SOCIO-ECONOMIC AND TECHNOLOGY TRANSFER FACTORS INFLUENCING ADOPTION OF DAIRY GOATS AMONG SMALLHOLDER FARMERS IN SOME DISTRICTS IN KENYA

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A Research Thesis Submitted to the Graduate School in Partial Fulfilment of the Requirements for the Award of Master of Science Degree in Agricultural Extension of Egerton University

EULIB 030 939

2012/89121

EGERTON UNIVERSITY

OCTOBER, 2010

DECLARATION AND RECOMMENDATION

DECLARATION

I declare that this is my original work and that it has not been presented in this or any other form for the award of a degree in this or any other University.

Mary Mwaura
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Date 25/10/2010

RECOMMENDATION

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ACKNOWLEDGMENT

I am thankful to the Ministry of Agriculture for granting me study leave to pursue my postgraduate education. I am greatly indebted to my supervisors, Prof. S. A. Abdulrazak, and Dr. D. M. Amudavi for working patiently with me to the completion of this study. I am also thankful to Egerton University through the Division of Research and Extension for providing funds to carry out the research.

I am grateful to the Faculty of Education and Community Studies, Department of Agricultural Education and Extension and Dr Chegge Mungai for their contribution in various ways that have shaped this study. I also give special thanks to all those who contributed in various ways during data collection, especially staff of MoA, MoLD, DGAK, MGBA and Farm-Africa and all farmers in Nakuru North, Muranga North and Meru Central districts where the research was carried out. Last but not least, I am thankful to my parents, Samuel and Elizabeth Mwaura, brothers, Joseph and John Peter and sisters, Jacinta and Margaret for their consistent encouragement.

GOD BLESS YOU ALL.

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DEDICATION

To God, for He Has made this possible.

To my lovely twin sons, Sammy and Steve, for their love, inspiration, patience and understanding during my long study period.

To my late brother, Andrew, and sister, Jane, who passed on during the course of this study.

ABSTRACT

Kenya's development challenges have been unemployment, poverty, food insecurity, and slow economic growth. Such challenges require adoption of productive and sustainable technologies exemplified in the improved dairy goat technologies. In spite of more than twenty years of research for an appropriate dairy goat breed, adoption of improved dairy goats among smallholder farmers in Kenya has been low. The purpose of this study was to investigate how socio-economic and technology transfer factors influenced the adoption of dairy goats among smallholder farmers in Nakuru North, Murang'a North, and Meru Central districts of Kenya. The study utilized a descriptive survey method of *ex-post facto* approach. The population consisted of all smallholder farmers in the three districts. Purposive, cluster and stratified random sampling methods were used to select a sample of 150 farmers and all the extension workers in the area of study. Data were collected using structured and unstructured questionnaires and analyzed using qualitative and quantitative methods. Descriptive methods of percentiles and frequencies, and inferential statistics of multiple regression analysis were applied to analyse the data using Statistical Package for Social Sciences (SPSS) and inferences tested at 0.05 level of significance.

Results indicated that a combination of socio-economic and technology transfer factors contributed about 37% towards adoption of dairy goats. However, socio-economic factors singly contributed 30%, and technology transfer factors contributed 5% only. Among the socio-economic factors, income, gender and time spent on dairy goat activities and among the technology transfer factors, use of mass media, were found to be positive and most influential and significant statistical factors influencing farmers' adoption of dairy goats. However, individual methods of extension and secondary level of education were found to negatively influence adoption. These findings will be helpful to the improvements of the dairy goat project designs by control and prediction of socio-economic and technology transfer factors in order to improve adoption. The findings will also assist policy makers, project designers', researchers and extension agents on project design, development, implementation, monitoring and evaluation strategies of dairy goat projects in Kenya.

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LIST OF ABBREVIATIONS AND ACRONYMS

ATIRI	Agricultural Technology and Information Response Initiative
CDN	Catholic Diocese of Nakuru
CIAT	International Centre for Tropical Agriculture
DG	Dairy goats
DGAK	Dairy Goat Association of Kenya
GoK	Government of Kenya
GTZ	German Technical Cooperation
HH	Household Head
ICT	Information Communication and Technology
ISLP	Integrated Small Livestock Project
KARI	Kenya Agricultural Research Institute
KDPG	Kenya Dual Purpose Goat
MDG	Millennium Development Goals
MGBA	Meru Goat Breeders Association
MoA	Ministry of Agriculture
MoALD	Ministry of Agriculture and Livestock Development.
MoLD	Ministry of Livestock Development
NALEP	National Agriculture and Livestock Extension Programme
PAES	Promotion of Agricultural Extension Services
PSDA	Private Sector Development in Agriculture
SADCC	Southern African Development Coordination Conference
SR-CRSP	Small Ruminant Collaborative Research Support Programme
TT	Technology Transfer

CHAPTER ONE
INTRODUCTION

1.1 Background Information

One of the most important means of accelerating National development in agricultural-based economies is the development, adaptation and evaluation of new agricultural innovations (Kuper and Kuper, 1996). According to Boyle (1981), technologies have been the focus of social scientists because of their potential impacts on society and they have the capacity to determine the course of development of a country. This is because the technologies promote economic and cultural advancement and save on resources. Kenya's economy and social development challenges are unemployment, poverty, food insecurity and slow economic growth among others, Ministry of Agriculture (MoA, 2004). Food and Agriculture Organisation (FAO, 1999) stipulates that poverty afflicts 56% of the Kenyan population and that Kenya is among other countries in Africa whose percentage of undernourished persons is high, greater than 35%.

According to the Government of Kenya (GoK, 2001a) some of the major factors contributing to food insecurity include food policies that focus on production at the expense of quality and access of both fresh and preserved foods, inadequate research and dissemination of technological innovations, weak farmers' institutions as well as poor linkages and coordination within the institutions. In Kenya, agriculture plays a significant role in the national economy and there is a direct relationship between its performance and overall economic growth (MOA, 2004). According to Ruthuku (2007), agriculture contributes 53% of Gross Domestic Product (GDP) directly and indirectly through crop development as well as linkages with manufacturing, distribution and other service related sectors. It also provides 59% of total export earnings and employment to over 70% of the country's population.

Kenya Agricultural Research Institute (KARI) has recognized the important role that dairy goats play and as an integral part of the small ruminants, prioritised it as number three (3) in about fifty-nine (59) commodities and factor research programmes (Wandera *et al.*, 2000). However, despite the over twenty years, that have been spent on dairy goat research, adoption remains low for farmers to feel the impact of this research effort (Wandera *et al.*, 2000). According to the Department for International Development (DFID, 2004), FARM-Africa and KARI carried out a research in Central Kenya on community based goat

productivity improvement. The results indicated that the breeding programmes failed because projects were designed and implemented without the beneficiaries' input.

Information gaps suggested for research at a workshop on dairy goats organized in the year 2000 in Machakos, Kenya included low dairy goat technology uptake, lack of dairy goat database, low nutrition levels and food insecurity (Wandera, Okwach and Njarui, 2000). In line with embracing the Millennium Development Goals (MDG), which includes eradicating extreme poverty and hunger (GoK, 2008), there is need for effective adoption of dairy goat technologies. Dairy goats can result in higher incomes, lower real prices of agricultural products for consumers, and enhance greater economic efficiency and growth in the national economy (Swanson, 1984). Dairy goat milk production per goat currently ranges from 1-3 litres per day, while the potential ranges from 3-4 litres per day. Achieving full potential of dairy goats requires an understanding of how and why farmers make long-term land-use decisions and applying this knowledge to the design, development and marketing of dairy goat technologies (Mercer, 2004). Poverty alleviation and food insecurity are among the major socio-economic problems, which must be urgently addressed due to their negative impact on people's quality of life (Kiome, 2003).

The livestock industry plays a major role in the economic development of Kenya. The industry contributes an estimate of 10% of the GDP and accounts for over 30% of farm-gate value of agricultural sector commodities (Ruthuku, 2007). The industry also employs about 50% of the total agricultural labour force directly and indirectly (Ruthuku, 2007). The sheep and goat industry plays an important role in the economic and social life of many Kenyans. Nationally, goats and sheep contribute about 30% of the total red meat and other products such as milk, wool, skins and manure (Smith *et al.*, 2004). The population of dairy goats in Kenya by 2001 were estimated to be 90, 826 of a total sheep and goat population of 19 million (Smith *et al.*, 2004). Of the total land area of Kenya, about 80% is arid and semi-arid (ASAL) rangeland supporting production of red meat as the major enterprise in ASAL areas, with milk produced for subsistence (Ahuya and Hellen, 1997). These figures translate to a 0.48% of dairy goats among shoats, indicating a very low uptake of dairy goats in Kenya.

In Nakuru North District Ministry of Livestock Development (MoLD), Dairy Goat Association of Kenya (DGAK) and Farming Systems-Kenya (FSK) have mainly supported dairy goat production. MoLD has mainly been involved in the formation and training of dairy

goat groups through the National Agriculture and Livestock Programme (NALEP). DGAK has been involved with the registration and provision of breeding stock, while FSK has been involved with trainings and provision of breeding stock. FSK sources its breeding stock from Eastern and Central Provinces of Kenya and have it multiplied in Nakuru North by the farmers in the FSK breeding programme. Kenya Agricultural Research Institute-Agricultural Information and Response Initiative (KARI-ATIRI) projects in collaboration with MoLD have also supported groups in the district with breeding bucks through FSK. An evaluation done by FSK in Nakuru found that the dairy goat enterprise adoption in the groups stood at 57% in 2004 (FSK, 2004).

The promotion of dairy goats in Muranga North was initiated by Integrated Small Livestock Projects (ISLP) and implemented by MoLD with assistance from German Technical Corporation (GTZ) between 1992-1997 (Wandera *et al.*, 2000). Upgrading scheme of the local goats was vigorously promoted using German Alpine bucks through groups to produce the Kenya Alpine dairy goat with a minimum blood level of 87.5%. To date, dairy goat promotion in the region is carried out by DGAK, Promotion of Agricultural Extension Services (PAES) and MoLD.

Dairy goat production in Meru Central and Tharaka Nithi Districts was supported by FARM-Africa, a British Non Governmental Organization in 1996 (Maigua, 2004). The project introduced the British Toggenburg dairy goats in farmer groups. The methodology included a buck given to a group to crossbreed with their local goats. Selected farmer groups were given four females and one male goat to carry out pure breeding (Ahuya and Hellen, 1997). Farm-Africa in conjunction with MoLD assisted small- scale dairy farmers to produce crossbred Toggenburg in order to ensure sustainability through continuous availability of suitable breeding stock particularly bucks (Smith *et al.*, 2004). Farmers in these areas have been assisted to form the Meru Goat Breeders Association (MGBA).

1.2 Statement of the Problem

In spite of the several years of research on developing an appropriate dairy goat breed, with potential for economic improvements and enhanced food security among smallholder farmers, adoption of the improved dairy goat in the three districts being studied has remained low. Several factors appear to influence the adoption of dairy goats by the farmer. In particular, the influence of socio-economic and technology transfer factors have not been

fully understood by stakeholders in this livestock enterprise. An understanding of these factors in relation to programme design, development and implementation will improve the adoption of dairy goats among smallholder farmers in selected districts of Kenya.

1.3 Purpose of the Study

The purpose of this study was to investigate how socio-economic and technology transfer factors influence the adoption of dairy goat technologies among smallholder farmers in some districts of Kenya.

1.4 Objectives of the Study

Based on the purpose of the study the following specific objectives were postulated:

1. Describe the characteristics of dairy goat farmers in Nakuru North, Murang'a North, and Meru Central districts of Kenya.
2. Characterize dairy goat technologies promoted to farmers in Nakuru North, Murang'a North, and Meru Central districts of Kenya.
3. Assess the influence of farmers' socio-economic factors on adoption of dairy goat technologies among smallholder farmers in Nakuru North, Murang'a North, and Meru Central districts of Kenya.
4. Examine the influence of technology transfer factors on adoption of dairy goat technologies among smallholder farmers in Nakuru North, Murang'a North, and Meru Central districts of Kenya.
5. Explore the Influence of the combined socio-economic and technology transfer factors on adoption of dairy goats Nakuru North, Murang'a North, and Meru Central districts of Kenya.

