley, Bomet district was surveyed. The characteristics of the research area are given in the Table 3 below.

Table 3.1: Characteristics of the research areas

Characteristic	Coast	Nyanza	Rift Valley
Agro-ecological zone	L_3 & L_4*	LM_1 – LM*	LH_2*
Average rainfall	900-1,100 mm	700-1,600 mm	1,266 mm
Major agricultural enterprise	Coast Composite maize, Bixa, Coconut, Cashewnut, Cassava	Finger millet, yams, sweet potatoes, maize	Maize, livestock
Pasture and forage	Napier and Rhodes grasses, Cenchrus ciliaris	Zebra grass, Guinea grass	Kikuyu grass, Red oat, Nandi setaria, Rhodes grass
Dairy project inception	1998	1998	2001
Soil fertility	Moderate to low	Moderate to low and shallow	Moderate to high

Source: Jaetzold and Schmidt (1983)

*L_3 & L_4 Lowland zone 3 and 4, LH_2 = Lower Highland zone 2, and LM_1 – LM = Lower Midland zone 1.

From each selected district of interest, farmers were randomly sampled from a sampling frame obtained from the HPIK offices in the respective province. Farmers were interviewed if they had reared the goats for at least one lactation period. From the selected areas in every province, at least 30 farmers were to have been selected, resulting in a sample population of 90. This was, however, not possible given cost constraints, distances to be covered, and other difficulties such as the terrain that made it impossible to achieve the desired target. The provinces were characterised by different agro–climatic zones where soil factors, cropping patterns, fodder resource endowments, land sizes, population densities and people's cultures. As in all rural areas in Kenya, the economies of these areas were mainly based on subsistence farming, characterized by mixed crop-livestock production systems.

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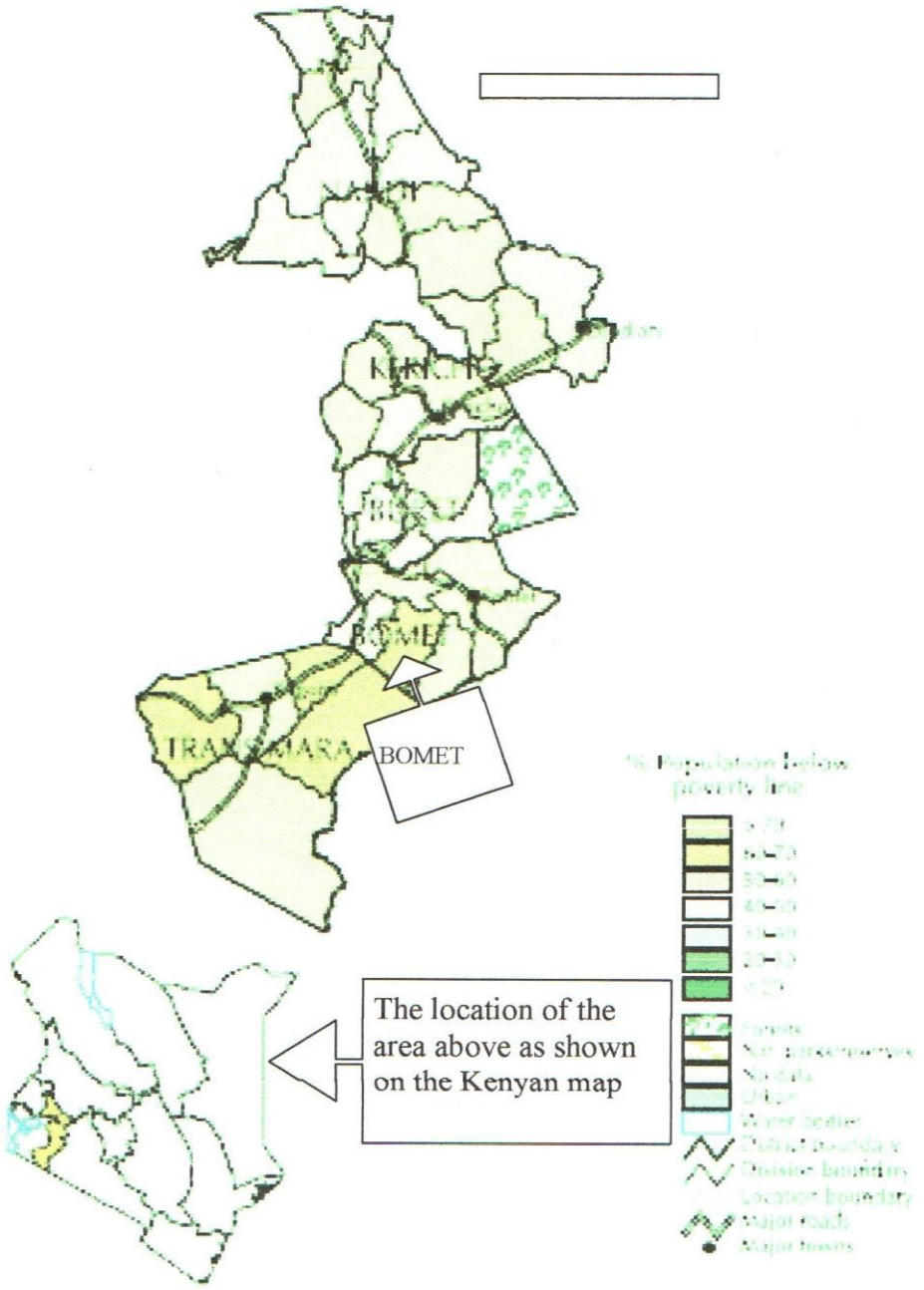


Figure 2: Location of site sampled in Rift Valley

Source: Ministry of Planning and National Development Geographical dimensions of well-being in Kenya 2003

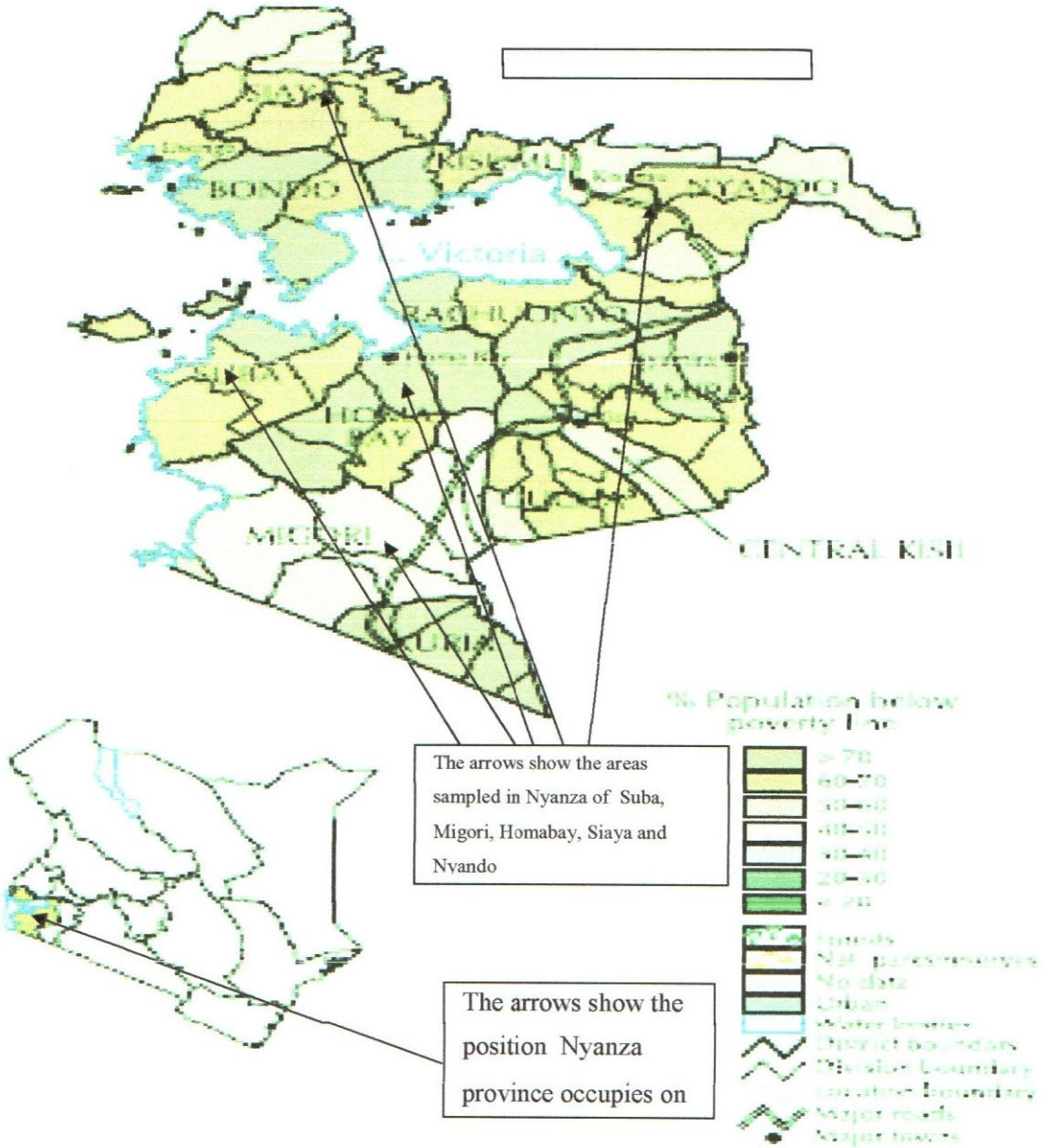


Figure 3: The location of sites sampled in Nyanza Province and the `districts

Source: Ministry of Planning and National Development Geographical dimensions of well-being in Kenya 2003.

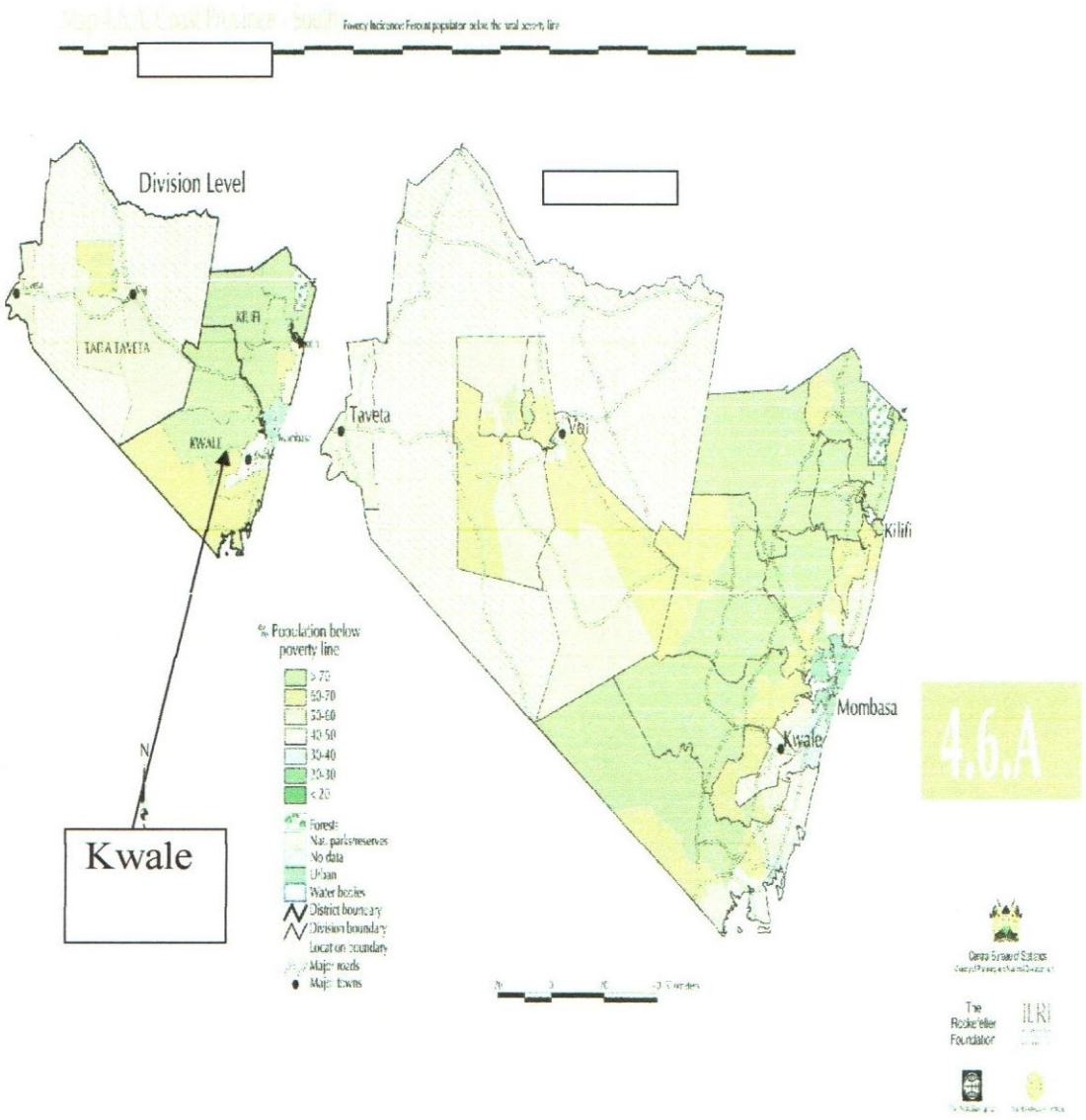


Figure 4: Location of Kwale district at the Coast Province
Source: Ministry of Planning and National Development Geographical dimensions of well- being in Kenya 2003.

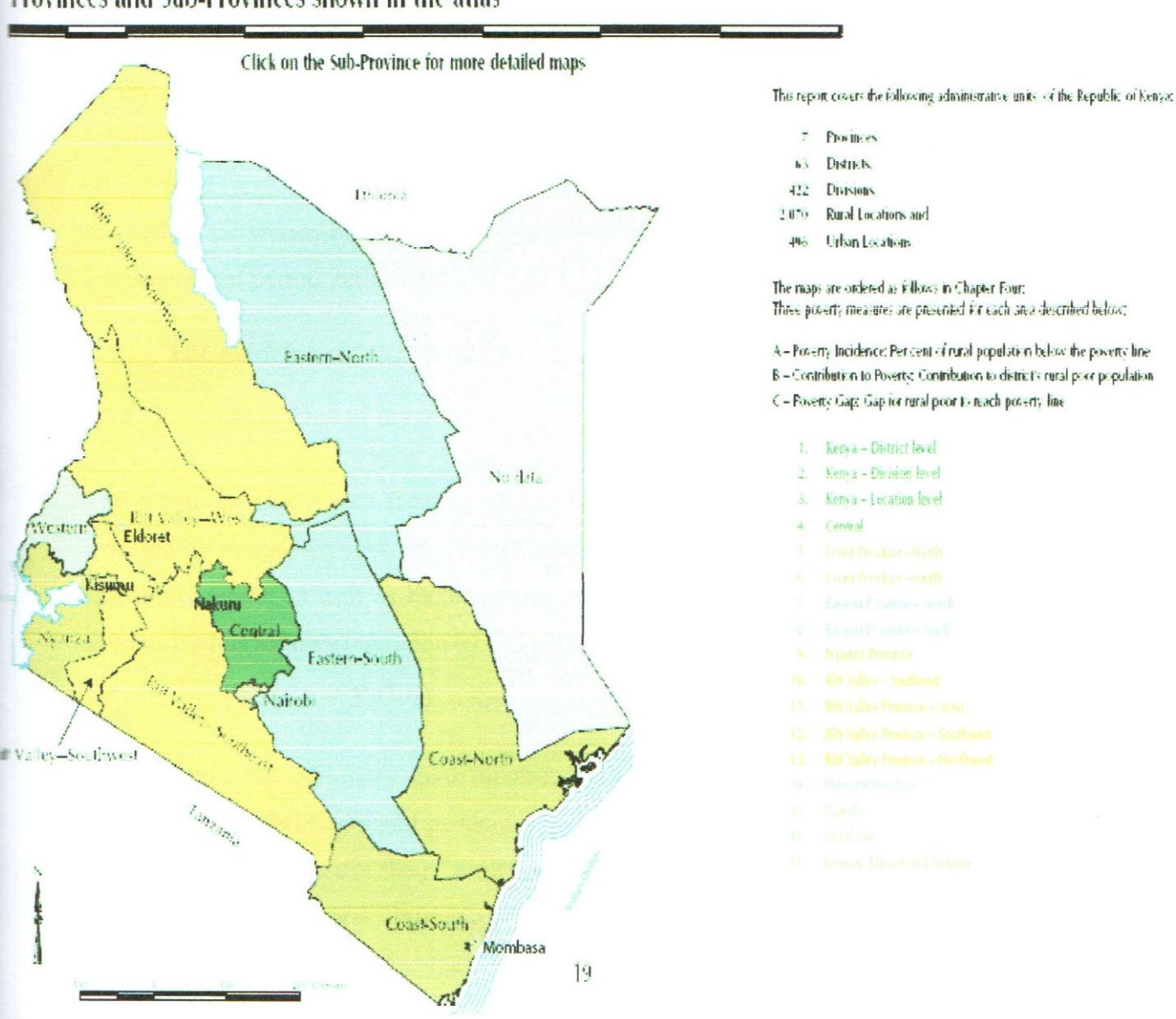


Figure 5: Provinces and Sub Provinces of Kenya

Source: Ministry of Planning and National Development Geographical dimensions of well-being in Kenya 2003.