1.5 Hypotheses

Based on the above objectives, the following three hypotheses were postulated and tested:

HO_1 There is no significant statistical influence of farmers' socio-economic factors on adoption of dairy goat technologies among smallholder farmers in Nakuru North, Murang'a North, and Meru Central districts of Kenya.

HO_2 There is no significant statistical influence of technology transfer factors on adoption of dairy goat technologies among smallholder farmers in selected districts of Kenya.

HO_3 There is no significant statistical influence of farmers' socio-economic and technology transfer factors on adoption of dairy goat technologies among smallholder farmers in Nakuru North, Murang'a North, and Meru Central districts of Kenya.

1.6 Significance of the Study

The study was designed to determine the influence of socio-economic and technology transfer factors on adoption of dairy goats among smallholder farmers in Nakuru North, Murang'a North, and Meru Central districts of Kenya. The study findings will contribute towards enhancing strategies to improve the design, development, implementation, monitoring and evaluation of dairy goat projects in Kenya. They will also be useful to policy makers to create an enabling environment to dairy goat farmers, extension workers in using suitable extension methods to reach the dairy goat farmers and researchers while researching for suitable dairy goat technologies in their endeavour to address the challenges in improved adoption of dairy goats. Ultimately, this will contribute to increased food security and improved standards of living of the smallholder farmers.

1.7 Scope of the Study

The study was designed to investigate the influence of socio-economic and technology transfer factors on adoption of dairy goats among smallholder farmers in Nakuru North, Murang'a North, and Meru Central districts of Kenya. Socio-economic factors were limited to age of Household Head (HH), gender of HH, level of education of HH, average farm income and labour availability on the farm. Technology transfer factors were limited to Technology Transfer (TT) channels and approaches used by extension agents' and their qualifications and experiences, and sources of information.

1.8 Assumptions

1 That the dairy goat breeds available were the most appropriate for the smallholder farmers.

2 That the respondents gave correct information meaningful for analysis and hypotheses testing.

3 That the moderator variables affected all farmers equally because of similarities in experience with institutional factors, micro/macroclimate and similar socio-cultural and personal characteristics.

1.9 Limitation

The generalizations of this study were limited to areas of similar characteristics with those of the study areas.

1.10 Definitions of Key Terms

Adoption: Is the decision, to make full use of a new idea as the best course of action available (Rogers, 1995). In this study adoption was defined as the decision to adopt the dairy goat and all the eight extension packages in the study.

Diffusion: Is the process by which an innovation is communicated through certain channels over time among the members of a social system (Rogers, 1995). In this study diffusion was be defined as communicating the dairy goat and the extension packages through mass media methods, group methods and individual methods to the farmers.

Innovation: Is a practice, idea or an object that is perceived as being new by individuals (Van den Ban, 1996). In this study, innovation represented the improved dairy goat and the packages that are perceived as being new to the farmers.

Smallholder: Kenya smallholders are defined as farmers owning 0.2-12 hectares and this definition was maintained in this study (GoK, 2005) .

Socio-economic factors: These are variables that relate to innovativeness of a farmer and include personal and socio-cultural characteristics (Rogers, 1995) for the purposes of this study they included age, gender, level of education of household head, labour availability and average annual income of the farm.

Technology transfer (TT): This is helping to convey information in such a way that (a) it fulfils a particular need of the client, and (b) it can be effectively applied by the client to his or her own situation (Blackburn, 1989). This definition was maintained in this study and the TT factors were TT agents, TT channels, TT approaches and information sources.

Technology: Is the transformation of scientific laws into machines, tools, mechanical devices, instruments, innovations, procedures and techniques to accomplish tangible ends (Rogers, 1995). In this study, technology referred to the adoption of the dairy goat and the dairy goat technologies, which range from kid rearing, housing, nutrition, records keeping, health, breeding, husbandry and milking.

Others are the TT factors will be TT agents, TT channels, TT approaches and information sources.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter reviews the economic importance of dairy goats, its nutritional values, challenges and opportunities. The chapter also reviews the global and African situation of dairy goats and the influence of socio-economic and technology transfer factors on adoption of technological agricultural innovations. An adopted theoretical framework and a conceptual framework have been used to provide a contextual setting of the independent variables and the dependent variables.

2.2 The Economic Importance of Dairy Goats in Kenya

With increasing population pressure, land size continues to decrease forcing farmers to consider alternative options in farming. Intensification and switching to enterprises that do not require large resource input base become more attractive (Wandera *et al.*, 2000). In this respect, dairy goat technologies have potential to offer farmers, without resource base for cattle, an opportunity to provide milk and other products to their families and contribute to food self sufficiency. The technology is suitable in many areas of the country such as Western Kenya, Central highlands and parts of the Rift Valley

Decrease in available land for grazing due to increasing human population and land sub-divisions, competition from other enterprises and conflict in resource allocation between livestock production-enterprises and food crop production are challenges in farming options. This has eliminated livestock production (especially the big stock) from small farms in the very densely populated areas of the country such as Western Province, Nyanza Province, Central Province and Taita Taveta District in Coast Province and some parts of Eastern province (Ahuya and Hellen, 1997). This is in spite of the farmer and their families in these areas still needing livestock products, particularly milk. A comparison of the average composition of dairy goat milk is as shown in Table 2.

Table 1: Average Composition of Goat, Cow and Human Milk

Species	Water %	Fat %	Sugar %	Protein %	Ash %	Total Solids %
Goat	85.2	4.9	5.1	4.0	0.8	14.8
Cow	86.0	4.7	4.8	5.8	0.7	14.0
Human	87.4	3.0	6.5	1.7	0.3	12.6

Source: Kaberia *et al.* (2003).

The information in table 2 indicates that dairy goat milk is more nutritious than cow or human milk since it has more solids and less water. Goat milk differs from cow and human milk in its higher digestibility, distinct alkalinity and higher buffering capacity, and certain therapeutic values (hypo-allegenicity) in medicine and human nutrition (Park, 2005). Farmers are aware of the importance of the high nutritional status of the goat milk especially to vulnerable groups and HIV/AIDS patients (Mwangi and Mosota, 2006). However the rates and levels of adoption of dairy goats still remains low. The dairy goat sector has potential for increased employment creation and income generation if its modernization is intensified through the use of appropriate technological packages, proper management, improved infrastructure, inputs access and efficient marketing (Mugunieri and Omiti, 2004).

Kenya has two indigenous goat breeds, the East African goat and the Galla breed. There are six popular exotic breeds of dairy goats, the Saanen, Anglo Nubian, Alpine, Toggenburg, LaMancha and Oberhasii. The dairy goat packages which need to be practiced by a dairy goat farmer range from kid rearing, housing, nutrition, records keeping, health, breeding, husbandry practices and milking, (Kaberia et al., 2003).

2.3 The Global Livestock Situation

According to Ehim *et al.* (2003), the consumption of meat and milk in developing countries will grow by 2.8 and 3.3% per year respectively between the early 1990 and 2020. Correspondingly, the growth rates in the developed world will be 0.6 and 0.2% per year, respectively. By 2020, developing countries will consume 100 million-tones more meat and 223 million tones more milk than they did in 1993, dwarfing developed countries' increase by 18 million tones in both meat and milk. This indicates a potential growing market for animal products in the developing countries. More people drink goat milk than milk of any other single species in the world (Park, 2005). Despite the prevailing potential for growing

markets for livestock producers, there are still concerns that the smallholder producers might not be able to benefit from the livestock revolutions unless specific policy actions are taken (Park, 2005).

According to the Food and Agricultural Organization (FAO) of the United Nations, the world goat population has grown by about 13%, and about 94% of the world's goats are located in the developing countries providing about 99% of the global supply of goat meat and 75% of global goat milk (Ehim *et al.*, 2003). These proportions indicate a sizable and valuable contribution of goats to the supply of high quality protein for people who have limited access to balanced diets. Despite their low milk production, goats contribute significantly to the economy and food supply and the demand for their products exceeds their availability (Ehim *et al.*, 2003). Improving the performance of goats and other small ruminants can directly improve the diet of many people, largely because these animals are inherently suited to the needs of smallholders and pastoralists in the developing countries (Semenye, 1992).

2.4 The African Situation

Of the developing world, the African continent has 17% of cattle and 26% of the small ruminant population (Lebbie, 2004). These percentages change to 11% and 17% respectively when compared with world populations. There are 161 million cattle and 264 million small ruminants in Africa. Sheep represent 46% and goats 54% of the small ruminant population. In addition, there is a population of 12 million camels, 12 million equines, 10 million pigs and some 460 million chickens. Sub-Saharan Africa (SSA) accounts for over 60% of the total goat population in Africa with an estimated population of 147 million goats (Lebbie, 2004). In terms of productivity, the developing countries have 64% of the small ruminant population and produce 54% of global meat.

In the Southern African region, the Southern African Development Coordination Conference (SADCC) suggested four strategic elements to increase smallholders' livestock production in member states (Kyomo, 2006). These are to: (a) strengthen national and regional capacity to develop and transfer technology needed to assist smallholders; (b) increase national capacity within the region to recruit, train and retrain professionals required in research, extension and training; (c) develop and strengthen use of a systems approach to agricultural research, extension and training for programmes that focus on smallholder

problems and solutions; and (d) upgrade national capacity to conduct agricultural policy research and analysis.

In recent years, several trends have led to an increased interest in intensive goat system among smallholder farmers in the highlands of Eastern Africa as shown in Table 1.

Table 2: Trends Leading to Increased Interest in Intensive Goat Development System in East Africa.

Trend	Implications
a) Land fragmentation	Farms are getting smaller as they are divided for each new generation inheriting land.
b) Retrenchment of staff	Government services are being reduced, including the supply of services such as veterinary and artificial insemination and extension services.
c) Privatization	Private services are developing in high potential areas only.
d) Marginalization	Cultivation of marginalized areas is increasing and communal grazing areas are being lost.
e) Impoverishment	There is an increase in absolute and relative poverty leading to increased food insecurity.
f) Insecurity	There is an increase in livestock raiding, especially cattle raiding.

Source: Adopted from Ahuya and Hellen, (1997).

These trends suggest that it is difficult to sustain cattle in smallholder production areas, hence the need for diversification into small ruminant production such as dairy goat keeping.

2.5 Dairy Goat Challenges and Opportunities in Kenya

Challenges to dairy goat management include breeds and breeding, feed development, nutrition and animal health, while the information gaps and potential research areas are breeds and breeding, feed development, nutrition, technology adoption and establishment of a dairy goat database (Wandera *et al.*, 2000). The demand for dairy goats by smallholder farmers in the whole country is high yet there is no local source of good breeding stock. This challenge is being addressed through farmer multiplication projects sponsored by the Dairy Goat Association of Kenya (Smith *et al.*, 2004). Other challenges include; (a) what goat genotype should be kept under what production system; (b) what baskets of technology, including husbandry, health management, product marketing and value addition options need to be put in place; (c) how the appropriate genotype and the supportive technologies will be packaged, promoted and disseminated to reach the desired target; and d) what policy and institutional framework need to be put in place to support the preferred goat development programs (Ahuya *et al.*, 2005).

Opportunities include decreasing small land sizes in most parts of the country. The dairy goat is adaptable to a relatively small farm setting and marginal grazing needs, and also includes adaptability to wider agro-ecological zones and climatic conditions (Park, 2005). Medium to high rainfall areas, have been turned to growing subsistence crops and consequently alternative livestock management systems have to be adopted. Dairy goats process short generation interval of less than two years and produce high quality milk having a higher butter fat content and medicinal value. There is lack of socio-cultural inhibitors to keeping goats and utilization of its milk in most areas. The goat is easily convertible to cash (highly liquid that meets pressing needs like school fees, medical care and others) at the household level (Wandera *et al.*, 2000). Future prospects in the sub-sector are therefore tied significantly to technology promotion; marketing and animal health services interventions. Successful innovations will lead to substantive increase in animal population (GOK, 2001a).