3.2. Research instruments and data collection

Random sampling was applied to obtain the actual sampling of case (informant). The research methodology constituted using face-to-face interviews, personal observations, review of farmer-kept records, and collections of secondary data whenever necessary and possible to fill in the questionnaires. The information collected was on-farm level quantitative and qualitative data such as demographic characteristics, production, marketing, purchases of inputs, and costs and revenues meant to cover one year during the production period 2006-2007.

3.3. The models used for the study

3.3.1. The contribution of the dairy goat to household income model

The impact of dairy goat farming on the farm household income or contribution was assessed by measuring cash and in-kind income from other enterprises such as crops and non-farm income as well as income attributable to dairy goats. These assessments were summarized as follows (equation 9):

$$Y_t = \sum (P_k Y_k - P_j X_j) \quad \text{where } j=1, 2, 3 \ldots n \qquad (9)$$

Yt represents the non-dairy goat income, P_j the price of the production factor X, for example, seeds, fertilizers and pesticides and P_k the price of the product Y, for example, fruits and bags of maize in the j^{th} enterprise. These enterprises were:-

(i) Subsistence or horticultural crops.

(ii) Productive animals other than dairy goats.

(iii) Non-farm enterprise.

(iv) Borrowing and lending; this could supplement what can be generated on the farm but may not enter into the calculations of farm income directly.

The net income generated through the operation of the dairy goat enterprise (Kg) was taken from equation 11 below. The impact of the dairy goat (I_t) in the farm household was represented as (equation 10):

$$I_t = \frac{K_g}{Y_t + K_g} \times 100 \qquad (10)$$

3.3.2. Gross and net margin model

The second objective used GM and NM as the units of analysis. Gross margin entailed finding the difference between the gross output and variable costs of production. Net margin entailed finding the difference between the GM and allowable fixed costs. The gross output of any farm is given by the sum of the monetary values of net meat production and milk off-take, and manure utilized during the observation period (Ayalew *et al.*, 2003). Milk production included the value of sales of milk as well as milk consumed by the farm household and the kid. Milk out yield was estimated from the regular weekly recordings of all lactating goats. This was multiplied by the prevailing market price of milk to determine the monetary value. Manure was taken as part of the gross output and was valued using available empirical evidence on the chemical composition and solubility of its key nutrients or the prevailing market price. The goat's value depended on the prices of transfers made when being sold or "passed-on". Costs of production were the enterprises' variable costs. Bought-in feeds were calculated on the basis of prevailing market prices, while non-priced items such as the use of farm produced feeds and labour were calculated on the basis of opportunity cost. The GM (equation 11) and NM (equation 12) were presented as follows:-

$$Kg = (PmMs + PmMc + PmMg + TVBP - \sum_{i=1}^{n} PxiXi \pm Ic \qquad (11)$$

Gross margin was, however, expressed as per the most limiting resource in the enterprise such as hectare of land, labour or variable cost for further analysis.

$$Kt = (PmMs + PmMc + PmMg + TVBP - \sum_{i=1}^{n} PxiXi \pm Ic - AFC) \qquad (12)$$

where Kg is the GM and Kt the NM generated through the operation of the dairy goat enterprise, P_m the unit price of milk, Ms the milk sold per lactation, Mc the milk consumed, Mg the milk given away, TVBP the total value of by-product such as manure, Pxi the per unit price of the ith variable input, Xi the number or quantity of the ith variable of input such as concentrates and veterinary medicine, Ic the value of change in

inventory of dairy goats, and AFC the allowable fixed costs such as labour and depreciation.

3.3.3. Logit model

The third objective used a logit model to find a set of characteristics that best allowed one to predict the probability of an enterprise being economically viable or not. The farmer was assumed to have two options, either be economically viable or not viable. The model used was equation 13:

Prob (Economic viability=1) = $\frac{1}{1+e^{-P}}$

$p_i = \beta_i + \beta_2 X_i + \beta_3 X_i + \ldots\ldots + \beta_n X_1 + \varepsilon_i$ (Rubinfeld and Pindyck, 1991)

In the model, the dependent variable was dichotomous in nature; a qualitative variable which is incorporated into the regression model as a dummy variable, where i took the value of 1 or 0, i.e., Pi = 0 if the enterprise is not viable and 1 otherwise, and

ϵ_i = independently distributed random variable with mean 0. The explanatory variables, represented by Xn are given in Table 3.2 below.

Table 3.2. Variable description and measurement

Code	Variable description	Measurement	Expected sign
	Socio-economic		
AGE	Age of beneficiary	No of years	?
AGESQRE	Age squared	No of years	
GEND	Sex of beneficiary	Dummy variable 0 = female, 1= male	-
EDUC	Education level of beneficiary	No of years	+
FMLSIZE	Family size	No	+
HHPROCC	If household participated in off-farm work	Dummy variable 0 = No, 1 = Yes	?
NYXPd	beneficiary years of experience in raising dairy goats	No of years	+
LAPRO	Dummy if labour was provided; 1 = family, 0 = hired labour	Dummy variable ; 1 family, 0 = hired labour	
	Managerial variables		
LNDOW	Land owned by farmer allocated to livestock	No	+
FDCOLE	Provided supplementary feeds	Dummy variable 0 = No, 1 = Yes	+
HLTHMGT	Carried out all health management practices	Dummy variable 0 = No, 1 = Yes	+
FLSIZE	Flock size in numbers	No	+
EXTVIS	If the family had access to extension service	Dummy variable 0 = No, 1 = Yes	+
ATTRA	Attended training on dairy goats	Dummy variable 0 = No, 1 = Yes	+
	Location Variables		
MKTPRB	If the household faced marketing problems	Dummy variable 0 = No, 1 = Yes	_
DISMKT	Distance to market centre	Kilometers	_
DISVET	Distance to the nearest veterinary centre,	1 = if within 0-5 km, 0 = otherwise	_
DISMOT	Distance to motorable road	Kilometers	_
MNTHIMP	Months in which road was impassable	Months	_
PROVCO	Provincial dummies Coast	1 = Coast, 0 = otherwise	
PROVRIFT	Provincial dummies Rift Valley	1 = Rift Valley, 0 = otherwise	
PROVNYAN	Provincial dummies	where 0 = Rift Valley, 0 = Coast implies Nyanza province	

3.4. Data analyses

The data collected was analyzed using Excel of Microsoft Vista software package and other available statistical packages such as SPSS and LIMDEP. Content analysis consisted describing, interpreting and analyzing patterns, observing qualitative data as well as the causal relationships that these data generated. For significant differences between two means t-test ($p<0.05$) was used but when three means were compared ANOVA was used. Hypothesis (ii) used both for analysis purposes. Hypotheses (iii) were tested using estimation of the logit model. Gross and net margins, which are based on the simple theory of cost and returns, were used to calculate the rate of return of different factors of production. Descriptive analyses were used to work out the resource use structure, and costs and returns in milk production.

CHAPTER FOUR

RESULTS AND DISCUSSION

This section discusses the results obtained from the survey and is divided into several Sections that include socio-economic conditions of dairy goat beneficiaries while at the same time describing the production systems of the surveyed areas, economic viability of the dairy goat and factor that influence economic viability of the dairy goat enterprise.

4.1. SOCIO-ECONOMIC CONDITIONS AND PRODUCTION SYSTEMS OF DAIRY GOAT FARMING

This section presents information on the socio-economic conditions of dairy goat beneficiaries while at the same time describing the production systems of the surveyed areas. The purpose of which was to:

- Provide an overall picture of the farmers' husbandry practices and production as a background to more in-depth analyses.
- Identify factors that constrain dairy goat production under the Heifer Project International Kenya.

4.1.1. Household characteristics and farming systems

Socioeconomic profile of survey respondents

The surveyed respondents were the beneficiaries of the dairy goats. Of the individuals interviewed, 87% were female and 13% male as shown in Table 4.1. In all the provinces, apart from the Coast, female respondents were more than the male respondents. Of the female respondents, 62.6% were spouses to the household head while 38.4% were widows and therefore, household heads. In the Coast province, the number of male and female respondents interviewed was the same and 71.4% of them were household heads. About 72.9% of the respondents were married. Of these, 70.1% were in monogamous union while 2.8% in polygamous unions. The percentage of those in monogamous unions was higher in the Rift Valley, followed by the Coast and lastly Nyanza. Widowed respondents were 25.2% of which Nyanza had the highest percentage followed by the Rift Valley then the Coast

Table 4.1. Household demographics of farmers who benefited from dairy goats

Parameter	Frequency	Percentage
Sex		
Male	14.0	13.0
Female	94.0	87.0
Total	108.0	100.0
Relationship to household Head		
Household head	40.0	37.0
Spouse to household head	68.0	63.0
Total	108.0	100.0
Marital Status		
Single	3.0	2.8
Monogamously married	75.0	69.4
Polygamously married	3.0	2.8
Widowed, separated, or divorced	27.0	25.
Total	108.0	100.0
Age structure		
<18 years	4.0	54.9
19-55 years	2.8	38.7
55+ years	0.5	6.3
Total		100.0
Average family members by gender		
Male	3.4	49.00
Female	3.8	51.00
Total	7.20	100.00

Source: Field survey, May 2007

A minority (1.9%) represented singles. These statistics suggest that the strategy by HPIK placed more emphasis on giving dairy goats to vulnerable families, and especially women who had no other source of income. Given that more emphasis was placed on expansion in Nyanza in the last couple of years, review of the beneficiaries joining the programme, indicated a change in strategy by the organization to target more widows.

The average family size for the surveyed areas was 7.2 people, which may indicate a family composed of either a male head of the household, his wife and 5 to 6 children, or other relatives or a widow with 7 to 8 children and other relatives. Desegregation of these data by province showed that the Coast had more members at 8.2 followed by Nyanza

(7.4) and the Rift Valley (6.3). Figures from the last National Population and Housing Census in 1999 (Statistical Abstracts 2000) found that the average family size for the region surveyed in the Coast was 4.9, Nyanza 4.3 and the Rift Valley 5.4, indicating an increase in the average family sizes in the current study.

Education

Table 4.2. Level of education attained by the respondents for all the three provinces combined

Education levela	Frequency	Percentage
None	31.0	28.7
Primary	56.0	51.9
Secondary	16.0	14.8
Post-Secondary	5.0	4.6
Total	108.0	100.0

aOn average, the respondents spent 8.1.years in school.

Source: Field survey, May 2007

Table 4.2 presents the level of education of the respondents. Majority of the respondents (71.3%) had received formal education (Table 2), which suggested that communication of technical knowledge on goat farming would be easy. Seemingly, those mostly involved in dairy goat farming were the illiterate (28.7%) and lowly educated (51.9%). Their education level may have limited opportunities to other forms of employment. Early marriages or deliberate focus on educating males were possible factors influencing education beyond primary school. Poverty could also be an important element here. On a provincial basis, 35.7% in the Coast had no formal education, 27.9% in Nyanza and 42.3% in the Rift Valley. The average number of years spent in school overall was 8.1, the highest being in the Rift Valley (8.6) followed by Nyanza (8.2) and, lastly, the Coast (6.8).

Land size

The average farm size was 2.1 hectares as shown in Table 4.3. More area was placed under crops than livestock in all the provinces. However, in the Rift Valley land placed under livestock and crops was not substantially different, reflecting an equal status in the

two enterprises. Only 12% of the respondents grew fodder on more than 1 hectare of land, indicating limited land allocation for fodder production.

Table 4.3: Land use and average acre allocated for all the three provinces

Land use	Average area	Percentage
Pasture	0.54	26.20
Crops	1.39	67.50
Other	0.13	6.30
Total area	2.06	100.00

Area in hectares (ha) under pasture among the three provinces

Province	Mean area under pastures	Mean area under crops
Coast	0.76	2.61
Nyanza	0.20a	1.64
Rift Valley	1.21a,	1
Total	0.54	1.39

Source: Field survey, May 2007

Nyanza province had the lowest farm area compared to the other provinces. This could be an indication of farm pressure as a result of farms being split up from generation to generation, possibly a consequence of high population growth and land tenure limitations linked to cultural practices or tradition. A study by Onim (1992) established that small land holdings limited the farmer's choice to cultivate improved forages as most available land was used for subsistence food crops, and suggested the use of more intensive technologies. Overall, land pressure favoured adoption of dairy goats, implying the breeding programme may be sustainable under the prevailing production circumstances.

Occupation

Table 4.4. Occupation of the respondents for all the three provinces combined

Occupation	Frequency	Percentage
Farming only	96	88.9
Occasional work	1	0.9
Salaried employment	3	2.8
Petty trader	6	5.6
Pottery maker	1	0.9
Animal health assistant	1	0.9
Total	108	100.0

Source: Field survey, May 2007

Table 4.4 presents the occupation of the respondents. About 88.9% of those interviewed were farmers. Out of these, 87% were women of which only 11% engaged in activities other than farming (e.g., teaching, petty trading and pottery making). About 72% of the 11% women involved in other activities were found in Nyanza province, 28% in the Rift Valley, with none in the Coast. Most women engaged in farm activities as men went for off-farm work. About 57.5% of the husbands to the female respondents took up off-farm jobs. For greater success and sustainability efforts to promote dairy goats should, therefore, mostly target women, which is in agreement with the findings of Verbeek et al (2006), and Kosgey et al (2008).

Overall, off-farm work was low and comprised less than 13% of all the respondents. Lack of alternative sources of income for majority of the respondents suggested strong reliance on agriculture. Farmers would, therefore, be expected to demonstrate a greater ability to participate and benefit from the dairy goat enterprise. Informal discussions with respondents indicated that they were unlikely to spend money from other sources on the dairy goat enterprise unless by an emergency such as an illness. This behaviour is likely to limit the expansion of the dairy goat breeding programme.

Reasons for keeping dairy goats

Table 4.5. How respondents learnt about the dairy goat enterprise

Parameter	Frequency	Percentage
Learnt about dairy goats		
Word of mouth	98.0	90.7
Farming magazines	9.0	8.3
Radio	6.0	5.5

Source: Field survey, May 2007

Most of those surveyed (91.6%) cited word of mouth as the most common method through which they learnt about dairy goats. Some of those who cited word of mouth also got to learn about dairy goats through the television and magazines. It could be inferred, therefore, that goats were being raised for milk and income, and personal contact in the rural context is a more important method of reaching the farmers than either electronic or the print media.

Of those interviewed, all kept goats for milk of which 90.2% expected that it would add secondary income to their families mainly through sale of the milk. Similar observations were made in a study to establish the contribution of goat husbandry to household income in Punjab Pakistan by Teufel *et al.*(1998). A study by Kosgey et al (2008), in general, strongly featured regular income and an insurance against emergencies as reasons for rearing goats. Apart from addition of secondary income through sale of milk, 22% also felt that the dairy goats could be used for meat.

Dairy goat farming experience

Table 4.6. Farming experiences of the respondents on dairy goat in all the three province

Attribute	Frequency	Percentage
Made practical use of skills		
Yes	27.0	26.0
No	1.0	1.0
Partly	76.0	73.0
Total	104.0	100.0
Reasons for not making practical use		
Could not afford	47.0	56.6
Not appropriate	3.0	3.6
Too demanding	29.0	34.9
Did not understand	11.0	13.3
Total	83.0	108.1
Problem with dairy goats		
Labour intensive	13.0	12.0
Lack of market	9.0	8.3
Disease prone	52.0	48.1
Expensive to maintain	11.0	10.2
Delayed conception	19.0	17.6
Lack of extension advice	19.0	17.6
Same sex kid (males)	12.0	11.1
Inbreeding	3.0	2.8
Low production/ growth of the Kid	10.0	9.3
Total	108.0	137.0

Source: Field survey, May 2007

Table 4.6 sets out the dairy goat farming experience of the respondents. Almost all of the recipients had attended training or two on dairy goats. Advice was sought by the farmers on various aspects of dairy goat farming. Most farmers sought advice from the veterinary officers and in case the distance was prohibitive, other farmers. Farmers also indicated that most officers from whom they sought advice from about dairy goats expressed ignorance. This could be as a result of lack of training or reference material and reflected bias towards other forms of livestock. This could have contributed towards lack of knowledge and poor managerial skills, especially for farmers who were not initially trained by the project and by extension officers, resulted in serious production constraints. When farmers who had received trainings organized by HPIK were asked if they had implemented what they had been taught fully, 26% said yes, 1 % no and 76% said partly. Various reasons were fronted for not implementing activities or doing so partly. About 56.7% cited that they could not afford, 34.9% claimed that the particular activity was too demanding, 11% said they did not understand and 3.6% attested to the particular technology being inappropriate. The most prominent areas identified were those relating to purchase of concentrates, drugs and record keeping. Mtenga and Kifaro (1992) identified lack of consistent management in terms of health and provision of feeds as a consequence of a limited financial base, unavailability of concentrates and a general lack of seriousness of the field workers among other considerations. Conroy and Rangnegar (2000) established that major constraints tended to be related to insufficient resources (such as feed, water, labour and cash) rather than information needs *per se* and suggested the use of appropriate messages based on the understanding of the farmer's objective, options and constraints.

Farmers identified various problems with the dairy goat enterprise. Majority identified diseases as the biggest problem. Most of the problems were interrelated. Farmers were asked in what way the problems could be solved. Some of the solutions proposed included increase of training, training paravets, provision of more goats and allowing for paddocking. It is also important to note that for sustainability, extension officers not affiliated to HPIK need to be trained as this would assist in dissemination of information on dairy goats to the farmers.

4.1.2. Production practices of dairy goat farmers

Flock structure

The goats were composed of different categories of sex and age groups as shown in Table 4.7 below.

Table 4.7. Dairy goat flock structure

Class of goat	Number	Percentage
Exotic kid doe	42	14.2
Exotic kid buck	43	14.6
Exotic doe	164	55.4
Exotic buck	47	15.9
Total	296	100.00

Source: Field survey, May 2007

The number of does was higher than any other category. Implied that, exotic does per farmer were averagely more than other categories. This was expected given that the project was promoting dairy goats (see Table 4. 8 below).

Table 4.8.Average dairy goat per farmer in all the three provinces.

Class of goat	Province					
	Coast		Nyanza		Rift Valley	
	Mean	Std. deviation	Mean	Std. deviation	Mean	Std. deviation
Exotic kid buck	1.33a	0.52	0.72a	0.69	1.20	0.45
Exotic kid doe	1.25	0.50	1.17	0.49	1.10	0.32
Exotic doe	2.09a	0.83	1.62a	0.58	1.68	2.19
Exotic buck	1.83	1.33	1.33b	0.73	2.67b	1.53

Compared to the other two provinces, the Coast tended to have more goats per farmer in all categories apart from exotic bucks. Significant differences were noted with exotic kid bucks and exotic between Nyanza and the Coast with the latter having more of both. This could be explained by the fact that most of the farmers in the Coast province had been in

the project longer than those in Nyanza. There were significant differences in the number of exotic bucks between Nyanza and the Rift Valley provinces with the former having fewer bucks. This could be as a result of there being a market for the bucks, which are bought and introduced in other areas for breeding bucks or due to higher mortality or chance. However, there were more similarities than differences among the provinces in terms of flock size and dynamics.

Housing

All the farmers surveyed used intensive management system in which goats were confined at all times. One of the reasons why farmers chose dairy goats was because they occupied little space. The floor design of most of the goat units sampled was slatted wood. Dung fell through the slats into a floor that, in certain areas, was made of concrete. Urine and any food which had fallen out of the trough ended up on the floor. The floor was cleaned at regular intervals and the manure was spread on the crops or fodder fields. The walls of the units were made of wooden sticks (fittos), planks or, in very few cases, wire mesh and mud. The open walls, together with the slatted floor, were beneficial in that they encouraged air circulation through the house. The sloping roof was mainly made out of iron sheets. The roof of the house had two functions:-

(a) To shade the house, by having a substantial overhang.

(b) To give protection against rain; it should have a good overhang to prevent raining in.

Usually, the animals left or entered the house using a ramp at one end. The food trough was mainly placed outside one of the long walls. In some cases, the construction also encompassed a walking area. The animals were kept in these structures mainly to prevent them from browsing on crops and also as a guard against tick-borne diseases. Furthermore, the houses provided a good physical environment. Given that the animals were kept inside the houses, possible heat stress was prevented. In certain areas like Kwale at the Coast, the house walls were made of mud to guard against tsetse flies. The houses were constructed entirely from materials easily available in the locality. The price of the houses averaged Kshs. 10,356. The durability of the house depended on the materials used. The cost of the houses in the Coast, Nyanza and the Rift Valley averaged

Kshs 5,111, 11,472 and 10,316, respectively, as shown in Table 4.5 below. There was a lot of variation in the cost of construction, especially in the Rift Valley province. The costs of stalls in Nyanza were significantly higher than that at the Coast. This may be due to scarcity of timber in Nyanza compared to the Coast, or more units being constructed in Nyanza at a later date than at the coast. Structures in Nyanza were mainly of fittos; these required frequent repairs compared to the structures found in the other two provinces.

Table 4.9. Average stall costs per province

Province	Mean	N	Std. deviation
Coast	5111.1a	9	1364.2
Nyanza	11472.1a	43	5593.2
Rift Valley	10315.8	19	7579.6
Total	10356.3	71	6169.1

a Significant differences between the Coast and Nyanza provinces ($p < 0.05$) Source: Field survey, May 2007.

Problems associated with the houses include high cost of construction and poor construction because of use of unskilled carpenters. The floor, if poorly constructed, resulted in broken legs, especially for the kids. There were reported cases of pneumonia which could only be attributed to the openness of the house. To guard against this during certain seasons of the year, the animals could be given more protection using cardboards and/ or sacks. Although sheds were available, optimal utilization and maintenance was poor. Dung disposal was regular, resulting in the control of flies and biting insects. Housing also assisted in clean milk production by having the goat milked on a raised platform which ensured less contamination from unclean floors.

Record Keeping

Although records kept by the farmer form the basis of future improvements of the dairy goat enterprise, inability to update farm records on a regular basis or consistently keep records posed the greatest challenge in monitoring progress and on assessing economic performance. For example, notebooks were used to record milk yields. At the end of the, month this was summed up by the farmers and transferred to a doe card by the extension officer. The monthly production would, therefore, be recorded at the project office,

thereby assisting in capturing the performance of the individual animals. This was, however, erratic and farmers were not consistent in updating their records on a regular basis, some had even lost their notebooks. Farmers did not seem to comprehend the reason for keeping records and were doing it mechanically as a project requirement, and consequently, did not do a good job. Lack of ownership of records meant to capture production data suggest that poor record keeping was a production and viability constraint.

Feeds used

Table 4.10. Area under pasture in the three provinces

Province	Mean	N	Std. deviation
Coast	1.9	11.0	1.5
Nyanza	0.5a	63.0	0.6
Rift Valley	3.0a,	28.0	6.0
Total	1.3	102.0	3.3

a Significant differences between the Rift Valley and Nyanza provinces ($p< 0.01$)

Source: Field survey, May 2007

Table 4.10 above shows the area under pasture in the three provinces. Pasture and feeding management are said to have an influence on feed costs and profit margin. Land or cultivated pastures for the goats was found to be relatively small (table 4.1). A one-way ANOVA indicated significant differences among the producers in the amount of land allocated towards pasture ($P<0.05$). In the Rift Valley, more land was allocated to pasture than either the Coast or Nyanza provinces. Shortage of land was a major constraint as goats competed with crops and other forms of livestock. In Nyanza, this was coupled with the fact that land was in most cases communally owned and decisions on its use had to be first deliberated upon by family members.

Table 4.11 below presents the dairy goat feeding practices. Most farmers had established Napier grass and fodder trees for purposes of dairy goat feeding. Many farmers (82%) used improved pasture to provide nutrition of their goats; 18% did not. Reasons for not

growing improved pastures for the latter varied; 84.8 % cited lack of land while 7.6% mentioned weather and difficulty in growing improved pasture. Approximately 94% used additional feeds such as sweet potato vines, fodder trees, twigs and other pastures. About 60% provided twigs and only 49% used concentrates. Non-arable land by the roadside and public wasteland, therefore, made a substantial contribution to feeds. The use of shrub, tree leaves, tender shoots and twigs as fodder was common amongst the beneficiaries. Many who did not use concentrates claimed that it was too expensive while others opined that feeds available were sufficient to provide the necessary nutrients.

Farmers who fed concentrates admitted that it was mostly done during milking to calm the goat. The quantities and frequency of concentrates fed depended on the farmer's ability to purchase and the distance to the point of purchase. Other factors linked to the purchase of concentrates were availability of markets for livestock products or as a cost reduction strategy by the farmer. From the farmers perspective, supplementary feeding seemed a major cost item. Given that the objective of any enterprise is to reduce costs or choose the least cost alternative, it is apparent that before assuming supplementary feeding, there is need to ensure that utilization of feed is efficient and, if there is supplementary feeding it should achieve maximum returns.

There were many cases of disparity between fodder base and the number of animals kept. It was difficult to determine a direct relationship between the amount of land and dairy goats because farmers admitted to using improved pasture both for the goats and other animals. Most farmers (97%) carried out feeding more than three times a day. Farmers also made no attempts to conserve fodder in times of plenty citing high labour demands and lack of know-how. Fodder conservation practices were carried out by only one farmer. This meant that most farmers had to spend money purchasing fodder during periods of inadequate or limited supply. The accessibility to natural pasture seemed to be a factor in the farmers' decision not to invest more in husbandry towards maintenance, conservation or growing of improved pasture production. The use of a mixture of feeds may in fact be responses that farmers had devised to address feed constraints.

Table 4.11. Dairy goat feeding practices

Attribute	Number	Percentage
Feed used		
Improved pasture	58	82.0
Normal pasture	13	18.0
Total	71	100.0
Reasons for not using improved pasture		
Difficult to grow	1	7.6
Non conducive Weather	1	7.6
Shortage of land	11	84.8
Total	13	100.0
Supplemented with other types of fodder		
Yes	62	87.0
No	9	13.0
Total	71	100.0
Fed concentrates		
Yes	35	49.0
No	36	51.0
Total	71	100.0
Reasons for not using concentrates		
Considered not necessary	16	36.0
Too expensive	29	64.0
Non-committal	45	100.0

Source: Field survey, May 2007

The use of various feed mixtures is an indication of lack of a strategy in feeding the dairy goat and management of feeds. In managing feed one needs to understand the nutrient composition of forages, which varies greatly during the year, and the pattern of change with the period of growth and rainfall. At the same time, understanding the nutrient requirements of the goat is important so that one can match with the composition of the forage. Nutrient requirement of the various classes of goats must, therefore be known. Management of the flock should be such that peaks and troughs of nutrient production coincide with the variation in nutrient requirement of the goat. This can only be achieved if kidding was seasonal and not spread throughout the year. The adequacy and timeliness of feeding management was viewed to be wanting and could eventually contribute to performance below the potential.

Waste destination

Table 4.12: Waste management and the effect of manure on purchase of inorganic fertilizer

Parameter	Number	Percentage
Waste destination		
Fodder plot	17	19.5
Crop farm	67	77.0
Fodder plot and crop farm	3	3.4
Total	87	100.0
Effect of the manure on purchase of inorganic fertilizer		
The same quantity	3	2.8
Less as a result of the dairy goat enterprise	22	20.4
Not using fertilizer	83	76.8
Total	108	100

Source: Field survey, May 2007

The table 4.12 above presents waste management and the effect of manure on purchase of inorganic fertilizer. It shows what farmers do with the manure collected from the dairy goat enterprise. Only about 20% of the farmers interviewed indicated that the manure was returned to the fodder plot; 80% directed it to their crop farms. Most of the farmers were actually using the manure for their kitchen gardens. Non fertilization of the pasture in the long-term would result in pasture damage and soil. This may eventually have cost implications with fodder production expected to decline due to poor sward growth. Purchases of fodder will increase thereafter, and by extension, affect the GM of the enterprise. This in the long-term would thus have an effect on productivity.

As a result of the dairy goat enterprise, 20.4% of the farmers who were using inorganic fertilizer reduced the amount normally purchased. This caused a saving of about Kshs 18,540. Only 2.8% of the farmers indicated purchasing the same quantity of inorganic fertilizer while 76.8% previously did not buy the inorganic fertilizer. Those that did not buy inorganic fertilizer opined that it would spoil their soils. All farmers interviewed were of the opinion that the organic fertilizer had improved crop yields where it was applied. Similar findings were made by Shirima (2005). Application of goat manure must have improved food security through improved yields and farmers made savings in less purchase of food rations and fertilizer. As observed by Onim (1992), the use of manure can have a positive environmental impact because its use on either crop land or fodder enhanced soil fertility through increased nutrient recycling.