2.6 Factors Influencing Adoption of Dairy Goat Technologies

Several factors influence the adoption of dairy goats and their recommended practices. An understanding of these factors is helpful to all concerned stakeholders for better programme design and implementation. A study by Rudat *et al.* (1993), identify such factors as the farmers' characteristics, attributes of the innovation, institutional factors, socio-economic and cultural factors, macro and microclimate and if one of the variables is

unfavourable to the receiving client, the rates and levels of adoption will certainly not be satisfactory. Adoption studies by Rudat *et al.* (1993), were done in the subsistence agricultural region of eastern Zambia to identify the factors influencing farmers' decision to adopt the technology of improved fallow for improved soil fertility. The study findings indicated that farmers' decision to adopt a new technology is not dependent upon a single factor, but depends on a matrix of factors including household characteristics, community level factors, socio-economic constraints and incentives that farmers face, access to information, local institutional management and macro policies on agriculture (Rudat *et al.*, 1993). For the purposes of this study socio-economic and technology transfer factors, and their influence on adoption of the dairy goat among smallholder farmers in Kenya were studied.

2.6.1 Technology Transfer Factors

These factors include technology transfer methods (mass, group, and individual), technology transfer agent's educational level and experiences, and information sources availability. A study done by International Centre for Tropical Agriculture (CIAT), on technology generation and dissemination included enhancing farmers' understanding about the problem and tapping their knowledge (CIAT, 2003). It illustrated an adaptive approach to Integrated Pest Management (IPM) development and dissemination with smallholder farmers in Lushoto Northern Tanzania (CIAT, 2003). Farmers preferred the following dissemination pathways; (a) On farm demonstrations of IPM technology; (b) demonstrations in schools; (c) training through community learning activities; (d) distribution of extension information leaflets, and posters among others about the problem and its management, and; (e) awareness creating seminars and field tours (CIAT, 2003). Those farmers having above average resources for production preferred hands-on group learning, while poorer farmers preferred activities that took less of their time such as field days, on-farm demonstrations, audio programs and drama. This adaptive approach to technology development and dissemination enhances farmers' capacity to analyze their production problems and to identify appropriate solutions (CIAT, 2003).

For research to be effective there must be an efficient mechanism for availing results to those who can use them. Transfer of results to farmers is one of the functions of agricultural extension (Mettrick, 1993). Kaberia *et al.*, (2003) identified several challenges affecting the promotion and dissemination strategy of a technology to a wider audience, such

Different communication channels have different effects on the decision maker as shown in Fig 1.

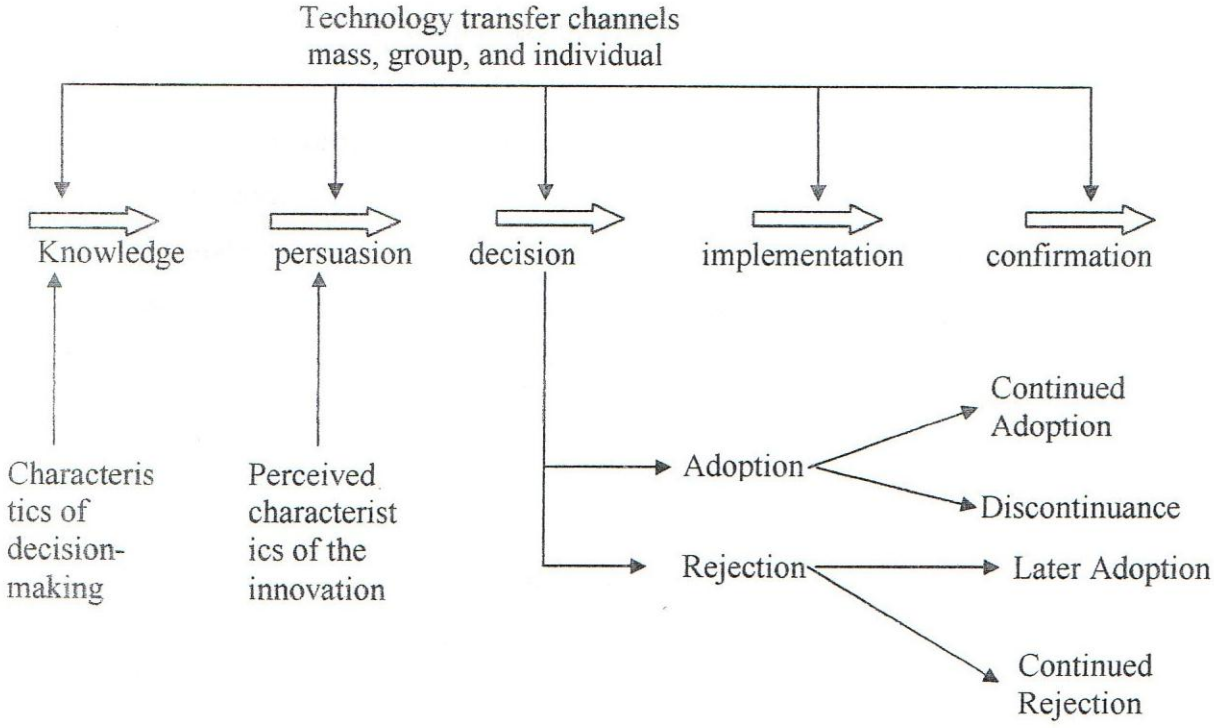


Figure 1: A Modified Model of Stages in the Innovation-Decision Process
Source: Rogers (1983).

Adoption is influenced by various factors including; (a) previous practice; (b) felt needs / problem; (c) innovativeness; and (d) norms of the social system (Rogers, 1983). Decision making is influenced by various characteristics which include; (a) socio-economic characteristics; (b) personality variables; and (c) communication behavior. Perceived characteristics of the innovation as shown in include; (a) relative advantage, which is the degree to which an innovation is perceived as better than its precursor; (b) compatibility is the degree to which an innovation is perceived as being consistent with the existing values, needs, and past experiences of potential adopters; (c) complexity is the degree to which an innovation is perceived as being difficult to use ; (d) trialability is the degree to which an innovation may be experimented with before adoption while; and (e) observability is the degree to which the results of an innovation are observable to others (Moore and Benbasat, 1991).

The use of farmer groups in extension has been popular due to its less consumption of time and other resources. It is important to realize that adoption is at the individual level and not at group level. A study by Amudavi (2005), in Kenya on linking institutional partnership,

community groups and rural livelihood improvement, found out that not all groups equally have successful economic outcomes, especially where some economic resources are required upfront. Local groups generate mainly social benefits. According to Onyango (1987), it is not possible to have an efficient extension system unless several factors operate correctly. Such factors include the structure of public services, which control the development strategy for both extension workers, and the clients of extension and finally the whole philosophy of extension and how it is expected to contribute to the national development effort. Etta and Parvyn-Wamahiu (2003), indicated that the effectiveness of an extension approach depends on; (a) the legal nature of the instrument; (b) the type of the technology; (c) objectives of the transfer; and (d) terms and conditions under which transfer of technology takes place.

Individual methods under this category provide opportunities for face-to-face or person-to-person contact between the farmers and the extension workers. These methods are very effective in teaching new skills and creating goodwill between farmers and the extension workers. The adoption diffusion continuum recognises five categories of participants; (a) innovators; (b) early adopters; (c) early majority; (d) late majority; and (e) traditionalist as shown in Figure 2.

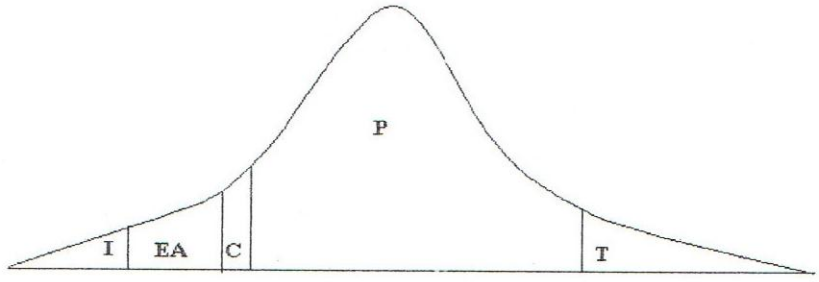


Figure 2: Adoption Life Cycle

Source: Moore (1991).

Table 3 shows the categorisation of successive groups of adopters in the adoption life cycle.

Table 3: Successive Groups of Adopters

Innovators (1)	The enthusiasts who like technology for its own sake.
Early Adopters (EA)	Those who have the vision to adopt an emerging technology to an opportunity that is important to them.
The chasm (C)	Time gap in technology adoption, which is between the early adopters and the pragmatists.
Pragmatists (P) Early Majority	Early majority pragmatists are the solid citizens who do not like to take the risks of pioneering, but are ready to see the advantages of tested technologies. They are the beginning of a mass market.
Pragmatists (P) Late Majority	Late majority pragmatists, who represent about one- third of available customers dislike discontinuous innovations and believe in tradition rather than progress. They buy high – technology products reluctantly and do not expect to like them.
Traditionalists (T)	Traditionalists (laggards) do not engage with high technology products-except to block them. They perform the valuable service of pointing out regularly the discrepancies between the day-to-day reality of the product and the claims made for it.

Source : Moore (1991).

According to Moore (1991), the chasm is the time gap in technology adoption, which is between the early adaptors and the early majority. These form the major client groups of extension. Moore also sees these groups as significantly different "markets" in the "selling" of an innovation. The innovation decision process is the process through which an individual passes from first knowledge of an innovation to a decision to adopt or reject the implementation of the new idea, and to confirmation of this decision. This process consists of five stages; (a) knowledge; (b) persuasion; (c) decision-making; (d) implementation; and (e) confirmation (Rogers, 1983). Technology transfer channels play different roles in creating knowledge or in persuading individuals to change their attitude towards an innovation. A study was done to determine the agricultural information preferences of crop producers in Iowa on Iowa corn, and soybean producers and to assess the implications for agricultural extension education. The study sought to identify the types of communication channels that farmers preferred for agricultural information. Producers indicated a preference for mass media channels for general information and interpersonal communication channels for specific and applicable information (Licht and Martin, 2007).

The concern to address special categories of clients implied a concern for 'targeting' extension categories to farmers who were homogenous in access to resources, production, objectives, and opportunities (Roling, 1990). Feder and Umali (1993), distinguishes between adoption factors during the early phases of adoption versus the final stages of adoption such as farm size, tenure, education, information and credit may be significant for the early adopters but not for later adopters. Extension activities must be client-oriented, and must therefore be guided by clients' needs (Arnon, 1989). It also has an obligation to serve the needs of all the multiple client-groups found in rural population (Swanson, 1984). The rural sector is extremely heterogeneous and extension must concern itself with the problems of each major client-group separately by targeting farmers who are homogeneous in access to resources, production objectives, and opportunities (Roling, 1990), as shown Figure 3 (a) and (b).

(a) Extension Agent

(b) Extension Agent

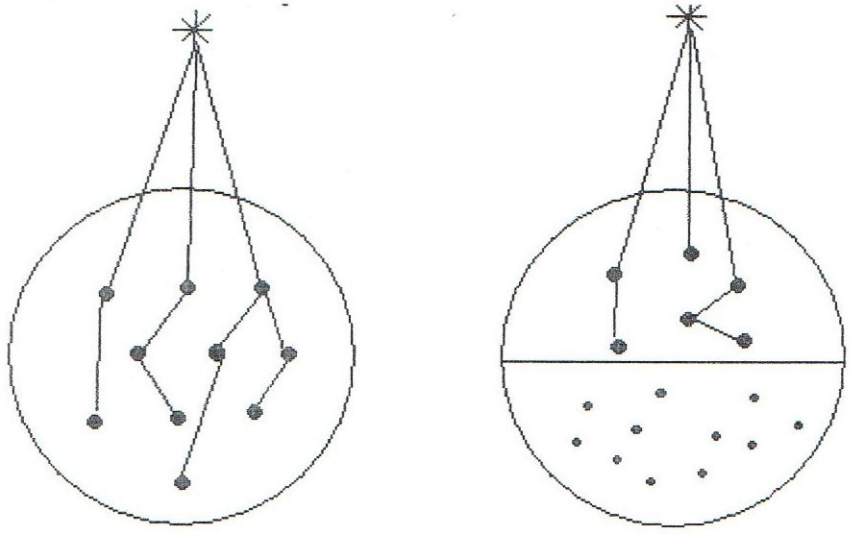


Figure 3: Two Models of Diffusion of Innovations.

a) Diffusion in a homogenous population

b) Diffusion in a heterogeneous population

Source: Arnon (1989).