Health management

Healthcare is essential in any livestock enterprise as it is a source of loss through limitation of productivity and mortality. Attempts aimed at improving nutrition or genotype only yields limited increase in productivity until effects of some of the infectious diseases are reduced. Preventive and treatment measures can assist in ensuring reduction of losses through reduced production or deaths. Most farmers applied proper healthcare practices. They controlled for both internal and external parasites albeit with some variation in the recommended versus the applied protocol. Only 4.3% of those

surveyed did not carry out the recommended deworming of four times in a year. Spraying saw the largest variation with 37.7% practising it according to the recommended weekly spraying, 52% spraying 26 times and 10.3% spraying 17 times or less in a year. About 7% of the farmers did not use mineral supplements to enhance their goat nutrition. Nearly 5.6% of them believed it was not necessary, as there were adequate minerals from the fodder, 2.8% believed it was too expensive and 1.4% did not know if minerals should be given. About 67.7% of the farmers did not vaccinate their goats. Of those farmers who did not vaccinate, the reason for not vaccinating was lack of know-how. Overally, farmers had some level of understanding of disease control measures, control of internal and external parasites, importance of use of mineral supplements, but a low understanding of vaccinations. However, variations in the number of times these were carried out were an indication that cost was an issue for most of the farmers. Onim (1992) also found that although inputs for adoption of improved DPG technologies such as veterinary drugs, salt licks and concentrate feeds were generally available, prices proved prohibitive for most farmers. Farmers were unable to identify causes of mortalities within their flocks. One commendable example under health management was when one of the beneficiaries took the initiative as a result of the project to undergo training in livestock disease control and now serves beneficiaries of the project.

Labour

Of those surveyed 21.8% hired labour while 78.2% used family labour. Labour in several cases was therefore provided by family members. Tasks involved cleaning of the unit, milking and feeding. Families that did not have a lot of land reported that during dry periods, they hired people to go and purchase for them fodder. The project, therefore, provided employment for some members of the community. Most activities were carried out by women or children. Sansoucy (1995) reported that goat, sheep, poultry and rabbit husbandry, especially in backyard production systems, provided an important source of part-time job opportunities, particularly for landless women and children. Majority decisions on activities, however, had to be taken in consultation with the men.

Milk production

Milk production was measured volumetrically using a variety of units of measure such as 1 litre or 750ml bottles. The results of this study showed that the average dairy goat milk production for the farmers when they started dairy goat farming was 2.1 litres per day and they milked for an average of six months. In their subsequent milking season, milk production dropped to an average of 1.9 litres per day and farmers milked for an average of five months. These values, however, excluded the consumption made by the kids as farmers preferred to suckle them rather than use a bucket. Reasons given for suckling of the kids were that it was less labour intensive and it reduced incidences of diarrhoea. Many farmers also reported that they did not use bucket feeding because of the fear that it might affect the growth of the kid through underfeeding. The average dairy goat production obtained in the study was therefore slightly higher than that recorded for the DPG by Onim (1992), and Mtenga and Kifaro (1992) for crossbreeds but in the range of that reported by Shirima (2005). It was lower than that established by Donkin and Boyazoglu (2000), who compared lactations of indigenous goats, crossbreeds and the exotics. The latter study established that crossbreeds and the exotic produced larger amounts of milk and sustained milk production for a longer period of 9 to 10 months. Given that these were pure animals, unlike the dual purpose types, on which Shirima (2005) carried out studies, the production of milk in the sampled areas could be said to be low. Furthermore, most of the goats were purchased when in-kid from outside the country and, therefore, reduction in milk production could be as a consequence of stress related to a change of the environment or low husbandry practices. It implied that there was room for increased production of the animals.

The average milk consumption was 1.36 litres with average milk sales of 0.7 litres per day. This indicated that a larger volume of the milk was consumed at home. Similar findings were found in a study by Singh *et al.* (1996). A higher volume consumed at home could be an indication that the production of the goat was low or there was difficulty in the marketing of milk products due to non-acceptance by consumers or that there were large family units. The average milk production per lactation was 365 litres

for the Coast, 322 for Nyanza and 281 litres for the Rift Valley. When all the provinces were considered, the average came to 316 litres. There were no significant differences in the amounts of milk produced per lactation across the provinces. The Coast province produced more milk on average per lactation than either Nyanza or the Rift Valley.

Marketing

One of the objectives of the farmer was to earn income from the enterprise through milk sales and from the sale of goats. About 47.9 % of the farmers sold milk, 35.2% sold less than 1 litre per day, 9.9% sold 1 litre while 2.8% sold more than 2 litres; 53.1% did not sell milk. About 64% of those who sold milk made sales at farm-gate, 24% at the market while only 12% sold in other areas. Given that more milk was sold at the farm gate and the average distance to the place of disposal did not exceed 170 metres could imply that demand for goat milk was high. The surveyed areas could be said to be either milk deficient or there was preference for fresh milk to packed milk, or fresh milk was cheaper than the packed milk. Farmers did not incur any costs during disposal of the milk. The fact that 53.1% of the farmers did not sell their milk could be an indicator of low production or production could be adequate but family made use of it.

Most of the milk (72%) was sold to outsiders and only 28% sold to neighbours and friends. Given that the projects were placed in rural areas, the reason for this skewed sale of milk could be the low purchasing power by the local communities or production of a similar product, and maybe even stigma. The market made up of outsiders in rural areas is more often than not limited and, if farmers' production were to increase, there would be difficulty in disposing of the extra milk.

About 64% of the payments were made mainly on a monthly basis, 12% daily, 4% weekly while 20% got payments on both monthly and daily basis. Many people, therefore, seemed to prefer contractual arrangements and this could impact negatively on the farmer's cash flow with respect to meeting some expenses. The average sale price for goat's milk was Kshs. 28; this was more than the price for cows milk at about Kshs 23. Only 18% of the total milk produced was sold. In the Rift Valley, less than 1% of the

milk was sold, the Coast 32% and Nyanza 25%. Low sales in the Rift Valley was attributed to availability of cow's milk as an alternative, resulting in more of the cows milk being sold and the goat's being retained. For the Coast and Nyanza, the amount of milk sold was a function of family size and production. Challenges faced by the dairy goat farmers in selling their milk included competition from local cows, especially during rainy seasons. Most of the farmers were of the opinion that the dairy goat milk supply was more consistent than that of the local cows. There` was a general feeling that goat's milk was of high density and, therefore, heavier than other milk sold in the market; this gave the farmers a head start over those with other livestock. The project had some nutritional impact by virtue of milk consumed. Onim (1992) found that the contribution of milk to the improvement of protein poor diets of small-scale farmers was significant, particularly for children. Many families found the DPG milk convenient in alleviating malnutrition among children whose parents were too poor to purchase milk.

Table 4.13: Stock sales for all the three provinces

Attribute	Number (n=108)	Percentage
Farmers selling goat		
Farmers selling	23	21.3
Farmers not selling	85	78.7
Total	108	100.0
Sex of goats sold		
Male	34	91.9
Females	3	8.1
Total	37	100.0
Age of goats sold		
Less than 1 year	32	86.5
More than 1 year	5	13.5
Total	37	100.0

Source: Field survey, May 2007

Table 4.13 present the stock sales made by the farmers. Stock sales were made by only 21.3% of the farmers. The price of sale of the goats ranged from Ksh 4,000-14,000. This was higher than the value of local goats that fetched between Ksh 1,500-2,000. In total, 37 goats were sold for the period under the study, bringing in an income of Ksh 212,000.The value of the goat compared to the value of the parent stock was low. The variation in the sales value was an indication of poor record keeping, lack of organized markets, or market organizations with no standards. More males were sold compared to females. Farmers incurred no cost during sale; 86. 6% of the goats sold were less than one year old, which could be considered an indication of unavailability of the dairy goats in the market or a need for cash. Overall, the results tended to indicate that the farmers were leaning more towards generation of savings, security and or asset protection, implying possibility of maximization of animal numbers even if individual productivity was low. Alam (2000) found that landless and marginal farmers (resource -poor) sold their goats at an early age, and with less market weight, as they largely depended on income from goats.

The money obtained from the dairy goat enterprise was put to various uses, with 16.7 % putting it to paying school fees, especially if the sale was as a result of sale of stock, 2.8% used it for development or purchase of other livestock, while the largest majority (80.2%) used the money within the household. The subsequent sales of yearlings, does and excess bucks generated money for paying school fees and medical bills for family members who had no other source of money. Gihad and El-Bedawy (2000) reported that keeping goats lowered financial risks and overcame periods of cash shortage, and inferred that it would remain attractive for the small-scale rural producer with limited alternative ways of earning cash income.

4.1.3. Indicators of output efficiency

Table 4.14 below presents Kidding and pre-weaning mortality rate of the dairy goat. The success and profitability of a dairy goat enterprise depends on the level of kid output

from the breeding stock. A high level of young born, weaned and reared to market is a good indicator of efficiency and profitability of the enterprise. A build up of numbers is, therefore, important in ensuring the success of the programme. This is measured by rates of kidding, survival and weaning. It is affected by management in terms of nutrition, health and housing. To be profitable, it is critical that each doe produces at least one marketable unit per year. The average litter size was 1.51, which meant that the twinning rate was high at 51%. The Coast had an average litter size of 1.7, Nyanza 1.5 and the Rift Valley 1.6. This suggests that in terms of doe efficiency, the surveyed areas were capable of producing one marketable unit per year. The overall pre-weaning mortality rate was 26% with that in Rift Valley being quite high at 31% while Coast had the lowest at 16% and Nyanza 26% (Table 4.14). This high mortality could be an indication of inadequate nutrition or negligence in taking care of kids. However there, was an irregular spread of lambing and milk harvesting and this could be an indication of poor reproductory management.

Table 4.14. Kidding and pre-weaning mortality rate of the dairy goat

	Province			
Parameter	Coast	Nyanza	Rift valley	Total
Kidding rate (%)	1.7	1. 5	1. 6	1.5
Pre-weaning mortality at 0-4 months (%)	16.0	26.0	31.0	26.0
Survival 0-4 months (%)	84.0	74.0	69.0	74.0

Source: Field survey, May 2007

4.1.4. Livestock credit programme

Of the goats introduced, out of 108 farmers only 22.3% sold them and 21.3% made any "pass-on". It can be surmised that there was a limited net expansion of numbers, which may not be able to generate a significant future impact on the projects during the period under review. This raises questions as to the farmers' ability to achieve the expected levels of "pass-on". At the current rate of "pass-on" as a proxy for repayment, performance through "pass-on" will be low. Low repayment cum "pass-on" can be as a result of poor reproductive performance because of stress and inadequate husbandry,

farmers not understanding the credit system and poor supervision. Low performance parameters for the goat highlights the potential for achieving significant gains in livestock output. There was evidence of inadequate supervision of the beneficiaries due to inadequate follow up to ensure repayment was achieved. This could be as a result of inadequate personnel or whether the program was more intent on implementation and less on support of the overall project. Consequently, the credit system operated without an effective credit supervisory or policing mechanism.

4.2. ECONOMIC VIABILITY OF DAIRY GOAT ENTERPRISES

This section presents results of the economic viability analysis in the short- and long-term of dairy goat enterprises in the surveyed areas. The purpose was to:

Establish the overall performance (viable or not in the short- or long-term) of the enterprise through GM and NM analysis.

Determine the contribution the dairy goat makes to the total household income across agro-climatic zones.

Provide variables for more in-depth econometric analyses.

Identify factors that constraint dairy goat production through the analysis. An analysis of a farm's internal capabilities and resources can identify its strengths and weaknesses. Analysis of the economic landscape within which the farm operates can illuminate opportunities or threats to its viability.

4.2.1 Enterprise viability

Table 4.15 below sets out the economic performance of the dairy goat enterprise across the three provinces. Analysis using ANOVA indicated the GMs across the different provinces showed significant differences ($P<0.01$) when GMs were calculated inclusive of roughage costs, and no significant differences when roughage costs were excluded. This may imply that fodder cost may affect GM overall. Critical difference revealed significant differences between Nyanza and the other two provinces. The Coast and the Rift Valley however did not differ significantly.

Table 4.15. Average economic performance of the dairy goat enterprise in the three provinces

PARAMETER	Province			All provinces combined
	Coast	Nyanza	Rift Valley	
REVENUE				
Milk sales/Home consumption	4,649.00a	8,490.70ab	3,435.90b	6,651.00
Stock sales	2,180.60	4,176.40	3,964.90	3,866.80
Manure value	1,560.60a	1,119.90 a,b	1,393.30b	1,248.90
sub-total 1 (Total Revenue)	8,390.20	13,787.00	8,794.10	11,766.70
COSTS				
Feed expenditure				
Natural feeds	4,683.60	3,777.80b	5,305.00b	4,301.30
Concentrates	466.70	1,088.20	423.20	831.40
Minerals	241.70a	507.30a,b	223.70b	397.80
Labour	2,006.20	2,027.80	1,931.4	1,999.30
Veterinary expenses	1,182.60	1,316.90	1,577.50	1,369.60
Sub-total 2	8,580.80	8,718.00	9,460.80	8,899.40
GROSS MARGIN				
Inclusive of roughage cost	-190.5a	5,068.90a,b	-666.80b	2,867.30
Exclusive of roughage cost	4,493.10	8,846.70	4,638.30	7,168.60
Fixed cost				
Depreciation and interest on stall	661.10	1,490.60	1,328.90	1,342.200
Depreciation and interest on equipment	79.20	79.20	144.60	96.70
Sub- total 3	740.30	1,569.90	1,473.60	1,438.90
NET MARGIN				
Inclusive of roughage cost	-930.80	3,499.10	-2,140.30	1,428.40
exclusive of roughage cost	3,752.80	7,276.90	3,164.70	5,729.70

Source: Field survey , May 2007.

a significant differences between the Coast and Nyanza provinces($p<0.01$).

b significant differences between the Nyanza and Rift Valley provinces ($p< 0.01$)

The study established that overall, the goat enterprise was viable both in the short- and long-term when all the provinces were considered as a single group. Individually, two provinces namely the Coast and the Rift valley were not viable. The GMs for most farmers were positive; out of 71 farms, 39 had positive GMs. However, GMs for some farms were disappointing, given the high genetic potential of the goats. The GMs varied from Kshs. -4,675 to 24,745 in the Coast with a mean of Kshs -190, Kshs -6810 to 33,837 in Nyanza with a mean of Kshs 5068 and - Kshs 7,491 to 15,930 with a mean of Kshs -667 in the Rift Valley.

The GMs varied from Kshs. -4,675 to 24,745 in the Coast with a mean of Kshs -190, Kshs -6810 to 33,837 in Nyanza with a mean of Kshs 5068 and - Kshs 7,491 to 15,930 with a mean of Kshs -667 in the Rift Valley. The goat enterprise was averagely not viable in the Coast province where 6 out of 9 farms were not viable and in the Rift Valley with 11 farmers out of 19 posting losses. The NMs for the Coast province varied from Kshs-5,584.5 to 5,890 with a mean of Kshs -930; Nyanza Kshs.-9,842.63 to 30,038.13 with a mean of Kshs 3499 and the Rift Valley Kshs.-10548 to 15137 with a mean of Kshs -2140. Of the farms which had negative NMs, 6 were found in the Coast, 18 in Nyanza and 13 in the Rift Valley.

In total, 34 farms were viable, indicating that 5 farms that had positive GMs became unviable enterprises on allocation of some fixed costs. On average, the NMs were positive when all the provinces were considered as a group but, individually, only Nyanza province had an average positive NM.

Table 4.16. Average economic performance of the dairy goat enterprise segregated by farmers obtaining positive and those with negative gross margins

	Gross Margin	
PARAMETER	Positive	Negative
REVENUE		
Milk sales/Home consumption	9580.24[a]	1310.06[a]
Stock sales	6565.24[a]	3080.98[a]
Manure value	1198.74	578.13
***Total* Revenue**	17344.21[a]	4969.17[a]
COSTS		
Feed expenditure		
Natural feeds	4185.26	4442.77
Concentrates	815.95	850.3125
Minerals	449.05	335.25
Labour	2057.75[a]	1927.97[a]
Veterinary expenses	1388.28	1346.89
Sub-total 2	8896.29	8903.19
GROSS MARGIN		
Inclusive of roughage cost	8447.93[a]	-3934.02[a]
exclusive of roughage cost	12633.18[a]	508.75[a]
Fixed cost		
Depreciation and interest on stall	1204.27	1510.31
Depreciation and interest on equipment	101.22	91.27
Sub- total 3	1305.49	1601.58
NET MARGIN		
Inclusive of roughage cost	7142.44[a]	-5535.60[a]
exclusive of roughage cost	11327.69[a]	1092.83[a]

Source: Field survey, May 2007

a - significant differences between those having positive gross margins and those with negative gross margins ($P<0.01$).

Table 4.16 above presents the average economic performance of the dairy goat enterprise segregated by all farmers getting positive and those getting negative GMs. The average margins for farmers obtaining positive GMs was Kshs 8447 while those getting negative GMs got Kshs-3934 Comparison of the GMs between those obtaining positive GMs and those who got negative GMs using t-test showed significant differences at ($P<0.01$) with or without fodder costs. There were significant differences between those with positive NMs and those with negative NMs.

4.2.2. Enterprise costs

The overall total variable cost made up of the sum of veterinary, labour, feed cost and mineral cost. Comparison of the provinces and of those who got positive and negative margins was carried out in order to examine the impact of cost items on the dairy goat enterprise across regions. The results are presented under the headings of feed cost, veterinary cost and labour costs.

Feed costs

Feed costs are made up of natural feeds cost, cost of concentrates and those of mineral salts. Feed costs are calculated using actual cost of purchased feed or hay equivalent, depending on the situation. Crop residues are considered as substitutes to natural pasture hay. Results showed that, on average, feed costs accounted for 62% (Table 4.15) of the total variable cost. Németh *et al.* (2004) when studying factors affecting different goat farms in Hungary, also found that feed costs made the largest contribution to overall costs. Feed cost analysis using ANOVA revealed significant differences between the provinces at ($P<0.01$). Further analysis using critical difference revealed that feed costs were significantly different between Nyanza and the Rift Valley ($P<0.01$).

Table 4.17. Level of production to feed cost

	Province		
Parameter	Rift Valley	Coast	Nyanza
Average milk production (A)	281.1	365.6	321.6
Average selling price milk (KES) (B)	19.7	16.7	34.3
Value of product (A×B)= (C)	4861.2	6369.4	10952.3
Average cost of feed (KES) (D)	5728.2	5150.3	3313.3
Return above feeds (KES) (C-D)	-867.0	1219.2	7639.0
Feed cost per litre (D/C)	1.2	0.8	0.3

Source: Field survey, May 2007

There was no significant difference in feed costs between the Coast and Nyanza and between the Coast and Rift Valley. The feed related expenses accounted for 51-70% of the TVC in the Coast with an average of 62%, 27-79% in Nyanza with an average cost of 62% and 44-77% in the Rift Valley with an average of 63%. Table 4.17 above of the level of production to feed cost shows that the average feed cost per litre of milk was least in Nyanza but greatest in the Rift Valley province. The returns above feed cost were more in Nyanza than both the Coast and the Rift Valley provinces. This could be attributed to lower feed costs in Nyanza, coupled with the favorable selling price for milk and overall milk production. For the Coast, the average milk production was higher but the selling price for milk was lower than in the Rift Valley. Returns above feed were more favourable than for the Rift Valley. These suggest that milk production must be complemented with the right price for it to contribute towards cost reduction in the dairy goat enterprise. Feed costs between farmers who got positive and those with an overall negative GM were also compared. Although there are differences in feed costs, these differences were not significant. On average, feed costs for those who had positive GMs were less than those who had negative GMs. The area of land allocated for fodder for the goats was slightly more for those obtaining positive GM than those with negative GM but the difference was not significant. Feed cost could, therefore, be an important factor in the viability of a dairy goat enterprise.

About 48% of the farms sampled supplemented their animals with concentrates, 61% of whom got positive GMs. The cost of concentrates showed wide variation; this was determined by the relative availability which was a function of proximity to relevant markets. However, differences between the provinces were not significant. The same was true for those who got positive GMs and those with negative GMs. About 52% of the farmers did not use concentrates and, of these, 51% got positive GMs.. The use of concentrates was more in Nyanza than both in the Coast and the Rift Valley. Most of these farmers who did not use concentrates offered the goats' sweet potato vines. This may imply that there are plant substitutes with high protein concentrations that could substitute concentrates. The presence of high quality roughage might mean that less of concentrates is needed. Low use of concentrates as a result of cost also favoured feed

intervention using fodder trees and leguminous plants. Comparatively the amount that was spent on natural feeds was less for Nyanza than the other two provinces which spent more on natural feeds and less on concentrates. Dairy goat farmers in Nyanza also spent significantly ($P<0.01$) more on the purchase of mineral salt than those in the Coast and the Rift valley provinces. There was no difference on the cost of mineral use between the Coast and the Rift Valley. There were no significant differences between those who had positive GM and those who got negative in terms of cost of mineral salt. Mineral requirement could possibly be a function of the feed quality, nutritional needs of the goat and, possibly, the financial position of the farmer at any one time.

Chi-square analysis ($P<0.05$) established no association between concentrates and GM. Likewise, there were no significant differences in the GMs between those who used concentrates and those who did not revealed that. This implies that it made no difference whether one used concentrates or not. Low nutritive value of grazing resource and restrictive feeding of dairy meal may be the reason why there was no significant difference between the two feeding regimes. Saving on feed costs through restrictive feeding may lead to the enterprise not maximizing on its potential.

Veterinary costs

Veterinary costs were made up of the sum of actual value of purchased drugs and charges on treatment. On average, veterinary costs in Rift Valley province were higher than that of the Coast and Nyanza provinces. These costs accounted for an average of 16% of the TVC for the sample survey. Cost on a provincial basis accounted for 4-24% of TVC in the Coast, 2-35% in Nyanza and 5-32% in the Rift Valley. Although there was a wide variation of the overall contribution made by veterinary costs to the TVC, there were no significant differences in the costs related to veterinary expenses between the provinces. The overall contribution made by veterinary costs to TVC for those with positive GMs was less compared to those with negative GMs. The differences of their means, however, were not significant. This may be as a result of the variability amongst individuals in veterinary costs

Labour costs

Labour costs were computed from the opportunity costs. They accounted for 21% of the TVC for the sample survey. Labour costs accounted for 15-42% in the Coast, 9-48% in Nyanza and 13-30% in the Rift Valley. In more extensive systems, labour tended to form a larger percentage of the overall total cost than feed costs (Kumar and Deoghare, 2000). Labour cost as a fraction of TVC, showed a lot of variation like all other previous costs. There were no significant differences in labour costs across the provinces. Labour cost may possibly be the same or the time spent by the farmers on goats would likely be similar across the provinces. However, comparison of labour costs between those with positive and negative GMs revealed that the differences were significant. Those with positive GMs spent less on labour cost. A contributing factor could be the fact that those who had positive GMs had larger tracts of land. Those with negative GM had smaller land pieces and may have had to spend more time in seeking for pasture. Labour productivity per man day was low in almost all situations, implying that a dairy goat enterprise may provide supplemental income.

Variable costs

The overall total variable cost made up of the sum of veterinary, labour and feed cost and mineral cost showed a lot of variation. These differences were not significant, which implied that in terms of cost, there were more similarities than differences between the provinces. The differences established were not large enough to influence the overall total costs. Similarly, there were no significant differences in total cost between those with positive and negative GMs were compared. It implied that cost across regions and within those who got positive and negative margins were more or less similar.

4.2.3 Enterprise revenue

The overall total revenue was made up of the sum of sale of milk, sales of stock and manure. Comparison of the provinces and of those who got positive and negative margins was carried out in order to examine the impact of revenue items on the dairy goat

enterprise across regions. The results are presented under the headings of milk revenue, stock revenue and manure value.

Milk revenue

Milk sales represented 56% of the total revenue. Therefore, the production objective of the dairy goat from revenue seems to be milk production. Across the provinces this was true at least for the Coast and Nyanza; however, for the Rift Valley, milk and stock sales almost made similar contribution to revenue. This may have implications for the way animals were managed. Milk revenue was calculated in terms of opportunity cost of milk produced. There were differences of revenue across the provinces in sale of milk ($P<0.01$). Generally, milk revenue from dairy goat milk in Nyanza was greater than in the Coast and the Rift Valley. Further analysis revealed that these differences were significant between Nyanza and the other two provinces of Coast and Rift valley at ($P<0.01$). No significant difference was established between the Coast and Rift Valley. With respect to revenue from milk There were significant differences in revenue ($P<0.01$) between those who had positive and those with negative GMs,. It was also observed that those closer to urban settings where demand for milk was higher had more opportunities of attracting better milk prices with more consistent demand.

Revenue from stock sales

Stock sales represented 33% of the total revenue. Stock sales did not show any significant differences across the provinces. There were, however, significant differences in revenue ($P<0.01$) on stock sales between those who had positive GMs and those with negative GMs. Those with positive GMs attracted better prices on sale of stock.

Manure

Manure value represented 11% of the total revenue. Significant differences were found on manure value between Nyanza and the other two provinces ($P<0.01$). The value of manure in the Coast and the Rift Valley were significantly higher than that of Nyanza. The Coast and the Rift Valley did not differ significantly on manure value. This implied

that location factors contributed towards some observed differences in manure revenue between Nyanza and either the Coast or the Rift valley. The Coast and the Rift Valley were similar in almost all respects. No significant differences were observed for manure revenue between those having positive and negative GMs.

Total revenue

Total revenue was made up of revenue from milk, stock and the value of manure. As there were no major differences in total revenue between the provinces, it can be surmised that the differences in manure and milk revenue were not major to bring about differences on the overall revenue across the provinces. Differences between regions cancelled each other out. There were significant differences on total revenue between those enterprises getting positive GMs and those with negative GM. The differences between individual revenue items contributed to the differences in revenue.

4.2.4. Enterprise viability indicators

Table 4.18 below presents the dairy goat GM viability indicators across the three provinces. Nyanza had the highest GM per goat and per ha. It also recorded the highest returns to investment, showing that it tended to be more economically efficient; of 43 farms, 28 farms were viable. The average return to investment cost as a whole was about 10% per each invested shilling. This seemed low but was better than what is offered by most banks of an interest of 1-3%. However, given the cost of borrowing of between 16-23%, it would indicate difficulty for the smallholder to instigate instant improvements on the dairy goat enterprise. Gross margins per labour cost were also extremely low. Staal (2002) reckoned that smallholder dairy production will only remain viable as long as wages and opportunity costs remain low for whatever reason.

Table 4.18 Dairy goat enterprise viability indicators across the three provinces

Viability indicators (Kshs.)	Province			
	Coast	Nyanza	Rift Valley	All provinces combined
Average NM/ goat	-930.80	3,499.09	-2,140.34	1,428.39
Average GM/ goat	-190.50	5,068.92	-666.77	2,867.33
Average GM/ ha	-632.65	40,018.35	-6,245.72	22,484.88
Average GM/ variable cost	-0.02	0.65	-0.10	0.36
Average GM/ enterprise cost	0.01	0.17	-0.01	0.10
GM/ feed cost	-0.01	1.17	-0.28	0.63
GM/ man-day	-0.02	2.04	-0.36	1.13

Source: Field survey, May 2007

Table 4.19 below presents the dairy goat GM viability indicators between farmers having positive GMs and those with negative GMs.

Table 4.19. Dairy goat enterprise viability indicators segregated by positive and negative gross margins

Viability Indicators (Kshs.)	Viability indicators of farmers getting Positive GMs and those getting negative GMs	
	Positive GM	Negative GM
Average NM/ goat	7142.44a	-5535.60a
Average GM/ goat	8447.93a	-3934.02a
Average GM/ ha	63491.7	-27492.2
Average GM/ variable cost	1.0	-0.5
Average GM/ enterprise cost	0.29	-0.13
GM/ feed cost	1.80	-0.78
GM/ man-day	4.005858	-2.3665

Source: Field survey, May 2007

The return to investment cost of about 29% per each invested shilling was indicative that, on average, the provinces were only fulfilling a third of their potential. It also provides evidence that given the cost of borrowing of between 16-23%, it was possible for the smallholder to instigate instant improvements on the dairy goat enterprise if they so wished using borrowed credit. Gross margins per labour cost were, however, low.

4.2.5. Milk price analysis at gross margin level

Table 4.20 below shows the milk price analysis per litre at the GM level by making adjustment to the total cost equal to the value of a goat and the manure produced. It had earlier been established that revenue from milk was significantly different between Nyanza province and either the Coast or Rift Valley. Milk revenue was the product of milk production and prevailing market price. An analysis of variance revealed no significant differences in the amount of milk produced across the provinces.

Table 4.20: The milk price analysis per litre at gross margin level (Kshs) for the three provinces

Factor	Province			
	Coast	Nyanza	Rift Valley	Average
Total expenses KES (A)	9,321.00	10,287.89	10,934.4	10,338.34
Income from stock sales and manure KES (B)	3,741.19	5,296.30	5,358.19	5115.73
Margin of income over expenses KES (B-A)	-5,579.8	-4,991.6	-5,576.21	-5,222.61
Average milk production litres (C)	365.63	321.56	281.09	316.32
Cost price of milk D KES = (B-A)/C	-33.06	-27.07	-32.83	-29.37
Sale price of milk KES (E)	16.67a	34.30a,b	19.68b	28.15
Margin of sale price over cost KES (D+E)	-16.40	7.23	-13.14	-1.21

a significant differences between the Coast and Nyanza provinces($p<0.01$).

b significant differences between the Nyanza and Rift Valley provinces ($p< 0.01$)

Methodology adopted from: Haenlein (2002)

When analysis was carried out for milk prices, it established significant differences ($P<0.05$) with respect to milk prices between Nyanza and the other two provinces of the Coast and Rift valley.The survey established that, given income from kids and manure, apart from Nyanza, the Coast and the Rift Valley provinces sold their milk at a loss. In order to break-even at the GM level, there was need for the Coast and the Rift Valley farmers to sell their milk at Kshs. 33 and 32 per litre, respectively. The other alternative would be for the reduction in cost of production or increased income through more sales of kids. One of the reasons why Nyanza province was attaining an overall positive GM was due to the fact that it was getting good prices for its milk compared to either the Coast or the Rift Valley.

Table 4.21 below presents milk price analysis between farmers getting positive and negative GM. It shows that farmers who were obtaining positive GMs were able to recoup most of their costs through stock sales of dairy goats and also make larger profits from sale of milk.

Table 4.21. The milk price analysis per litre at gross margin level (Kshs) between those who got positive GMs and negative GMs

Factor	Gross Margins	
	Positive	Negative
Total expenses KES (A)	10201.78	10504.77
Income from stock sales and manure KES (B)	8472.64	2206.58
Margin of income over expenses KES (B-A)	-1729.14	-8298.19
Average milk production (C)	415.73	195.16
Cost price of milk KES D = (B-A)/C	-3.72	-57.80
Sale price of milk KES (E)	30.18	25.69
Margin of sale price over cost KES (D+E)	26.45	-32.10

Source: Field survey, May 2007.

Those with negative GMs seemed to be disadvantaged by the selling price of their milk. Low income from manure and sale of stock from the said farmers could possibly be as a

result of lack of market for the same, poor husbandry practices leading to high mortality rate and this is possibly so when one considers the amount of milk produced.

4.2.6 Income contribution of small ruminants

Table 4.22 below presents the percentage contribution of livestock, crop and off-farm income to total income. The average net income for the surveyed households was Kshs 115,287 per year. Off-farm income at 53.7% on average was the biggest contributor to income. This was followed by livestock at 31.7% then crops at 14.7%. These findings partly differs from that made by Panin and Mahabile (1997) who found that the net revenue from livestock accounted for the greater share of income but was in agreement that contribution from crops, on average, was small.