In the Figure 3 (a) above, in a homogenous population both horizontal and vertical diffusion takes place easily, while Figure 3 (b) shows that in a heterogeneous rural society, horizontal diffusion could take place while vertical diffusion could not (Arnon, 1989).

2. The Extension Agent

An extension agent is one who has the knowledge of the teaching/learning process and can effectively communicate information to clients. The officer is an adviser, an educator, a technician, and an intermediary between agricultural research institutions and the farm families (Crowder, 1996). The workers' level of education and experiences influences this capability and their influences were examined in this study. According to Rogers (1995), the change agency normally has seven roles: (a) to develop need for change on the point of clients; (b) to establish information exchange relationship; (c) to diagnose their problems; (d) to create intent to change in the clients; (e) to translate this intent into action; (f) to stabilize adoption and prevent discontinuance; and (g) to achieve a terminal relationship with clients. In order to understand more fully the extension workers' role in technology transfer one can distinguish between knowledge acquisition and knowledge use phases of the transfer process (Blackburn, 1989). For the extension agent to perform his or her duties effectively there must be quality and quantity information available and therefore the effectiveness of extension services must depend heavily on the information and sources they themselves draw upon (Swanson, 1984). The key role that extension services perform is that of being 'information providers' to various communities. They are charged with the responsibility of selecting, disseminating, and interpreting information generated by one community (research and development) for the benefit of a second community (farmers) (Swanson, 1984).

3. Sources of Information

According to Hill (1989), the absence of adequate information on the incomes of farmers does not stop agricultural policy from implementation. Rather it means that decision makers have an imperfect picture against which to operate. The traditional view of technology transfer is as a one-way process. According to this view, research produces innovations, which are passed on to extension, and which finally passes them to farmers. Such feedback takes place only informally and researchers have no direct contact with farmers (Mettrik, 1993). Therefore, services designed to make information more readily accessible, relevant and appropriate to particular needs, are becoming increasingly important throughout society (Swanson, 1984). A study conducted on the status of awareness of livestock and fisheries technologies in Nigeria. According to Bolorunduro *et al.* (2004), research institutes, universities and agricultural development projects were interviewed using a structured questionnaire. Results indicated that awareness of disseminated livestock production techniques ranged from 5.4-70.9% and those of adoption from 1.4-60.1%. The

extension agents were farmers' most important sources of information and production recommendations while the radio and village extension agents were the most important channels of communication. Method demonstration was the most popular approach for technology dissemination to farmers (Bolorunduro *et al.*, 2004).

Another study conducted in India to examine the performance of three Information and Communication Technology (ICT) projects concerned with improving the delivery of information to farmers and other rural dwellers on marketing (Meera *et al.* 2004). The projects originated from three sources: (a) the government; (b) the cooperative; and (c) the private sector. In the government projects, users valued market information, land records and rural development programmes. In the cooperative project, users valued accounting and farm management information while in the private sector, users valued management of pests and diseases and rural development practices information (Meera *et al,* 2004). This research will investigate the sources and availability of information provided by different sources and their influence on adoption.

According to Menou (1993), there is little research done on consumers' decision to adopt technological innovations. A study was done by Menou (1993), in Michigan on the effects of communication source and modality on consumers' adoption of technological innovations. The results found out that communication factors could serve as significant predictors of consumer adoption. Information services contribute to the empowerment of the people and are a catalyst to transform people. The information can start on a 'bottom-up' approach that relies on the mobilization of resources at the rural level to meet information needs identified by members of the community. The resources include information and data materials, personnel, facilities and funding as well as existing organizations (Menou, 1993). Peacock (1996) stipulates that farmers' own records and the reports of extension workers are sources of information. Monitoring and evaluation of projects also provide quality and quantity information and should therefore be seen as an integral and continuous part of project life, involving producers, extension staff, development agencies, and donors on equal terms. Table 4 shows an example of basic information stipulated from an extension workers report, and used for monitoring and evaluation of a dairy goat project.

Table 4: Basic Monitoring Information Required for Quantifiable Outputs

Topic	Minimum monitoring information
Credit	Rate of credit disbursement credit repayment rates.
Productivity	Births, deaths
	Milk production (daily yield, lactation length).
Health	Death (Causes if possible)
	Sickness (Causes if possible)
	Paravet treatment book
Nutrition	Growth rates, milk production
Forage	Number of seedlings distributed and surviving
Marketing	Number and price of goats sold
	Amount and price of milk sold

Source: Peacock (1996).

Information on risks and uncertainty of technologies needs to be available to extension workers (Peacock, 1996). The first is the riskiness of the new technologies themselves, since this may have an important bearing on whether farmers choose to adopt them. The second is the implication of production risks for the stability of national food supplies in prices, since this can affect the food security of the poor. The third is the management of production losses due to catastrophic events, such as draughts, reduces harmful effects on natural resources and future agricultural productivity (Anderson, 1994).

2.6.2. Socio-economic Factors

Socio-economic factors are variables that influence adoption leading to the adopter categories (Rogers, 1983). An understanding of the circumstance that leads to change of attitude of the adopters is valuable information to the efforts to enhance adoption rates. In a survey done in agro-forestry adoption in Haiti, found that farmers made decisions about tree planting culture based on characteristics of the household and the field (Bannister and Nair, 2003). This study will investigate age, education, gender, time, and income as socio-economic factors affecting adoption of dairy goats in selected districts of Kenya. Rogers (1983) revealed that 19% of studies done showed that earlier adopters are younger, 38% indicate that they are older while about 50% show inconsistent evidence about age. The same study shows that earlier adopters have more years of education than late adopters; they have higher social status and also have larger farms Rogers (1983).

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A study by Arnon (1987), showed that there were four categories of recipients whose education affected agricultural development: (a) farmers including farm owner, operators' tenants, and workers; (b) those serving farms directly such as extension agents, development planners, researchers, and rural administrators; (c) those serving farms indirectly such as merchants, credit agencies, and supplies of agricultural inputs; and (d) leaders and policy makers. This research was concerned with the level of education of farmers and extension workers. The combined labor supply of the operator and spouse indicates the total amount of time available for farming and non-farming activities. Operator and or spouse off-farm employment may constrain adoption of management intensive technologies because it competes for farm managerial time (McNamara *et al.*1991).

A study done in Gaighata and Bagdah blocks of West Bengal on adoption behaviour of dairy farmers in cooperative farming systems (Ghosh *et al.* 2004), of 60 member co-operative societies (MCS) and 60 non-member co-operative societies (NMCS) were selected. An interview method of data collection carried out to determine the influence of selected socio-economic, socio-psychological and communication characteristics of the dairy farmers in relation to adoption of some selected animal husbandry practices. The study revealed that all communication variables significantly correlated with adoption of improved animal husbandry practices in NMCS whereas mass media communication, personal local sources and personal cosmopolitan sources were significantly correlated with adoption in MCS (Ghosh *et al.*, 2004). Age and education of the respondents were significantly correlated with adoption. Communication source and knowledge about de-worming were the key variables that directly and indirectly influenced the adoption of improved animal husbandly practices in MCS and NMCS, respectively (Ghosh *et al.*2004). In a similar study conducted in Cameroon on factors, affecting adoption of sheep and goats, results revealed that age, hired labour, and expected future returns did not significantly affect the decision to adopt sheep and goats (Tambi, 2003). This study, sought to find out the influence of age and time among other factors on the adoption of dairy goats since they are known to be labour and capital intensive.

Lapar and Ehui (2004) conducted a study in the uplands of the Philippines on the effects of policy and socio-economic factors affecting the adoption of dual-purpose forages as hedgerow species among smallholder farmers. An econometric approach was used and results indicated that farmers who are more educated, have higher income, and have access to credit are more likely to adopt the dual-purpose forages. In another study on adoption and impact on

smallholder dairy technology in three districts of coastal Kenya, revealed that the most important sources of information were extension agents, demonstrators and other farmers (Sechrest *et al.*, 1998). Adoption of grade cattle were negatively correlated to suitable alternative of agricultural uses for land and positively correlated with size of household. Lack of money to purchase a grade animal was a reason for non-adoption as farmers owning such animals tended to have higher off-farm incomes. Other non-adoption reasons included loss of cattle due to diseases and potential difficulties in selling milk, the latter reflecting primary lack of information (Sechrest *et al.*, 1998).

Gender based differences according to Nycander *et al.* (2002), affect access to land, extension, technology finance, time, mobility, education and training. Gender roles shape the opportunities and constraints that women and men face in securing their livelihoods in different areas. Gender has a significant contribution towards sustainable agriculture and livestock development. Socio-economic experience supports equal investment in both men and women through education and extension by increasing their access to physical, human and financial resources (Nycander, *et al.*, 2002). According to Ochola (2002), gender biases are a constraint to increasing agricultural productivity. Women farmers face more socio-economic and technological barriers than men in operating effectively and as a result they incur higher effective cost to information, technology, inputs and credit and their productivity is lowered. Devendra (2001) identified three types of dairy production systems that are smallholder systems, smallholder cooperative dairy production system and intensive dairy production system. The first two systems are the most preferred in some countries, but neglected in development programmes (Devendra, 2001).

In Conclusion, a number of studies have been done on breeds and breeding, feed development, nutrition and animal health. Literature reviewed reveals that very few studies, much of which has not been documented, have been undertaken on the influence of socio-economic and technology transfer factors on the adoption of dairy goats in Kenya. According to Soedjana *et al.* (2003) the rapid adoption of a technology by farmers is the proper evaluation criterion of appropriateness of a new technology, and implicitly, for the validity of the procedures used to generate that technology. However, the low levels of adoption of new crop-livestock technologies that have been observed throughout the developing world are not due to short comings in the Farming Systems Research and Extension (FSR&E) concept itself, but are instead due to failures in implementation (Soedjana *et al.*, 2003).

2.7 Theoretical Framework

In adoption/diffusion theories, Rogers (1995) postulated that the "top-down" and "bottom-up" models of adoption/diffusion provide a directional perspective to the process. According to Carr (2006) adoption and diffusion process generally follow what has been termed the "traditional model," a "top-down" process in which administrative "mandate" introduce the technology and administrative perceptions, decisions and strategies drive adoption and diffusion. Successful adoption is highly dependent on the degree, stability and wisdom of administrative sponsorship. Carr (2006) also explains that in "bottom-up" approach the desire for the innovation frequently grows from individual users of the technology, and as their communication and influence increases through their contacts, adoption of the technology also increases. Another dichotomy of diffusion theories by Rogers (1995) relates to the scale of innovation efforts by distinguishing between macro-level theories and micro-level theories. Macro-level theories focus on the institution and systematic change initiatives while micro-level focus on the individual adopters and a specific innovation. This study will deal with the micro-level theory.

Rogers (1995) presented four adoption/diffusion theories as follows:

1. *Innovation Decision Process theory.* Rogers (1995) posits that potential adopters of a technology, progress over time through five stages in the diffusion process. First, they learn about the innovation (knowledge); second, they get persuaded of the value of the innovation (persuasion); third they decide to adopt it (decision); forth the innovation gets implemented (implementation); and finally, the decision gets reaffirmed or rejected (confirmation). The focus is on the user or adopter.
2. *Individual Innovativeness theory.* According to this theory, individuals who are risk takers or otherwise innovative will adopt an innovation earlier than other individuals in the continuum of adoption/diffusion.
3. *Rate of Adoption theory.* This theory claims that diffusion takes place over time with innovations going through a slow, gradual growth period, followed by dramatic and rapid growth, and then a gradual stabilization and finally a decline.
4. *Perceived Attributes theory.* According to this theory, there are five attributes upon which an innovation is judged: that it can be tried out (trialability), that results can be observed (observability), that it has an advantage over other innovations or the present circumstance (relative advantage), that it is not overly complex to learn or use (complexity), that it fits in or is compatible with the circumstances into which it will

be adopted (compatibility). Other variables that affect its rate/level of adoption are, the nature of communication channels diffusing the innovation at various stages in the innovation decision process, the nature of the social system, and the extent of change agents' efforts in diffusing the innovation. The innovation-decision process can lead to either adoption or rejection of an innovation.

Such decisions can be reversed at a later stage e.g. discontinuance (Rogers, 1995). This occurs when an individual becomes dissatisfied with an innovation or because the innovation is replaced with an improved idea. The diffusion effect is the cumulatively increasing degree of influence upon an individual to adopt or reject an innovation in a social system. As the rate of awareness knowledge in a social system increases up to about 20-30%, there is very little adoption, but once this threshold is passed, further increases in awareness knowledge lead to increase in adoption. The diffusion effect is greater in a social system with a higher degree of interconnectedness. The degree of interconnectedness in a social system is positively related to the rate of adoption of innovations (Rogers, 1995). Rogers (1995) also postulated that technology and society are inseparable and hence the design, development, adoption, utilization and diffusion of technology are inherently a social project. Rogers and shoemaker (1971) summarizes a number of variables that influence adoption of innovation as shown in Figure 4.

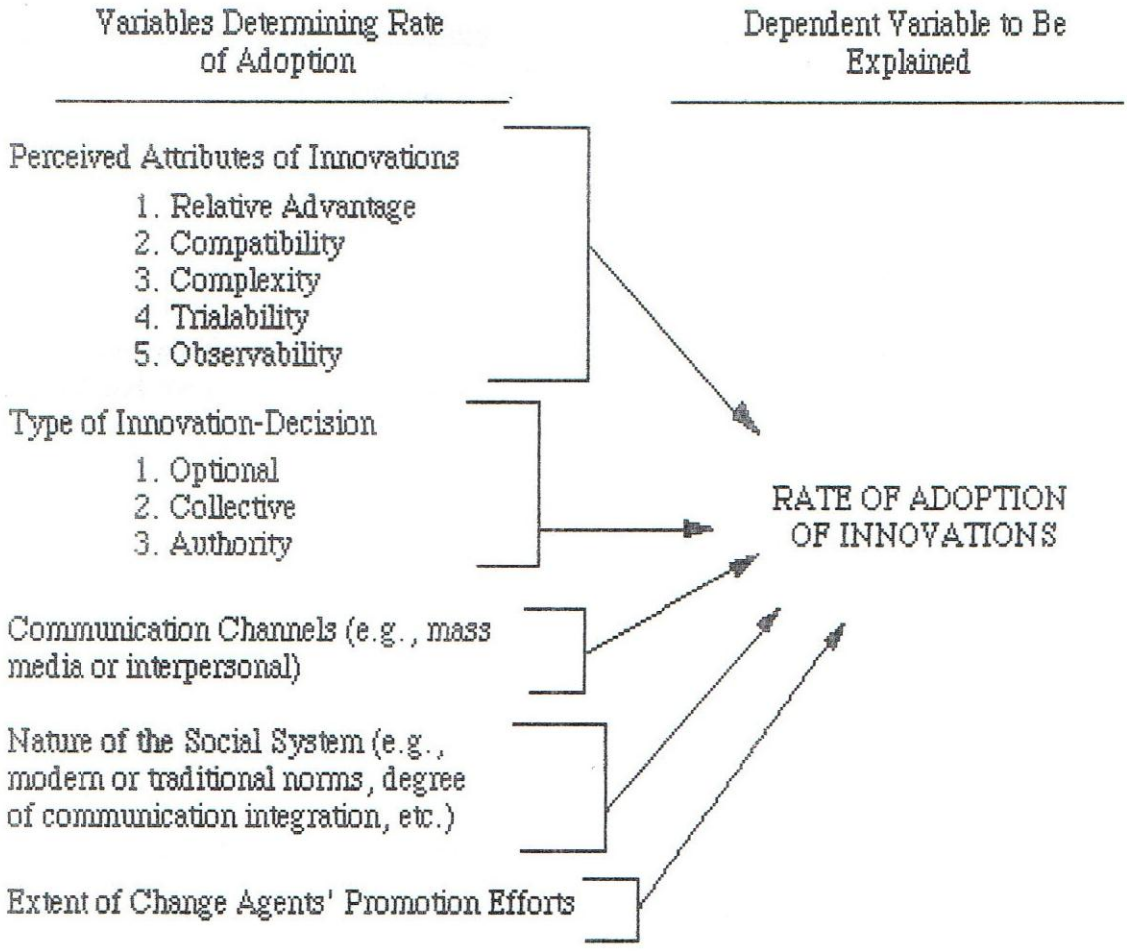


Figure 4: The Variables, which Influence an Innovation's Adoption
Source: Rogers and Shoemaker (1971).

As shown in Figure 4, a number of factors play a role in determining adoption of an innovation. Rogers' model noted that the technological superiority of an innovation plays a relatively minor role in determining rate of adoption. Many other factors, most of them relating to the social factors present at the adopting site, play just as large a role as technological superiority in influencing rate of adoption. Among the factors identified by Rogers (1995) are: (a) the way the innovation is perceived by potential adopters; (b) the type of decision making processes at the adopting site; and (c) the social system (the values and norms) in place at the adopting site. The above theoretical framework of Rogers and Shoemaker (1971) was adopted and modified for the purposes of this study as shown in Figure 5.

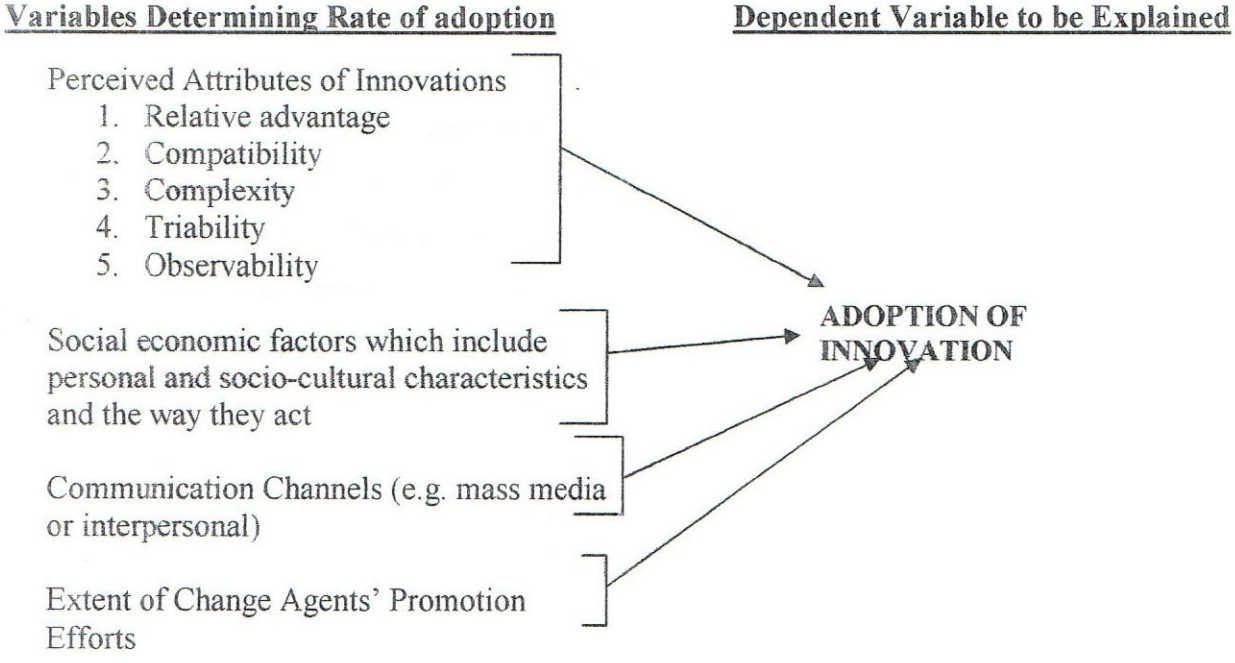


Figure 5: A Modified Theoretical Framework showing Relationships between Variables and Adoption of Innovations.

The theoretical framework above indicates a set of interrelated independent variables that represents a systematic view of a phenomenon by specifying relations between variables, with the purpose of explaining natural phenomena (Mutai, 2000). From the theoretical framework, innovation decision process theory and individual innovativeness theory will be modified to provide the conceptual framework of independent variables on dependant variables in order to meet the purpose of the study.

2.8 Conceptual Framework

The conceptual framework in Figure 6 provides a contextual setting under which several factors influence the adoption of dairy goat technologies among smallholder farmers. The conceptual framework shows socio-economic and technology transfer factors as independent variables. They influence the moderator variables that also influence both the independent and the dependent variables. Hypotheses were been postulated and tested about influences of these socio-economic and technology transfer factors on adoption of dairy goats.

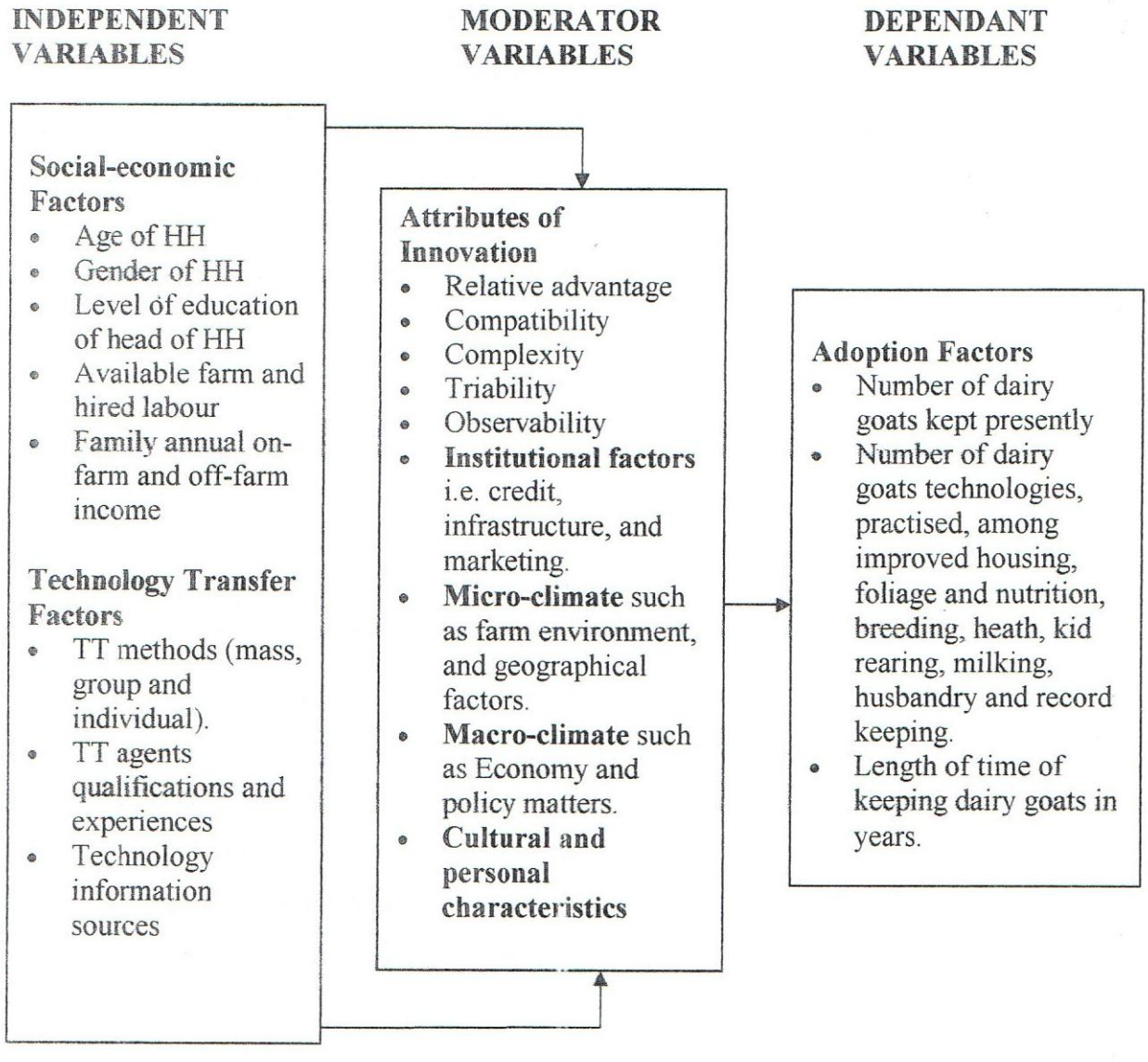


Figure 6: Conceptual Framework Model Identifying Factors Influencing the Adoption of Dairy Goats.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the research design, the location of the study, population, sample and sampling procedures, instrumentation, data collection and data analysis of the study.