Table 4.22. Percentage contribution of livestock, crops and off-farm income to total amount of income in Kshs per province.

Income Source	Province						Total	
	Coast		Rift Valley		Nyanza			
	Amount (Kshs)	% contribution	Amount (Kshs)	% contribution	Amount (Kshs)	% contribution	Amount (Kshs)	% contribution
Livestock	51,736.10	56.1	69,884.21	43.5	18,134.30	18.1	36,242.20	31.7
off-farm income	0.0	0.0	69,157.90	43.0	71,720.90	71.7	61,943.70	53.6
Crops	40,472.20	43.9	21,698.40	13.5	10,178.40	10.2	17,101.30	14.7
Total income	92,208.30	100.0	160,740.50	100.0	100,033.60	100.0	115,287.2	100

Source: Field survey, May 2007.

However, this pattern was not followed when provinces were looked at separately. In the Coast, the biggest contributor was livestock followed by crops, and none of the farmers

surveyed benefited from off-farm income. For the Rift Valley, livestock was the biggest contributor followed by salary and lastly, crops. Salary was the biggest income contributor in Nyanza followed by livestock then crops.

Dairy goats, on the average, gave a contribution of 15.2% to the total livestock income as shown in Table 4.23. This was about three times more than poultry but over three times less than the contribution of dairy cows. Across the provinces, the contribution was highest in Nyanza. The lower contribution in the Coast and the Rift Valley could be as a result of dairy cows being a good alternative. This suggests that it may be more relevant to distribute the goats to those with no complemental livestock.

Table 4.23. Percentage contribution of livestock to total amount of income (Kshs) by type across the three provinces

Factor Income source	Province						Total	
	Coast		Nyanza		Rift Valley			
	Amount (Kshs)	% contribution	Amount (Kshs)	% contribution	Amount (Kshs)	% contribution	Amount (Kshs)	% contribution
Dairy Goats	1,713.90	3.30	7,976.10	44.0	1,720.90	2.50	5,508.40	15.20
Cows	44,833.30	86.70	514.40	2.80	54,813.40	78.40	20,663.00	57.00
Chicken	411.10	0.80	1,491.90	8.20	3,190.50	4.60	1,809.40	5.00
income from other livestock sectors	4,777.80	9.20	8,151.90	45.00	10,159.30	14.50	8,261.40	22.80
Donkeys draft								
Total livestock income	51,736.10	100.00	18,134.30	100.00	69,884.20	100.00	36,242.20	100.00

Source: Field survey, May 2007

Dairy goats contributed 1.1-8 % to the overall household income with the biggest contribution being in Nyanza. On average, goats made an overall contribution of 4.8 % to the household income (Table 4.24)

Table 4.24. Percentage contribution of dairy goat enterprise income to total amount of income (Kshs) across the three provinces.

Factor Income source	Province						Total	
	Coast		Nyanza		Rift Valley			
	Amount (Kshs)	% contribution	Amount (Kshs)	% contribution	Amount (Kshs)	% contribution	Amount (Kshs)	% contribution
Goats	1,713.90	1.90	7,976.10	8.00	1,720.90	1.10	5,508.40	4.80
Total income	92,208.30	100.00	100,033.60	100.0	160,740.50	100.00	115,287.20	100.00

Source: Field survey, May 2007

4.3. FACTORS INFLUENCING VIABILITY OF A GOAT ENTERPRISE.

This section presents the results of the econometric model used in this thesis. The influence of a set of characteristics that affect the probability of dairy goat enterprise viability in the short run was analysed at two levels. A good understanding of the determinants of viability would assist in the design of a dairy goat programme, and draw policy conclusions with respect to the programme.

4.3.1. Descriptive statistics of dependent and explanatory variables

Tables 4.25 and 4.26 below present the descriptive statistics of the dependent and explanatory variables used in the models, respectively.

Table 4.25. Descriptive statistics of the dependent variables for the three provinces

Dependent variable	N	Minimum	Maximum	Mean	Standard deviation
Economic viability short-term	71	0.00	1.00	0.55	0.50
Economic viability long-term	"	"	"	0.48	"

Table 4.26. Descriptive statistics of the independent variables

INDEPENDENT VARIABLE	N	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
AGE	66	27.00	70.00	45.42	10.95
AGE SQUARED	66	729.00	4,900.00	2181.49	1,057.19
ACCESSED EXTENSION	"	1.00	1.00	1.00	0.00
ATTENDED TRAINING	"	0.00	"	0.99	0.12
CARRIED OUT HEALTH MANAGEMENT PRACTICES	"	1.00	"	1.00	0.00
DISTANCE TO MARKETING CENTRE	"	"	"	0.82	0.39
DISTANCE TO VETERINARY CENTRE	"	"	"	0.32	0.42
DISTANCE TO MOTORABLE ROAD	"	1.00	"	1.00	0.00
EDUCATION LEVEL	"	"	16.00	6.28	4.19
EXPERIENCE IN RAISING DAIRY GOATS	69	0.30	9.00	3.21	2.10
FACED MARKETING PROBLEMS					
FAMILY SIZE	"	"	32.00	7.21	4.58
FLOCK SIZE	"	0.00	18.00	3.12	2.27
GENDER OF HOUSEHOLD HEAD	71	0.00	1.00	0.73	0.45
LAND ALLOCATED	"	"	30.00	1.28	3.65
MONTHS IN WHICH ROAD WAS IMPASSABLE	"	0.00	5.50	1.73	1.81
PROVIDED LABOUR	71	0.00	1.00	0.72	0.45
PARTICIPATED ON OF-FARM WORK	"	"	1.00	0.28	0.45
PROVINCIAL DUMMY COAST	"	"	1.00	0.13	0.335
PROVINCIAL DUMMY RIFT VALLEY	"	"	"	0.27	0.446
SUPPLEMENTED FEED	"	"	1.00	0.51	0.50

4.3.2 Determinants of viability at the gross margin level

An economic viability logistic model was used to determine which characteristics influenced viability at the gross margin level. The dependent variable was chosen as 1 if the enterprise was able to get a gross margin of 0 and above and 0 otherwise if it was below 0 . In the logistic regression procedure, the likelihood ratio of the full model including all variables was run. In all cases, the variables related to health management (HLTHMGT), extension visit (EXTVIS), training (ATTRA) and distance to motorable road (DISTMOT) predicted economic viability perfectly and were considered as constants and, therefore, dropped. All the farmers were carrying out health management practices, were being visited by extension officers, had all attended training before

receiving the dairy goats and were near a motorable road within a distance of less than 5 Kilometres. The logit model predicting economic viability from the remaining variables, which included socio-economic factors (age of respondents, gender, education level of farmer, family size, participation in off-farm work and years of experience raising dairy goats) managerial variables (land allocated to livestock and supplementary feeding, carried out health management practices, herd size in numbers labour provided whether family or otherwise, land allocated to livestock and feed supplemented); location variables (distance to the market and distance to the nearest veterinary centre), was statistically significant (Chi-squared=38.51, df=17) ($P<0.01$). The logit model yielded an acceptable fit, being able to predict 78.9% of the observations correctly. It also correctly predicted 75% of the farmers who were not economically viable and 82% who were viable as seen in Table 4.27 below, which shows the frequencies of actual and predicted outcomes.

Table 4.27. Frequencies of actual and predicted outcomes of the logit regression model at the gross margin level

Frequencies		Predicted		
		0	1	Total
Actual	0	24	8	32
	1	7	32	39
	Total	31	40	71

From the 17 predicted variables, 7 were significant as follows; 3 ($P<0.05$), 2 ($P<0.05$) and 2 ($P<0.01$).This is shown in table 4.28 below which presents logit model estimates for the probability of viability when gross margin is used.

Age, gender, education and distance to the market had a negative impact on economic viability while family size, distance to veterinary centre and labour provided had a positive impact. Not all variables entered the model with the expected sign. For instance, education of the farmer (EDUC) exhibited a negative sign yet it was expected to be positive, implying that educated people were less likely to attain economic viability than the less educated. Higher education level in the case of dairy goat farming did not, therefore, translate to more modern husbandry practices. This is perhaps because the

more educated, by virtue of their learned status, have more opportunities available to them. It could also imply that they engaged in other activities that did not give them time to concentrate on the dairy goat enterprise. This is in agreement with the findings of Ahmadu *et al.* (2000) who found an inverse relationship between education and adoption of better goat production practices; the fairly educated did not give much attention to goat rearing. Distance to the veterinary centre (DISVET) exhibited a positive sign yet it was expected to be negative. This is surprising it is possible that those further away exercised a higher degree of care as limited access to routine medication and prophylaxis may force the farmers to focus on improved husbandry and, therefore, improve the overall quality of life of the stock. Improved management practices, included slatted floors, zero-grazing and once-a-year vaccinations against PPR with TCRV that reduced cases of the disease. It may also be that goats did not suffer from diseases frequently and, consequently, were suitable for the small-scale farmers who tended to be risk averse.

Table 4.28 Binary Logit model estimates for the probability of viability at the gross margin level n = 71).

Variable	Coefficient	Standard Error	T ratio	P[|Z|>z]	Mean of X
Constant	3.53	2.45	1.44	0.15	
AGE	-0.07	0.03	-2.68***	0.01	49.20
AGESQRE	-0.00	0.00	-0.79	0.43	2034.83
DITMKT	-3.52	1.82	-1.94*	0.05	0.82
DISVET	5.08	1.95	2.61***	0.01	0.32
EDUC	-0.33	0.15	-2.21**	0.03	6.28
FECOLE	0.38	0.91	0.42	0.68	0.51
FLSIZE	0.18	0.34	0.53	0.60	3.12
FMLSIZE	0.31	0.15	2.08**	0.04	7.21
GEND	-2.62	1.13	-2.32 **	0.02	0.73
HHPROCC	0.32	0.81	0.40	0.70	0.28
LAPRO	2.17	1.11	1.95*	0.05	0.72
LNDOW	0.65	0.43	1.49	0.14	1.27
MKTPRB	-0.16	1.09	-0.15	0.88	0.13
MNTHIMP	0.71	0.47	1.50	0.13	1.73
NYXPD	-0.03	0.08	-0.40	0.69	5.91
PROVCO	-0.71	1.74	-0.41	0.68	0.13
PROVRIFT	-0.31	1.58	-0.20	0.84	0.27

Log likelihood function -29.60791; Restricted log likelihood -48.86782; Model df=17, Chi-squared = 38.51981*.
***, **, *, Indicate that the coefficients are statistically different from 0 at the 1, 5, and 10% levels, respectively.

It may also be that goats did not suffer from diseases frequently and, consequently, were suitable for the small-scale farmers who tended to be risk averse. Age of the respondent in years (AGE) was found to be negatively correlated to economic viability, meaning that as one aged chances of enterprise viability decreased. Aggelopoulos *et al.* (2007) found younger farmers to have a positive correlation with farm viability. Tasks such as cutting napier grass may become even more difficult with age. Gender (GEND) variable was a dummy (1=male; 0=female), and indicated that women were more likely to attain economic viability than men. This was mainly in reference to the fact that female headed households performed better on economic viability with dairy goats than male headed households. This was expected given that women tended to spent most of their time within their compounds tending to the goats and on other household chores. As such, they were keener in taking care of the goats given that the goats were confined on their compounds. The men on the other hand seemed to give more priority to the large stock.

Distance to the market (DITMKT) was negatively correlated to economic viability. Those near the market were more competitive or receive competitive prices compared to those further away. This was expected in that the further the market the more difficult to sell milk or the more costly. The marketing of raw milk and surplus stock was considered difficult and time consuming by most of the farmers, especially against the backdrop of poor infrastructure, low technology level, lack of an organized market and absence of market information. The farmers were, therefore, not in a position to recognize and appreciate the market opportunities and exploit them. In the absence of market information, the farmers also lacked the motivation to explore newer and better options for marketing. Family size (FMLSIZE) and hiring of labour (LAPRO) were positively associated with economic viability, showing that availability of labour improved the chances that an enterprise would be economically viable.

4.3.3 Determinants of economic viability at the net margin level

A logit model was again used to determine factors influencing viability. In this case, however, some fixed costs were allocated to the gross margin and this resulted in the Net Margin. The logit model predicting economic viability was then run under the foregoing

considerations. The socio-economic variables in the model were; age of respondents, gender, education level of farmer, family size, participation in off-farm work and years of experience raising dairy goats. The managerial variables were; land allocated to livestock, provision of supplementary feeds, carried out health management practices, flock size in numbers, labour provided whether family or otherwise. The location variables included distance to the market, whether household faced marketing problems, distance to the nearest veterinary centre and months in which the road was impassable. The model was statistically significant (Chi-squared=45.01, df=17) ($P<0.001$). All variables taken together may influence viability whereas each individual variable may not be significant by itself. The logit model yielded an acceptable fit and was able to correctly explain 83% of the results as shown in Table 4.29, which shows the frequencies of actual and predicted outcomes.

Table 4.29. Frequencies of actual and predicted outcomes of the logit regression model at the net margin level

Frequencies		Predicted		
		0	1	TOTAL
Actual	0	32	5	37
	1	7	27	34
	Total	39	32	71

Table 4.30 below presents the logit model estimates for the probability of economic viability at the net margin level (n = 71). From the 17 predicted variables, 8 were significant as follows; 2 ($P<0.10$) and 6 ($P<0.05$). Age, gender, education and distance to the market had negative impacts on viability at the net margin level. Family size, distance to veterinary centre, labour provided and months in which the roads were impassable had a positive effect on viability at the net margin level.

Table 4.30. Logit model estimates for the probability of economic viability at the net nargin levels. (n = 71).

Variable	Coefficient	Standard Error	T ratio	P[|Z|>z]	Mean of X
Constant	4.89	2.83	1.73	0.08	
AGE	-0.08	0.03	-2.48**	0.01	49.20
AGESQRE	-0.00	0.00	-1.09	0.28	2034.83
DITMKT	-10.11	5.02	-2.01**	0.04	0.82
DISVET	12.23	5.29	2.31**	0.02	0.32
EDUC	-0.48	0.20	-2.44**	0.02	6.28
FECOLE	0.75	0.96	0.78	0.51	0.44
FLSIZE	-0.09	0.33	-0.26	0.80	3.12
FMLSIZE	0.34	0.16	2.07**	0.04	7.21
GEND	-3.01	1.19	-2.54**	0.01	0.73
HHPROCC	0.76	0.91	0.84	0.40	0.28
LAPRO	2.17	1.25	1.73*	0.08	0.72
LNDOW	0.63	0.51	1.22	0.22	1.28
MKTPRB	-0.59	1.31	-0.45	0.65	0.13
MNTHIMP	2.15	1.17	1.83*	0.07	1.73
NYXPD	0.06	0.07	0.85	0.39	5.91
PROVCO	1.00	2.03	0.49	0.62	0.13
PROVRIFT	1.33	2.01	0.66	0.51	0.27

*Log likelihood function -26.64492, Restricted log likelihood -49.15005, Chi-squared 45.01027*** , Degrees of freedom 17, Significance level 0.2426521E-03.* ***, **, *, Indicates that the coefficients are statistically different from 0 at the 1, 5, and 10% levels, respectively.

The variables that were significant at the gross margin level were equally significant at the net margin level with one addition; months in which the road was impassable was positively associated with economic viability. Bad roads could negatively impact on the delivery of both processed milk and raw milk. Unavailability of processed milk or raw milk from other areas would result in increased demand for raw milk, which could favour dairy goat farmers.

CHAPTER FIVE

CONCLUSIONS, RECOMMENDATIONS AND RESEARCH ISSUES

This section presents the conclusions from the study, recommendations and research issues.