3.2 Research Design

This study utilized a descriptive survey method of *ex-post facto* of causal comparative approach in which the researcher, rather than creating the treatment, examined the influence of a treatment after the treatment had already occurred (Kathuri and Pals, 1993). The design assisted to describe the conditions and quantify factors, which may be associated with or contribute to the independent variables of the study (Kaewswonthi and Harding, 1992). The descriptive survey study was to collect data in order to determine the current status of the population at that particular point in time (Cohen and Manion, 1989). This was in respect to socio-economic and technology transfer factors and their influences on the adoption of the dairy goats.

3.3 The Location of the Study

The study was conducted in three divisions of three districts in Kenya. These were Bahati division of Nakuru North district at latitude of 0.15'N and longitude of 36^{0}04'E, Kiharu division of Murang'a North district at latitude of 0.45'N and longitude of 37^{0}09'E and Abothuguchi East division of Meru Central district at latitude of 0.03'N and longitude of 37^{0}40'E as shown in Appendix C. These areas were selected because they have high population density and have experience with dairy goat projects for over 10 years under tha support of different institutions. They also lay within similar agro ecological zones with almost similar infrastructure and socio-cultural characteristics.

3.4 Population of the Study

The target population of the study comprised of all smallholder farmers in the three districts and all the extension workers promoting the uptake of dairy goats in the three districts. The accessible population consisted of 248,000 (GoK, 2001b) smallholder farmers in the 3 divisions and all extension workers in these areas.

3.5 Sampling Procedures and Sample size

The provinces, districts and divisions were purposively selected in order to allow the researcher to use representative cases that provided the required information with respect to the objectives of the study (Mugenda and Mugenda, 1999). Purposive sampling built a sample that was satisfactory to the researcher's specific needs to meet the objectives (Cohen and Manion, 1989). The smallholder farmers were stratified into 2 strata, those that affiliate into dairy goat groups and those that do not. Since most dairy goat farmers affiliate themselves into groups, the groups were considered as clusters. According to Kaewswonthi and Harding (1992), a sample size of 100 for a population size of over 10,000 would have been appropriate, but due to the nature of the study, the objectives, the heterogeneity of the population and the method of data analysis (multiple regression analysis) and to cater for natural attrition a higher sample size of 150 was considered. The 150 smallholder farmers were divided equally among the three divisions at 50 farmers per division. A list of all dairy goat groups in the three divisions was compiled and one group of about 25 members was selected at random in each division as stipulated by Frankfort-Nachmias and Nachmias, (1996), and Peil (1995). They stipulate that the selection of an intact group and all members of such a group can be sampled. In each division 25 farmers who were non-group members were selected by systematic random sampling giving a total of 50 farmers per division.

3.6 Instrumentation

Questionnaires were used to collect data. They were found suitable since they collect primary data, which was necessary for a survey research of ex-*post facto* approach. The items in the questionnaire were both closed-ended (structured) and open-ended (unstructured) where more information was required. Questionnaires were in two sets, set one for smallholder farmers and set two for extension workers as shown in Appendices A and B. The questionnaire for farmers sought information on socio-economic and technology transfer factors influencing adoption of dairy goats. The questionnaire for extension workers was used to supplement the questionnaire for smallholder farmers on the influence of technology transfer factors on adoption

3.6.1 Validity

Validity is the degree to which results obtained from the analysis of the data actually represents the phenomena under study (Mugenda and Mugenda, 1999). The instrument was measured for content validity, appropriateness, meaningfulness and usefulness by pilot-

testing and by having the instruments read by experts who are lecturers in the Department of Agricultural Education and Extension of Egerton University.

3.6.2 Reliability

Reliability is a measure of the degree to which a research instrument yields consistent data after repeated trials (Mugenda and Mugenda, 1999). It reduces random errors, which include inaccuracy of the instrument, error due to inaccuracy of scoring by the researcher and unexplained error. Reliability was achieved by pilot testing and by use of a reliability test. Data was determined from scores obtained from a single questionnaire. A score obtained in one item was correlated with scores obtained from other items in the instrument. The Cronbach's coefficient Alpha shown below, that is a general form of the Kunder- Richandson (K-R) 20 formulas were computed by computer SPSS analysis to determine how items correlated among themselves.

$$KR_{20} = \frac{(K)(S^2 - \sum s^2)}{(S^2)(K-1)}$$

Where

KR_{20} = Reliability coefficient of internal consistency

K = Number of items used to measure the concept

S^2 = variance of all scores

s^2 = variance of individual items

A correlation coefficient of over 0.7 in a range of 0-1 is usually accepted as criterion for questionnaire reliance (Mugenda and Mugenda, 1999). The reliability test indicated that the correlation coefficient was .9141; hence, this indicated that the questionnaire was reliable.

3.6.3 Pilot-study

The pilot-study was done in Njoro division of Nakuru district, which has similar agro-ecological, infrastructure and socio-cultural characteristics to the actual research area. This was done with the permission of the local extension officers and local leaders. The pilot-study sample comprised 5% of the cases in the actual sample. These said questionnaires were used in reliability test and were analysed to confirm appropriateness of methods of analysis (Mugenda and Mugenda, 1999).

3.7 Data Collection Procedures

The researcher sought authority from the Division of Research and Extension of Egerton University and Egerton University's Graduate School to obtain a permit from the Ministry of Education, Research, Science and Technology for data collection. Questionnaires in Appendices A and B were administered in two ways: (a) Self-administered questionnaires whereby respondents were expected to complete the questionnaires themselves; and (b) Researcher administered questionnaires, whereby the researcher used the questionnaire to interview the respondents who were not able to neither read nor write. Confidentiality was assured to the farmers. This was done in the local language. Pre-study visits were made to the District Livestock Production Officers of the respective districts to plan for data collection done with the farmers' content. Visits were made to respective divisions and arrangements made to visit the farmers.

3.8 Data Analysis Procedures

The data collected were coded and entered into the computer for analysis by the use of Statistical Package for Social Science (SPSS) version 11.5 and inference made at a 0.05 level of significance. Qualitative and quantitative method of descriptive and inferential analysis was used. Information obtained from the open-ended questions were analysed qualitatively. This served as detailed information about the phenomenon being studied (Mugenda and Mugenda, 1999). Qualitative analysis tried to establish trends and patterns of influences from the information gathered.

Descriptive statistics were used to summarize data in order to assist the researcher to describe distribution of scores. Percentiles and frequency distribution tables were used to establish trends. Inferential statistics of multiple regression analysis were used to determine the influence of the independent variables on a formulated composite adoption index as constructed in Table 5, and "to assist the researcher to generalize the results from samples to populations by use of hypothesis testing" (Mugenda and Mugenda, 1999). Multiple regression analysis will provided information on control and prediction of the dependent variable by independent variables by use of the following formula,

$Y=B_0+B_1X_1+B_2X_2+\ldots\ldots\ldots\ldots B_kX_k+ e$

Where by:

Y - Is the dependent variable

Xi-k - are the independent variables

B_0 - Is a constant and may be zero.

B_1-B_k – are the regression coefficients or change induced in Y by a unit increase in X

e - Is the error term

3.8.1 Construction of Adoption Index

A composite adoption index was constructed using three indices as shown in Table 5. The index was derived from computation involving number of dairy goats, number of dairy goat packages, and longevity of keeping the dairy goats.

Table 5: Sources of the Adoption Index

Number of Dairy Goats Index (NDGI)	Score	Categories
0	0	None
1-2	1	Few
3-4	2	Moderate
5-6	3	Many
Over 7	4	Very many

Number of Dairy Goat Packages Index (NDGPI)	Score	Categories
0	0	None
1-2	1	Few
3-4	2	Moderate
5-6	3	Many
Over 7	4	Very many

Length of Time of Keeping Dairy Goat Index (LTDGI)	Score	
Yet to start	0	None
1-2.9 years	1	Short
3-4.9 years	2	Moderate
5-6.9 years	3	Long
Over 7years	4	Very long

A composite adoption index was computed using the following formula: Adoption index = $((NDGI)\ (NDGPI)\ (LTDGI))^{1/3}$

It was raised to power 1/3 since the adoption index was constructed from the three variables and was expected to lie between one and four. Based on this, the adoption index was split into five categories: (1) No adoption, with an index of zero (2) Low adoption, with an index of 0.1-0.99 (3) Medium adoption, with an index of 1-1.99 (4) High adoption with an index of

2-2.99 and 5) Very high adoption with an index of 3-3.99. Multiple regression analysis were used to provide information on magnitude of influences, and whether the influences on the adoption index by each of the selected independent variables were positive or negative, and whether they were statistically significant. It was useful to the study because several independent variables were used to explain the dependent variable (adoption index)

Table 6: Summary of Hypotheses Tested

Hypothesis	Independent variables	Dependant variable	Statistical method of analysis
H_{O1} There is no significant statistical influence between farmers socio-economic factors and adoption of dairy goats	Socio-economic factors • (Age of HH in years • Gender of HH • Level of Education of HH • Number hours of available farm labour • Family annual total farm income)	Adoption Index derived from: • Number of dairy goats owned presently • Number of practices adopted among breeds and breeding, improved housing, feeds and nutrition, kidding, management and husbandly practices, milking and goat heath. • Length of time of keeping dairy goats measured in years.	Partial multiple regression analysis Frequencies tables and percentiles
Ho_2 There is no significant statistical influence between Technology transfer factors and adoption of the dairy goats.	Technology transfer methods • (Mass • Individual • Group • Extension agents education and experience • Sources of information)	Adoption Index • (Number of dairy goats owned presently • Number of practices adopted among, breeding, improved housing, foliage and nutrition, kid rearing, husbandly practices, milking, goat health and records keeping. • Length of time of adoption measured in years)	Partial multiple regression analysis Frequency tables and percentiles
	A combination of socio-economic factors and technology transfer factors	Adoption index	Full multiple regression analysis

CHAPER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presented the results of the study. The purpose of the study was to investigate the influence of socio-economic and technology transfer factors on adoption of dairy goats among smallholder farmers in Nakuru North, Murang'a North, and Meru Central districts of Kenya. In presenting the results and the discussion of the study, the following four objectives were taken into consideration.

1. Describe the characteristics of dairy goat farmers in Nakuru North, Murang'a North, and Meru Central districts of Kenya.
2. Characterize dairy goat technologies promoted to farmers in Nakuru North, Murang'a North, and Meru Central districts of Kenya.
3. Assess the influence of farmers' socio-economic factors on adoption of dairy goat technologies among smallholder farmers in Nakuru North, Murang'a North, and Meru Central districts of Kenya.
4. Examine the influence of technology transfer factors on adoption of dairy goat technologies among smallholder farmers in Nakuru North, Murang'a North, and Meru Central districts of Kenya.
5. Examine the influence of the combined socio-economic and technology transfer factors on adoption of dairy goat technologies among smallholder farmers in Nakuru North, Murang'a North, and Meru Central districts of Kenya.

The socio-economic factors considered in this study included, age of household head, gender of household head, time spent on dairy goat activities on the farms, total annual income, and educational level of the household head. The technology transfer factors considered in this study included technology transfer methods (mass, group, individual), technology transfer agents (qualifications and experiences) and information sources and availability. These factors formed the independent variables. The adoption factors included, number of dairy goats adopted, number of dairy goat technologies adopted and number of years of experiences with dairy goat keeping for the dependent variable.

4.2. Data Analysis by Objectives

4.2.1 Descriptive analysis of farmers' characteristics in the three districts

A descriptive analysis of respondents' distributions in the three districts revealed the results as shown in Table 7.