5.1. Conclusions

The current study established the following main conclusions:-

The dairy goat enterprise on the whole was viable and may increase revenues, broaden the income base of smallholder farmers, create employment opportunities and provide food security. There was adequate demonstration to a role in sustainable development in different agro-ecological zones by the fact that even where the overall GM and NM was negative there were farmers with positive GM or NM. Policy makers and extension personnel can, therefore, encourage farmers to adopt the enterprise across regions.

Variations existed in the economic performance of the goats across agro-climatic zones on consideration of feed costs and milk price. Because of the higher percentage to total costs, feeds costs strongly influenced the gross and net margins. Caution is, however, required with the use of opportunity costs for the valuation of fodder for farms that may make decisions on the enterprise using production cost of fodder, which tended to be lower. The enterprise was not doing well in the Coast and the Rift Valley provinces. This was traced to low milk sale value, attributable to lack of organized marketing and competition from cows' milk. More labour time directed towards the activity could translate to higher returns, possibly due to fewer disease incidences and better feeding of the goats.

Categorization of farmers into those having positive and those with negative gross margins revealed that farmers had still not fulfilled their potential. Cost factors with respect to depreciation could not be considered due to lack of reliable data on the productive lifetime of the goats, resulting in further reduction of the gross and net margins.

It is important to note of partial adoption or application of certain technologies or practices possibly due to a low capital base or revenue. This is exemplified in the use of concentrates and possibly mineral salts and drugs. Additionally, complications possibly

brought upon by incompatibility with normal practice whereby managing dairy goats involved regular deworming spraying and management of fodder through weeding fertilization, harvesting while no management is provided to local goats may have further contributed to affecting productivity.

The study also identified a set of characteristics that influenced the economic viability of the dairy goat breeding programme in the short term using gross margin and net margin. Results from the logit model indicated these factors to include age, gender, education and distance to the market, and all had a negative effect on economic viability of the breeding programme. Family size, distance to veterinary centre, labour provided and months in which the road was impassable had a positive effect. Besides the latter, the variables that were significant at the level of gross margin were equally significant when net margin was used with one exception. That is, months in which the motorable road was not passable. Regression analysis returned expected signs on all but education and distance to the veterinary centre.

5.2. Recommendations

Dairy goat farming is an activity that can generate income, create employment opportunities and provide food security. This can only happen if a conducive environment was established and farmers were to exploit the potential of the exotic animal. In order to improve on performance and output of dairy goat production as livestock development strategy the following recommendations are made;-

Exploitation of contrasts and the complementary roles of different areas within a region (integrated development) should be enhanced to increase the overall productivity from the region. For example Nyanza was a milk deficit area and pressure of land limited raising of large stock. The success of dairy goat promotion was attributed to better milk prices. Areas where dairy goat milk supplemented cows milk received low prices. Alternatively, these areas may be used breeding or as multiplication zones to provide goats for land challenged areas.

Strengthen extension component possibly through a policy enacted by the government given that most farmers were not fully exploiting the potential of the dairy goats and also

assist farmers who were not viable such as establishment of technical special teams to help farmers through specialized courses. Special extension and rural education programs should cover, farm organization, financial management, marketing aspects application of recommended practices coupled with farm demonstrations that incorporate research institutions organized to provide farmers more opportunity to learn about dairy goats. Integration of rural extension services among extension providers may assist in avoiding duplication and wasting resources as well as addressing linkages. Constant training of the farmers, and monitoring and evaluation of the breeding programme are required to guide and entrench introduced technologies.

Use of appropriate messages and technologies based on the understanding of the farmer's objectives, options, constraints and commensurate with the farmer's resource and management capacity

Enhance group meetings to exchange ideas which can assist in diffusion of successful practices.

The situation of producers in the country needs to be assessed against other livestock production sectors. Experiences from existing support regimes in other countries are required to help guide the local dairy goat sector.

Achieve efficiency by linking production and post production components to efficient services and marketing schemes. One way of establishing this is by initiating the development of an organization of producer and marketing groups that will encourage distribution and marketing of dairy products and goats.

Government support for fair commodity prices and towards the establishment of an effective integration of market from primary producer to final consumer as well as develop standards that guide the industry. This suggests that the most effective and sustainable means of helping the sector lie in developing the market, communicating with consumers, highlighting the nutritional and health benefits of the products concerned and boosting consumption

Further research is necessary on labour studies to understand the time spent by individuals in carrying out specific tasks and whether it has an impact on productivity by extension gross margin. There is also need to carry out research on the productive lifetime of dairy goats. Additionally research should be carried out on how

socioeconomic characteristics and production orientation of the systems relate to the sociological and information seeking characteristics of the farmers. These aspects may play a substantial role in determining the management intensity under which the systems operate. There is need to research on alternative technologies that may be cheaper to adopt especially for those technologies that involve cost on consideration of agro-ecological zones.

It maybe important to link activity to gender, age and location with respect to markets.

Develop crossbreds between local and exotic goats which may be a solution to the prevailing environmental, nutritional, production and management constraints.

Overall, the success of the breeding programme will depend on the response of the farmers to the rising demand for the goats and their products through improved management practices. Dairy goat breeding programme for poverty alleviation should, therefore, be to ensure success, and. Furthermore, to enhance success of a dairy goat breeding programme, labour, markets,.

5.3. Research issues

Future research should explore the following areas :-

1. Relationship of socioeconomic factors and the economic viability in the long term.
2. There is need to carry out a comparative study between the dairy cow and the dairy goat.
3. Investigate the technical efficiency of the dairy goat enterprise

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APPENDIX

QUESTIONNAIRE - DAIRY GOAT PROJECT.

Heifer International/Egerton University Kenya Collaborative project

DEPARTMENT OF AGRICULTURE ECONOMICS AND AGRIBUSINESS MANAGEMENT, MSc THESIS PROJECT

TITLE: ECONOMIC VIABILITY AND CONTRIBUTION OF DAIRY GOATS TO IMPROVED LIVELIHOODS

CONFIDENTIAL: The questionnaire is being administered for the purpose of research and for the benefit of all stakeholders concerned. Your participation in answering these questions will be much appreciated You are free to refuse to answer questions or withdraw from participation at any point. Confidentiality will be strictly adhered to.

	NAME (please write)	Code No	
Province name		**PROV**	
District name		**DIS**	
Division name		**DIV**	
Location name		**LOC**	
Sub-Location name		**SUBLOC**	
Agro-Ecological zone		**AGROECO**	
Farmer Group		**GRP**	
GPS code		**GPS**	
Household (HH) Number		**HHID**	
HH-name			
Respondent's name			
Date	...../...../2007		
Enumerator's name		**ENUM**	

HHID_____

Q1. Household demographics

ID	Name (start with that of the household head) (NAME)	Age (AGE)	Sex 1=M 2=F (SEX)	Relationship to head (RELA) See code below	Marital status 1=single 2=monogamuosly married 3=polygamously married 4=divorced 5=widowed 6=separated 7=other (MSTAT)	Is this person in school 1=yes 2=No (SCH)	Level of schooling 1=primary 2=secondary 3=college 4=none (LSCH)	Did this person engage in any business or informal, or formal labour activities during the past 12 months(inclusive of jua kali, Farm kibaruas 1=Yes 2=No	What form of occupation were they involved in. See code below. (OCCUP)
MEM	Name	DO1	DO2	D03	DO4	D05	DO6	DO7	DO8

Relation to Head (DO3)

1 = household head	5 = parent
2 = spouse	6 = other related adult
3 = child	7 = other related child
4 = unrelated adult	8 = unrelated child

Primary occupation (DO8)

1 = crop farmer	6 = occasional work	11 = livestock farmer	16 = mining
2 = horticultural farmer	7 = sewing or knitting	12 = fish farmer	17 = beer brewing
3 = salaried employment	8 = grass weaving	13 = self- employed (business)	18 = pottery
4 = school	9 = fisherman	14 = cattle herder	19 = too old
5 = looking for work	10 = household chores	15 = petty trading (hawker)	20 = other, specify

HHID_____

Q2: Composition and area of farming unit

a) Land owned by you and farmed by yourself.

Arable (acres)…….. ☐

Grazing (acres)…….. ☐

b) Land owned by you and rented or leased out.

Arable (acres)…….. ☐

Grazing (acres)…….. ☐

c) Land not owned by you but on which you farm.

Arable (acres)…….. ☐

Grazing (acres)…….. ☐

Common resource (acres) ☐

Q3:Ownership of farm implements ,machinery and household assets

Implement	Number	Value	Year bought	Hired (h) or borrowed (b)
shovel				
jembe				
wheel barrow				
axes				
Cart				
Car				
water trough				
water pump				
water tank				
zero grazing unit				
bore hole				
spray pumps				
grass cutters				
sickles				
ploughs				
buckets				
animal crush				
others (specify)				

HHID_____

Q4: Animals, animal products, other products sold and gross farm income

Animal (ANIMAL)	Number on farm (NANIM)	Did you sell any of this type of animal over the past 12 months? 1=yes 2=No (SELLANIM)	Number sold to abattoirs during the year	Number sold elsewhere during the year	Gross farm income
Dairy cow					
Beef cow					
Sheep					
Dairy goats					
Meat goats					
Donkeys					
Pigs					
Chicken					
Rabbits					
Other (specify)					
				Total	

HHID_____

Q5 Livestock products

Livestock products (ANIMPROD)	Did you produce any of these products over the last 12 months? 1=yes 2=no (NPROD)	Did you sell any of these products over the last 12 months? 1=yes 2=no (SELLPROD)	Quantity consumed at home (value) (CONPROD)	Quantity sold (kg, ,litres, dozen) (QSOLD)	Gross farm income
Dairycow milk products					
Dairycow value added products					
Dairygoat milk products					
Dairygoat value added products					
Hidesand skins					
Chicken eggs					
Honey					
Other(specify)					
				Total	

HHID_____

Q6: Current expenditure in respect of this farming unit incurred in connection with farming operations during the financial year

a) Full time employees

Salaries, cash wages and bonuses (FSAL) ☐

Cost price of payment in kind (FPINKIND) ☐

b) Casual and part-time workers

Salaries, cash wages and bonuses (CSAL) ☐

Cost price of payment in kind (CPINKIND) ☐

c) Have you had any difficulty finding people to work on your farm (LABDIFF)? yes (Y) or no (N) ☐

d) In which months of the year did you hire most labour to work on your farm? (January =01)(WHENLAB)? ☐

e) Use of hired labour

Activity	Family man days	Hired man days	Cost per day

f) Other current expenditures

Source of feeds: own (O) or purchased (P) (FSOURCE) ☐

g)feeds purchased

Dairy goats (concentrates) COCOST ☐

Others (Napier) FECOST ☐

h) Is water purchased? yes(Y)/no(N) WPURCH ☐

i) How much do you pay? (WCOST) ☐

j) Remedies purchased (LRCOST) ☐

k) Dips (Acaricides) (ACACOST) ☐

l) Dosing remedies (dewormers) (DOSINGCOST) ☐

m) Disinfectants (DCOST) ☐

n) Vaccines (VACOST) ☐

o) Veterinary charges (VECOST) ☐

p) Amount paid for transportation of the products to the market ☐

q) Amount paid for maintenance and repair of buildings ☐

r) Amount paid for maintenance and repair of implements ☐

s) Rates paid to regional services and other local authorities. ☐

t) Depreciation provided for during the financial year ☐

u) Other current expenditure ☐

Total current expenditure ☐

v) Have you been forced to switch or change enterprises because of the cost? ☐

w) Have you been forced to switch or change enterprises because of lack of market? yes (Y) or no (N) ☐

HHID_____

Q7a: Agriculture activities

Crop (CROP)		Planted area	Did you purchase any seeds? 1=yes 2=no	What was the cost of the seeds purchased?	Did you apply any fertilizer to this crop during harvest? 1=yes 2=No	What was the cost of fertilizer applied ?	Did this crop sustain any damage from pests, or weather, or disease or any other problem? 1=yes 2=no	Did you apply chemicals, and what was the cost?	Did you completely lose this crop from any field during harvest? 1=yes 2=no	How much did you harvest? See code below for crops harvested		How many bags did you sell?	Gross farming income
CROP				SEEDPURCH	FERT	COSTFERT	DAMAGE	CHEMCOST	LOSE	HARVEST		BAGSELL	CASHCTP
Maize	1												
Green maize	2												
Beans	3												
Sorghum	4												
Cassava	5												
Other (specify)	6												
	7												

Code for crops harvested

1=90 kg bag	5 = numbers
2=50 kg bag	6 = debe
3=kgs	7 = gorogoro
4 = crates	8 = tons

Q7b: Current expenditure for crops not included in the above table

i) Amount paid for plant and health remedies (PRCOST) ☐	b..... ☐
ii) Others, (please indicate below)	c..... ☐
a..... ☐	d..... ☐

HHID

Q8: Other sources of income (estimated amount)

a) Salaried employment (SEMPLOY)

b) Business (BUSIN)

c) Petty trading (PTRAD)

d) Occasional work (OWORK)

Q9) **Dairy goat farming evolution**

a) How did you learn about HPIK in general and the dairy goats? (tick)

Word of mouth	
Radio or TV	
Farming magazines or newspaper	
Others, (explain).....	

b) When did you first attend a HPIK /dairy goat group meeting? (tick)

At the set up meeting	
After the set up meeting	

c) For how long have you been a member? (years)

d) Have you attended group meetings regularly since then? (tick)

Yes, all or most	
Only some	
Hardly any/ none	
Attended regularly then stopped	

e) For how long have you raised goats

	Years	Reasons for raising
Exotic		
Crossbreed		
Native		

1=cash: 2=milk: 3=meat: 4=breeding; 5=insurance: 6=financing: 7=social roles

f) Please tick those activities you have participated in and specify how many years ago it was?

	Tick	Years ago
Farm and other visits		
Animal husbandry		
Animal health		
Animal recording		

g) Have you been able to make practical use of the skills and information you have learned? 1=yes: 2=no

If so, give examples.

h) If not is there a particular reason? see codes 1=cannot afford; 2=not appropriate; 3=not interested; 4=same as what I have been using; 5=too demanding of my time; 6=did not understand

i) Are you a member of any farming co-operative? 1=Yes: 2=no

j) In general, which farmers around would you normally discuss things? 1=farmers adjacent; 2=farmers with a similar farming system; 3=farmers who are also friends; 4=farmers in the same group; 5=others (specify).....

k) If you need advice about aspects of goat farming whom do you talk to? 1=Extension officer; 2=HPIK officer/NGO; 3=other goat farmers; 4=market; 5=Veterinary officer; 6=field days/shows/demonstrations; 7=traders of agricultural inputs; 8=no one, is difficult to get advice; 9=other, (specify).....

l) Where do you usually meet with other farmers or extension agent? 1=own fields; 2=other farmers fields; 3=Extension office; 4=designated fields; 5=other, (specify).....

m) How do you get there? 1=foot; 2=bicycle; 3=public transport; 4=others(specify)

n) What is the distance; time to get there and cost?

Distance	Time	Cost

HHID

i)

Can you recall what attracted you to the HPIK or dairy goat scheme? (tick)	Have those expectations been met yes (Y) or no (N) and P if in part
To obtain cash	
To obtain food (milk or meat)	
It was a new technology	
Fits in well with my other activities	
To obtain manure	
Did not take too much land	
Other (specify)	

j) Has the HPIK/Dairy goat project changed your participation in your farm business and management? Please tick the most appropriate comment or write in your own comment, or both

Not a lot- but I understand what is going on much better now	
Not a lot- I already knew about much of what we have studied	
Not a lot- it really did not relate to my farm	
Not a lot-(please write your own comment)	
Very much-It was all relevant and I am able to use it directly	
Very much-(please write your own comment)	
What have you found not useful, uninteresting or boring about HPIK group activities?	
How could these be improved?	

k) Give important problems that you are facing with your goats?

[ ] 1=takes too much time; 2=takes too much land; 3=lack of extension advice; 4=it is too difficult; 5=problems with market; 6=prone to diseases; 7=not profitable; 8=too expensive to maintain; 9=others (specify)

.....

.....

Q10. Feeding and health management

a) How often are the goats fed? Tick

Once a day	Twice a day	Three times a day	Other (specify)

b) What feeds are used? 1=Napier; 2=other pasture; 3=legumes; [ ] 4=concentrates; 5=twigs

c) Are the given feeds whole or chopped? [ ]

d) Who in the household decides the feeding of the goats? Tick

Owner	Spouse	Children	Other (specify)

e) Who in the household actually does the feeding?

Owner	Spouse	Children	Other (specify)

f) What food are the goats given during seasons: (See codes for guidance)

Rainy season	Dry season	When dry (not in milk)	In milk

1=Napier; 2=grass; 3=fodder trees; 4=fodder crops; 5=concentrates; 6=twigs; 7=other (specify).....

g) During gestation, do you think that;
1=grass or supplementation should be fed;
2=nothing extra needs to be fed; 3=no opinion

h) Reasons for not using improved pasture?
1=very difficult to grow;
2=too few goats;
3=insufficient grazing area; 4=sufficient native grass

i) Reasons for not feeding legumes?
1 =very difficult to grow;
2=too few goats; 3=insufficient grazing area; 4=lack of time;5=difficult to grow

j) Reasons for not feeding concentrates?
1=considered not necessary;
2=lack of knowledge; 3=cause diarrhoea; 4=too expensive; 5=lack of market for milk means there is no need to purchase it

k) Do you deworm, dip or spray, vaccinate provide minerals; If no, what is the reason for not doing it (see codes below the table); If yes, how regularly do you do it?

	Yes(Y)/or No (N)	Reason (see codes)	How many times in a year ?
Deworm			
Spray			
Vaccinate			
Mineral salt			

Codes for reasons: 1=not necessary 'goats in good health'; 2=drugs are not available; 3=lack of knowledge of proper use; 4=use native knowledge; 5=drugs are expensive

l)For good management, is deworming, vaccination, mineral salts and spraying necessary? 1=necessary; 2=not necessary; 3=no opinion

Deworm	Vaccinate	Spray	Minerals

Q11a) When you started goat farming, for how many months did you milk the goats?

b) What was the average production per day?

c) In the last milking session, for how many months did you milk the goat?

Goat 1	Goat 2	Goat 3

d) What was the average production per day?

Goat 1	Goat 2	Goat 3

e) Which parity order were the goats in?

Goat 1	Goat 2	Goat 3

f) What is their stage of lactation in months?

Goat 1	Goat 2	Goat 3

g) If dry, what was its length of lactation?

Goat 1	Goat 2	Goat 3

h) Did you sell the milk? 1=yes; 2=no

i) How much did you sell (in litres)?

j) At what price do you sell milk? (Kshs)

Season	Goats	Cows
Dry		
Wet		

k) Where did the transaction take place? What was the distance to the place of disposal? What mode of transport was used? What was the cost of transportation?

	Farm	Market	Other (specify)
Tick			
Distance			
Mode			
Cost			

Codes for mode of transport:
=head load; 2=bicycle; 3=motorcycle; 4=hand cart/donkey/oxen; 5=motor vehicle

l) Intervals at which payments are received?

Monthly	Weekly	Daily	Other (specify)

m) To whom do you sell the milk?
1=friends/neighbours; 2=hawkers; 3=other people in the area; 4=institution; 5=co-operative society; 6=others (specify).....

n) Mode of payment?

Cash	In-kind	Others (specify)

HHID

o) In feeding kids, which system do you use and the quantity fed? 1=hand-feeding; 2=bucket fed

System	Quantity (litres)

p) How much did you consume (litres)?

Goat 1	Goat 2	Goat 3

q) Was there any value addition of milk to mala or ghee? yes(Y) or no(N)

r) How much was set apart for home use (litres)?

Goat 1	Goat 2	Goat 3

s) How much was set apart for sale of the value added product?

Goat 1	Goat 2	Goat 3

t) What was the price of sale of value added product?

	Goat 1	Goat 2	Goat 3
Dry season			
Wet season			

u) What is the major reason for selling goat milk?
1=when I have a surplus; 2=when I need money; 3=because I do not consume it; 4=others (specify).....
.....
.....

v) To whom do you sell the value added milk?

1=friends/neighbours; 2=hawkers; 3=other people in the area; 4=middlemen; 5=others (specify).....
.....
.....

w) Is it difficult to sell milk?

1=yes, people do not like goats milk; 2=yes, people do not have money to buy; 3=everybody is producing the same product: 4= there are other cheaper alternatives; 5=other (specify).....

x) Do you ever exchange milk for labour or goods? 1=yes; 2=no

z) What do you normally exchange milk for?
1=labour; 2=vegetables; 3=grains;
4=other (specify).....
.....

aa) Whom in the household drinks milk? use codes below;
1=everybody; 2=except old people
3=adults only; 4=household head only; 5=no one;
6=other (specify).....
.....

ab) If you do not consume goats milk, what are the reasons?
1=do not like taste; 2=religious reasons; 3=cultural reasons; 4=allergic; 5=smell; 6=other (specify)
.....

ac) Preparation: If you drink the milk, do you take it ?
1=raw; 2=boiled first; 3=both

ae) Are you drinking more or less milk than you did before?
1=more; 2=less

af) What are the reasons for the choice made above?
1=do not like the taste; 2=religious reasons: 3=cultural reasons; 4=allergy; 5=smell; 6=like taste; 7=promotes health; 8=quality is better than other alternatives; 9=other (specify).....

ag) How much additional milk do you purchase per day?
Quantity Price

ah) What are the reasons?
1=short supply;
2=not allowed to hawk milk anymore;
3=price of milk went down relative to other milk sources; 4=price of milk went up;
5=increased milk production; 6=other (specify).....

ai) Who usually milks the goat?
1=husband; 2=wife; 3=children;
4=worker; 5=neighbor; 6=other (specify)

aj) Place of milking?
1=stall; 2=common milking shed; 3=consumer's door

Ak) How many times do you milk your goats? 1=once; 2=twice; 3=thrice

Al) Is the milk obtained from the dairy goats sufficient for your needs currently?
1=yes; 2= no

Am) If no, do you purchase additional milk to supplement home consumption?
1=yes ; 2= no

Q12a) In the year under review, how many of the does were served?

b) Of those does that were served, how many kidded?

c)? During the last year, how many of your goats kidded

d) How many kids were born in total including those born dead?

	Goat 1	Goat 2	Goat 3
Male			
Fenal e			

e) How many kids were born dead?

	Goat 1	Goat 2	Goat 3
Male			
Fenale			

f) How many of the kids died before four months were over of those that survived?

	Goat 1	Goat 2	Goat 3
Male			
Female			

g) How many died after four months were over?

	Goat 1	Goat 2	Goat 3
Male			
Female			

h) Do you know the cause of death?(specify)
.....
.....
.....

i) What was the age at first service?

	Goat 1	Goat 2
Age		

j) How many goats left the farm through sale?

k) How many goats left the farm through a ''pass–on''?

l) Were they male or female (tick): "Pass-on" or sale (tick): Age sold (years or months): What price were they sold for (value)?

	Goat 1	Goat 2	Goat 3
Male			
Female			
Pass-on			
Sale			
Age at sale			
Price			

m) To whom did you sell the goats?
1=friends/neighbours; 2=hawkers;
3= other people in the area; 4= middlemen; 5= others (specify).....

n) Where was the point of sale?(tick)

	farm	market	Other (specify)
Distance			
Mode			
Cost			

codes for mode of transport:
1=head load; 2=bicycle; 3=motorcycle; 4=hand cart/donkey/oxen; 5=motor vehicle

o) In order of importance if you want to have more milk, what strategy do you think should be taken?
1=try to increase the production of one goat;2=try to increase the number of goats;3=improve health and extension services;4=improve on feeding;5=have better markets

Ak) How many times do you milk your goats? 1=once; 2=twice; 3=thrice

Al) Is the milk obtained from the dairy goats sufficient for your needs currently?
1=yes; 2= no

Am) If no, do you purchase additional milk to supplement home consumption?
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	Goat 1	Goat 2	Goat 3
Male			
Fenal e			

e) How many kids were born dead?

	Goat 1	Goat 2	Goat 3
Male			
Fenale			

f) How many of the kids died before four months were over of those that survived?

	Goat 1	Goat 2	Goat 3
Male			
Female			

g) How many died after four months were over?

	Goat 1	Goat 2	Goat 3
Male			
Female			

h) Do you know the cause of death?(specify)
.....
.....
.....

i) What was the age at first service?

	Goat 1	Goat 2
Age		

j) How many goats left the farm through sale?

k) How many goats left the farm through a ``pass–on''?

l) Were they male or female (tick): "Pass-on" or sale (tick): Age sold (years or months): What price were they sold for (value)?

	Goat 1	Goat 2	Goat 3
Male			
Female			
Pass-on			
Sale			
Age at sale			
Price			

m) To whom did you sell the goats?
1=friends/neighbours; 2=hawkers;
3= other people in the area; 4= middlemen; 5= others (specify).....

n) Where was the point of sale?(tick)

	farm	market	Other (specify)
Distance			
Mode			
Cost			

codes for mode of transport:
1=head load; 2=bicycle; 3=motorcycle; 4=hand cart/donkey/oxen; 5=motor vehicle

o) In order of importance if you want to have more milk, what strategy do you think should be taken?
1=try to increase the production of one goat;2=try to increase the number of goats;3=improve health and extension services;4=improve on feeding;5=have better markets

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Q13a: Do you select animals for breeding?
1=yes ;2=no

b) If not, what reasons do you have for not selecting?.....
.....

c) With goat selection, it is recommended to select only;1=goats in good health; 2= all goats, even with defects

d) For buck selection, it is recommended to use?
1=within a flock;
2=outside a flock

e) At what age should female or male kids be mated? Specify in the appropriate box

	Female	Male
Less than one year		
More than one year		
Any time when in season		

f) Do you cull?
1=Yes;2= No

g) What are the reasons for culling?
1=poor performance;
2=temperament;3=health;
4=old age; 5=poor fertility; 6=size;7=other specify

h) Is construction of shelter necessary
1=necessary; 2=not necessary; 3=no opinion

i) What is your source of water?

1=borehole; 2=dam/pond; 3=river; 4=water well; 5=spring; 6=municipal/piped; 7=rain; 8=other specify

j) What is the distance to the watering point?

1=at household; 2=1-5km; 3=greater than 5km

Approximately how many minutes/hours do you take to get there?

Q14;Animal waste management

a)Type of waste? 1=manure; 2=slurry

b) Estimated production? Fills a wheelbarrow after how many days

	Manure	Slurry
Days		

c) Waste destination?
1=fodder plot; 2=farm; 3=sale

d) Do you buy 1=more fertilizer ; 2=the same quantity ; 3=less as a result of the dairy goat enterprise?

e) How many bags were you purchasing before you joined the dairy goat enterprise and at what price?

Bags Price

f) How many bags are you buying now and at what price?

Bags Price

Q15: Distance to nearest service and amenities

Amenity	Distance
Veterinary centre	
Market for agro-vet	
Market for animal products	
Primary school	
Secondary school	
Health centre	
Public transport route/Motorable road	
Post office	

Codes; 1=0≤5 km; 2=over 5 km

HHID

Q16:On farm decision making

The following examples illustrate three types of farm related decisions

STRATEGIC: changing cereal crops to horticulture: Increasing grazing area.

MANAGEMENT: Changing feed ration during the season; buying new convenient food ration in bulk; selecting similar crops or fodder within an establishment.

OPERATIONAL: Deciding to dry a goat based on its milk yield; disposing of a goat; selecting the crop variety according to the weather pattern. (Tick as appropriate)

Persons involved	Strategic	Management	Operational
Farmer			
Spouse			
Other members			

Q17: The future

a) What would you say are your objectives for the next 5 years? 1=maximizing profit; 2=carrying on as usual; 3=being a progressive farmer; 4=other (specify)

.....

.....

.....

b) Do you have any firm plans to change the following in the next five years (1=yes; 2=no and in what way?

	Change	Way
Farm size		
Goat enterprise		
Labour organization		

Dairy goat production practices in Kenya: Implications for a breeding programme

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Abstract

Smallholder dairy goat farming in Kenya is increasingly being promoted by development organizations and policy makers as an option to boost incomes of farmers and to improve rural livelihoods. Heifer Project International-Kenya (HPIK), a non-governmental organization, initiated a dairy goat breeding programme in 1994 in three different agro-ecological zones in Kenya. However, production practices influencing the sustainability of the breeding programme have hardly been studied. The present study aimed to document dairy goat management practices in order to better understand the potentials and constraints of the dairy goat breeding programme. A total of 108 beneficiaries of the HPIK dairy goat project were interviewed in the Coast, Nyanza and the Rift Valley provinces using a set of pre-tested structured and semi-structured questionnaires. Information on socio-economic characteristics and management practices of the farmers were collected. Results are presented in the form of descriptive statistics, and chi-square and t- tests done where appropriate to establish the statistical significance or otherwise of observations. Income generation and milk were ranked top as reasons for keeping dairy goats. Good management practices were evident, but high variation was found in feeding, health management and general husbandry practices, and this affected the overall performance of the breeding programme. Average milk production at 1.9 litres per day was lower than or closer to that of crossbred goats. Twinning rate was favourable (51%) but mortality was relatively high (26%). Constraints were related to insufficient resources (e.g., land, feed and finances) and the external market rather than lack of technical

information. For sustainability of dairy goat breeding programmes targeting poverty alleviation, the initiative should be commensurate with the farmer's capacity to ensure success, i.e., appropriate messages and technologies based on the understanding of the farmer's production objectives, options and constraints.

Key words: pass-on, Heifer Project International-Kenya, community-based, output efficiency, sustainability

Economic contribution and viability of dairy goats: implications for a breeding programme

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Abstract

To augment the incomes of smallholder farmers in Kenya and, consequently improve their nutrition and income, many development organizations and policy makers are increasingly promoting dairy goat farming. Among the key organizations supporting the initiative is Heifer Project International-Kenya (HPIK). However, the economic contribution and viability of dairy goats under the HPIK project have not been studied. The aim of the present study was to determine the contribution of dairy goats to household income, and the performance of the dairy goat enterprise using gross and net margins from dairy goat farming as an indicator of economic viability. A survey covering 71 farmers was carried out in the Coast, Nyanza and the Rift Valley provinces of Kenya using a set of pre-tested structured and semi-structured questionnaires. Results showed that, on average, the dairy goat enterprise contributed, correspondingly, about 15.2% and 4.8% to the total livestock and overall household income, and was viable. Differences in gross and net margins across agro-ecological zones were attributed to milk prices. Despite the existence of non-viable enterprises in two of the provinces, the few present suggest the possibility of obtaining reliable incomes from the enterprise. Redoubling of effort or re-orientation of production to match the local and external requirements would, however, be necessary. Costs and revenues were similar across the agro-ecological zones. Farmers with positive gross margins had better milk and stock sales and vice-versa. The success of a dairy goat enterprise is attributed to location and good management. Besides, farmers' awareness of the market demands within and outside the community is

important in establishing production goals, and may be crucial to achieving a positive gross margin.

Keywords Dairy goats · economic contribution · economic viability · smallholder · Kenya

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