Table 7: Percent Distribution of Respondents by Districts (N = 149)

Valid	Frequency	Percent
Nakuru	44	29.5
Murang'a	50	33.6
Meru	53	35.6
Total	147	98.7
Missing system	2	1.3
Total	**149**	**100.0**

Meru Central district produced the highest number 53 (35.6%) of respondents, while Nakuru North district produced the least number of respondents at 44 (29.5) %. The study interviewed 147 respondents of a possible 150 targeted giving a percentage of 98.7% respondents.

The characteristics of the dairy goat farmers studied included, age, t gender, educational level, income levels and time spent on dairy goat activities on the farm. Simple cross tabulations were used to summarize the respondents' characteristics by districts. A frequency distribution has been used to describe the ages of the respondents in the study area as shown in Table 8.

Table 8: Frequency Distribution of Age Categories by the Three Districts (N =140)

Age Categories	District			Total	Percent
	Nakuru	Murang'a	Meru		
20-30	1	7	4	12	9
31-40	13	15	8	36	26
41-50	10	11	13	34	24
51-60	12	7	18	37	26
61-70	3	7	7	17	12
Over 70	0	1	3	4	3
Total	**39**	**48**	**53**	**140**	**100**

Meru Central district had more farmers over 50 years while Murang'a North district had more farmers younger than 50. In all the three districts, 89 % (109) of the respondents were in the age range of 31-60 years In the study area 48 of the farmers were younger than 40

yrs, 71 farmers were between 40-60 years, and 28 farmers were over 60 years. This indicates that most farmers in dairy goat farming are middle aged.

A descriptive analysis of a bar graph described the gender distribution of the respondents in the study area as shown in Figure 7.

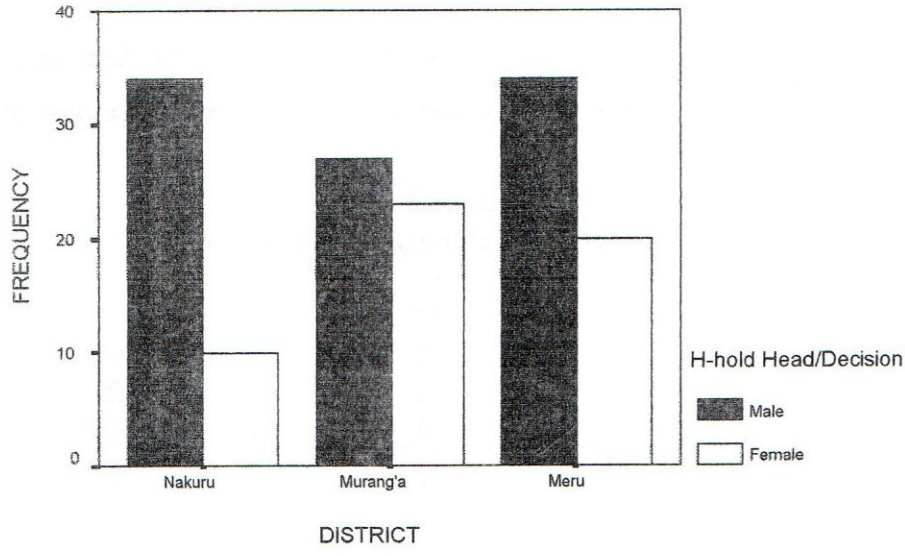


Figure 7: Gender Distribution of Respondents by Districts

The data revealed that in all the three districts, males were predominant. Nakuru district produced the lowest number of female respondents, while Muranga district produced the highest number of female respondents. These results indicate that there are more males than females in dairy goat farming in the study area.

A descriptive analysis to describe the educational levels of the respondents and the results are shown in Table 9.

Table 9: Frequency Distribution of Educational Levels across the Districts (N = 141)

Highest level of education	District			Total	Percent
	Nakuru	Murang'a	Meru		
No education	5	8	11	24	17
Primary Education	24	20	36	80	57
Secondary Education	9	21	4	34	24
Tertiary Education	1	1	1	3	2
Total	**39**	**50**	**52**	**141**	**100**

In Nakuru and Meru districts, most of the respondents' level of education was primary but in Murang'a most had achieved secondary education. The analysis of educational level of

household head in the three districts indicated that of 141 farmers, 24 farmers in the study area had no education, 80 farmers had primary education, 34 had secondary education and 3 had tertiary education. All the three farmers with tertiary education were retired officers. In all the three districts, the results indicated that most of the farmers in the dairy goat farming are of primary school level and few had attained tertiary education.

A descriptive analysis of the average annual incomes of the respondents in the study areas summarized in a frequency distribution table as shown in Table 10.

Table 10: Average Annual Income across the Three Districts (N = 130)

Average Annual Income	District			Total	Percent
	Nakuru	Murang'a	Meru		
0-10,000	14	19	18	51	39
10,000-30,000	11	24	21	56	43
30,000-50,000	4	2	2	8	6
50,000-70,000	3	2	5	10	8
Above 70,000	3	0	2	5	4
Total	**35**	**47**	**48**	**130**	**100**

Analysis indicated that most farmers in the study area earned an average annual income of less that K.shs 30,000 per annum. Of the 35 respondents from Nakuru 14 earned less than Kshs 10,000 while in Murang'a and Meru most earned between K.shs 10,000 per nnum and 30,000. Only 5 (4%) of the 130 farmers who responded to this question earned more than Kshs 70,000 per annum and study results indicated that most of the respondents earned less than Kshs 30,000 per annum.

The working hours available on the farm for dairy goats across the districts was summarized in a frequency distribution table shown in Table 11.

Table 11: Frequency Distribution of Working Hours Available on the Farm for Dairy Goats across the Districts (N =134)

Hours working on the farm for dairy goat	District Nakuru	Murang'a	Meru	Total	Percent
1	8	2	4	14	10.3
1.5	2	0	0	2	1.5
2	15	25	9	49	37
2 .5	3	0	0	3	2.2
3	5	13	18	36	27
4	1	3	11	15	11
5	0	1	5	6	4.5
6	0	0	5	5	3.7
8	0	2	0	2	1.5
10	0	2	0	2	1.5
Total	**34**	**48**	**52**	**134**	**100**

In Murang'a and Nakuru districts, most farmers dedicated two hours per day to their dairy goats while in Meru most dedicated three hours. On average 88 (66%) farmers in the study, area spent 2-3 hours working on the dairy goats. The amount of time spent on the dairy goats depended on factors such as number of dairy goats owned, age of the farmer, gender of the farmer, and income. The results indicated that farmers do not require a lot of time to venture in the dairy goat farming, and hence was mainly done as a part time job. Results also indicated that most farmers used family labour as opposed to hired labour.

4.2.2 Characteristics of Dairy Goat Technologies Promoted to the Farmers.

This study examined eight basic dairy goat technologies promoted to the farmers in the study area, which included: (a) improved housing; (b) foliage and nutrition; (c) breeding; (d) goat health: (e) kid rearing; (f) milking; (g) husbandry practices; and (h) record keeping. The study was concerned with the number of packages adopted by the farmers. Results in Table 12 indicated that of the 95.8% of the respondents, 15.4 % had adopted 4 packages and only 4.2% had adopted all the 8 packages in the study area. A total of 54.6% of the respondents had practiced between 1-4 technologies, while 4.2% of the respondents had adopted no technology.

Table 12: Percent Distribution of Number of Extension Packages Adopted (N = 143)

No of packages adopted	Frequency	Percent
0	6	4.2
1	23	16.1
2	14	9.8
3	19	13.3
4	22	15.4
5	12	8.4
6	12	8.4
7	23	16.1
8	6	4.2
Total	137	95.8
Missing system	6	4.2
Total	**143**	**100.0**

1. Number of Extension Packages Adopted by Gender

Table 13 presents the number of dairy goat extension packages practised by gender.

Table 13: Frequency Table on the Number of Extension Packages Adopted by the Respondents by Gender (N=142)

	Extension packages practiced									Total	Percent
Gender of H-hold Head/Decision Maker	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**		
Male	2	14	9	13	20	9	9	12	4	92	65
Female	4	9	5	8	4	4	3	11	2	50	35
Total	**6**	**23**	**14**	**21**	**24**	**13**	**12**	**23**	**6**	**142**	**100**

Results indicated that of the 145 farmers, 20 male farmers adopted four extension packages while 11 females had adopted seven extension packages. Two females had adopted all the eight packages while four males had adopted all the eight packages. 12 farmers did not keep goats, even though they belonged to dairy goat groups. Results indicated that more males had adopted more packages as compared to females.

2. Number of Extension Packages Adopted by Educational Level

A descriptive analysis of the number of extension packages practiced by Educational level indicated the results on Table 14.

Table 14: Frequency Table of the Highest Level of Education and the Number of Extension Packages Adopted (N=140)

Highest level of education	Extension packages practiced									Total	Percent
	0	1	2	3	4	5	6	7	8		
No education	2	3	1	7	1	2	0	7	0	23	16.5
Primary Education	3	11	10	8	16	8	8	11	4	79	56.5
Secondary Education	1	9	2	6	6	2	4	4	1	35	25
Tertiary Education	0	0	0	0	1	1	0	0	1	3	2
Total	**6**	**23**	**13**	**21**	**24**	**13**	**12**	**22**	**6**	**140**	**1000**

Results indicated that of the 140 respondents, 79 (57%) farmers were of primary school level and of these 48 of them had adopted four of the eight packages. Farmers with no education and those of tertiary education recorded the least number of adoptions of packages. Analysis on distribution of age and extension packages adopted by the farmers was as shown on Table 15.

Table 15 Frequency Table Showing Age brackets and the Extension Packages Adopted (N = 134)

Age brackets	Extension packages practiced									Total	Percent
	0	1	2	3	4	5	6	7	8		
less than 30	0	1	1	1	2	1	1	1	0	8	6.5
30 - 39	0	6	3	5	4	4	3	5	2	32	24
40 - 49	1	6	6	3	6	3	3	5	1	34	25
50 - 59	1	6	2	4	6	4	2	4	2	31	23
60 +	4	2	2	6	3	0	3	8	1	29	21.5
Total	**6**	**21**	**14**	**19**	**21**	**12**	**12**	**23**	**6**	**134**	**100**

The results in Table 15 indicated that farmers younger than 30 adopted less packages than the older farmers. Results also indicated that most farmers were able to adopt only 4 packages of a possible 8 packages. Analysis on the income levels and the extension packages showed the results on Table 16.

Table 16 Frequency Table Showing Income Levels and the Extension Packages Adopted (N = 126)

Income	Extension packages practiced									Total	Percent
	0	1	2	3	4	5	6	7	8		
less than 20,000	5	16	12	13	12	6	5	13	1	83	65
20,000 – 40,000	1	2	2	2	2	2	2	4	4	21	17
40,000 – 60,000	0	1	0	1	5	0	2	1	0	10	8
60,000 – 80,000	0	0	0	0	1	2	3	1	0	7	6
100,000 +	0	0	0	1	1	0	0	3	0	5	4
Total	**6**	**19**	**14**	**17**	**21**	**10**	**12**	**22**	**5**	**126**	**100**

The results indicated that 83 (66 %)of the farmers earned less than Kshs. 20,000 annually while only 5 (4 %) earned more than Kshs 100,000 annually. Results also indicated that farmers who earned less also adopted more packages than those who earned more. An analysis on the frequency of time in hours spent on dairy goat activities and the extension packages adopted indicated the results in Table 17.

Table 17 Frequency Table Showing Time in hours spent on dairy goat activities and the Extension Packages Adopted (N = 128)

Time in hours	Extension Packages Practiced									Total	Per cent
	0	1	2	3	4	5	6	7	8		
1-2	0	2	4	2	5	1	0	2	0	16	13
2.1-3	6	4	4	8	12	4	5	5	2	50	39
3.1-4	0	9	4	7	3	2	4	6	0	35	27
4+	0	4	1	2	2	4	2	8	4	27	21
Total	**6**	**19**	**13**	**19**	**22**	**11**	**11**	**21**	**6**	**128**	**100**

The results indicated that 50 (39%) people spent 2-3 hrs on the dairy goat activities as compared to 16 (135%) people who spent 1-2 hrs.

4.2.3 Categories of the Adoption Index

A frequency table described the categories of adoption as per the indices as shown on Table 18.

Table 18: Frequency Table Showing Different Categories of the Adoption Index

Categories	Frequency	Percent
Low adoption	40	28.0
Medium Adoption	59	41.3
High Adoption	22	15.4
Very High Adoption	4	2.8
Total	125	87.4
Missing system	18	12.6
Total	**143**	**100.0**

Results indicated that 28% of the respondents were ranking at low adoption while 41% were at medium adoption which indicates a need for an improvement on the adoption of dairy goat projects

4.2.4. Analysis of the Influence of Socio-Economic Factors on the Adoption Index

Hypothesis 1: There is no significant statistical influence of farmers' socio-economic factors on adoption of dairy goat technologies among smallholder farmers in Nakuru North, Murang'a North, and Meru Central districts of Kenya.

1. Partial Regression for Socio- Economic Factors

The coefficient of determination (R square) measures the proportion of variability in a data set that is accounted for by a statistical model and the results are shown in Table 19.

Table 19: Partial Regression Test for Socio- Economic Factors

Model	R	R Square	Adjusted R Square	F	p-Value
1	.525(a)	.276	.226	5.492	.0001

Regression model coefficients

	Unstandardized coefficients		Standardized coefficients	t	p-values
Variables	B	Std. Error	Beta		
(Constant)	.721	.528		1.366	.175
Age (years)	.004	.008	.048	.480	.633
Primary education 1=yes, 0=no	-.005	.258	-.002	-.018	.986
Secondary education 1=yes, 0=no	-.699	.326	-.300	-2.144	.034*
Tertiary education 1=yes, 0=no	1.132	.675	.151	1.677	.097
Total Income (Kshs)	1.325E-05	.000	.454	5.057	.000*
Hours working on the farm for dairy goat (#)	.174	.055	.279	3.158	.002*
Gender of the Head/Decision Maker 1=male, 0=female?	.322	.188	.153	1.711	.090

a Dependent Variable: Adoption index

* shows values that are significant at p-value < 0.05

The results indicated that the socio-economic factors accounted for 30% of the adoption-index and that socio-economic factors are statistically significant at 5% level of significance since the p- value is 0.0001. The partial regression model coefficients for socio-economic factors indicate that total income, time spent on the farm, gender, tertially education and age positively influenced the adoption index. The order of influence was given by the standardized coefficients (Beta wt) as the most important variable being total income, time spent on the farm on dairy goat activities, gender, tertiary education and age in that order. Primary education and secondary education were found to influence adoption negatively. These results indicate that the higher the total annual income, available farm working hours, the higher the adoption index. Gender was coded as male =1 and female=0. Since the coefficients for gender are positive, it is therefore concluded that males had a higher adoption index than females in the three districts.

However, only total income and time spent on dairy goats were found to be positive and significant statistically, while secondary education was found to influence adoption negatively and was statistically significant at 0.05 level of significance. These results indicated that a unit increase in total income and time in hours spent on dairy goats on the farm would increase the adoption index by .454 and .279 units respectively, while every unit increase in secondary education as compared to no education decreased the adoption index by .300 units. The F-test was significant at 5.492 at 0.05 level of significance. We therefore reject the hypothesis that there is no statistical influence of farmers' socio economic factors on adoption of dairy goats.

2. Discussion on Socio- Economic Factors

Socio-economic factors are variables that influence adoption and an understanding of these factors is valuable information to the efforts to enhance adoption rates (Rogers, 1983). This study showed that age positively influenced the adoption index of dairy goats in the three districts, but it was not significant statistically and, therefore agrees with other studies that age shows inconsistent evidence on influence on adoption. On the other hand, Rogers (1983) revealed that 19% of studies show that earlier adopters are younger, 38% indicated they are older while 50% show inconsistent evidence about age. A study by Tambi (2003) revealed that age did not significantly affect the decision to adopt sheep and goats.

This study also revealed that gender positively influenced adoption of dairy goats in the three districts and it was found not to significantly statistically influence the adoption of dairy goats at 0.05 level of significance. According to Nycander *et a.* (2002) gender based differences affect access to resources and gender roles have significant contribution towards sustainable agriculture and livestock development. Ochola (2002) stipulated that gender is a variable that influenced agricultural productivity. This study agreed with former studies since it showed that males were predominant and had a higher adoption index. This calls for support for gender mainstreaming and to equal investment opportunities in both men and women through education and extension.

The results of this study showed that total annual average income had the highest and most important influence in adoption of dairy goats and the subsequent technologies. This result agree with the study done by Lapar and Ehui (2004) conducted on the uplands of the

Philippines on adoption of dual purpose forages and results indicated that farmers with higher income and had access to credit were more likely to adopt the dual purpose forages. A study done in three coastal districts of Kenya Sechrest *et al.* (1998) on adoption of grade cattle revealed that lack of money to purchase a grade animal was reason for non adoption as farmers owning such animals tended to have higher off-farm income.

This study also showed the following results on education; that primary education as compared to no education had a negative influence and was not significant statistically. Secondary education influenced adoption negatively and was significant statistically. Tertiary education positively influenced adoption but was not significant statistically. This is inconsistent with findings by Lapar and Ehui (2004) who found out that those farmers who were more educated were more likely to adopt the dual purpose forages. However this study agrees with a study by Rogers (1983) who indicated that earlier adopters have more years of education than late adopters, have higher social status and have larger farms. Farmers are encouraged to attain at least primary education since Secondary education was not considered influential.

Most of the farmers in the study area spent 2-3 hours daily on dairy goat activities on the farm. Analysis indicated that time spent on dairy goats was the second most important factor in adoption of dairy goats, and that every hour put in dairy goat activities increased adoption. The results agreed with a study done by McNamara *et al.* (1991) who found that the combined labor supply of the operator (farmer) and spouse indicated the total amount of time available for farming and non-farming activities. Operator and spouse off-farm employment may constrain adoption of management of intensive technologies because they compete for other farm activies.

4.2.5. Influence of Technology Transfer Factors on the Adoption Index

Hypothesis 2 There is no significant statistical influence of technology transfer factors on adoption of dairy goat technologies among smallholder farmers in Nakuru North, Murang'a North, and Meru Central districts of Kenya.

1. Descriptive analysis of extension agents' education and experiences

Descriptive analysis of the extension agents by gender is as shown in Table 20.

Table 20: Frequency Distribution of Extension Workers by Gender in the Districts

		Gender		Total	Percent
		Male		Female	
Name of district	Meru	4	1	5	42
	Muranga	2	1	3	25
	Nakuru	4	0	4	33
Total		**10**	**2**	**12**	**100**

There were 13 extension officers in the study area of which one did not respond to the questionnaire. The accessible population was 248,000 (G.O.K, 2001b) and this indicates a low population of staff to farmer ratio. In total there were 83% males and 17% females working in the study area. This also indicates a gender imbalance in staff deployment. Table 21 shows that 25% of the extension agents had primary level of education, 25% degree level while 34% were of certificate level.

Table 21: Frequency Distribution of Educational Level of the Extension Agents (N=12)

	Frequency	Percent
Primary	3	25.0
Secondary	1	8
Certificate	4	34
Diploma	1	8
Degree level	3	25.0
Total	**12**	**100.0**

The workers' level of education indicated that education was not satisfactory since there were farmer trainers who were of primary school level especially in Meru Central and Nakuru North Districts, while some of the farmers were of secondary and tertiary levels. This obviously affects how the trainer interprets the messages and how the message is passed on to the farmer. This will influence the adoption of the message. All trainers had enough experience in their work as ten had worked for more than five years. The two workers who worked for less than five years were farmer-to-farmer trainers in farmer training centres and who were also of primary level of education. They were not employed by the government.

Table 22: A Cross Tabulation of the Districts and Working Experience of the Workers. (N=12)

		Working experience			Total
		1-5 years	6-10 years	11-15 years	
Name of district	Meru	0	3	2	5
	Muranga	0	0	3	3
	Nakuru	2	1	1	4
Total		**2**	**4**	**6**	**12**

Table 22 shows that 6 of the extension agents had a working experience of between 11-15 years, 4 had 6-10 years and 2 had 1-5 years of working experience.

2. Farmers sources of information

Table 23 shows the frequency distribution of how farmers sourced for information from different sources.

Table 23: Percent Distribution of Farmers Sources of Information (N=143)

	Frequency	Percent
Farmer	64	44.8
Farm Africa	11	7.7
Govt officers	35	24.5
DGAK/MGBA	15	10.5
Farming systems	3	2.1
Total	128	89.5
Missing system	15	10.5
Total	**143**	**100.0**

Less than half of the farmers 64 (44.8%) of the farmers in the study area got their information from other farmers. This indicates the importance of farmer to farmer extension and the need for farmers to get their information from reliable sources. Government officers were not always available even though they were available on demand. Some private officers were reported to train the group members mainly at a fee. Farmers expressed the need to have a reliable information source available at all times. Farmers in the study areas did not have any print, audio, audio-visual and visual materials for their reference on the farms except for

the officials who had attended trainings (TOTs). Where institutions use farmers as trainers of other farmers they should have more formal and professional education in order for other farmers to gain confidence in them. This will also avoid conflicts and misinterpretation of messages in the communities.

3. Regression for technology transfer factors

R square was 5% showing that the technology transfer factors on their own contribute 5% to the adoption-index as shown in Table 24.

Table 24 Model Summary and Regression Model Coefficients for Technology Transfer Factors

Model	R	R Square	Adjusted R Square	F	p-value
1	.228(a)	.052	.007	1.101	.364

Regression model coefficients

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	1.780	.322		5.535	.000
Group method	-.019	.269	-.007	-.069	.945
Individual method	-.352	.217	-.171	-1.623	.108
Availability of extension worker	.099	.343	.031	.289	.773
Mass Media	.058	.237	.026	.243	.809
Availability to source of information	.432	.251	.168	1.725	.088

a Dependent Variable: Adoption index

Since the calculated p- value was 0.364 which was greater than 0.05, the regression was not significant statistically at 5% significance level. The combination of technological factors did not significantly affect the adoption index. The regression coefficients for the technology transfer factors were as tabulated in Table 24. Technology transfer methods were measured as binary variables 1=yes otherwise 0. Mass media method, availability of extension workers and information sources was found to positively influence adoption of dairy goats. Group method and individual methods were found to negatively influence adoption. However, none of the technology transfer factors were found to be statistically significant.

4. Discussions on the technology transfer factors

According to the results, technology transfer factors were not statistically significant although mass media, availability of extension workers and availability of information sources were positive factors of adoption in the study area. The choices of an appropriate medium appear to be crucial. No one medium is best, but the selected media must be adapted to the message, target audience, and social environment (Wete, 1991). According to Moore (1991), the chasm is the time gap in technology adoption, which is between the early adopters and the early majority. These form the major client groups of extension. Moore also sees these groups as significantly different "markets" in the "selling" of an innovation. With a proper choice of mass media the early majority can be transformed into early adopters. This study agree with the study done in Gaighata and Bagdah blocks of West Bengal indicating that mass media variables is significantly correlated with adoption of improved animal husbandry practices in non member (Ghosh *et al.*, 2004).

4.2.6. Influence of farmers' socio-economic and technology transfer factors on adoption index

Hypothesis 3: There is no significant statistical influence of farmers' socio-economic and technology transfer factors on adoption of dairy goat technologies among smallholder farmers in Nakuru North, Murang'a North, and Meru Central selected districts of Kenya.

1 Full Regression Analysis

A full regression analysis was undertaken in order to find out the influences of the combined socio-economic and technology transfer factors on the adoption index. The results are as stipulated in Table 25.

Table 25 Influence of the Combined Factors on the Adoption Index

Mode	R	R Square	Adjusted R Square	F	p-value
1	.604(a)	.365	.275	3.628	.0001

Regression model coefficients

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	.181	.603		.299	.765
	Group method	.197	.296	.067	.665	.508
	Individual method	-.409	.198	-.198	-2.067	.042*
	Availability of extension worker	.017	.316	.005	.054	.957
	Mass Media	.536	.240	.239	2.237	.028*
	Availability to source of information	.130	.237	.052	.551	.583
	Gender	.473	.192	.233	2.468	.016*
	Age	.006	.008	.086	.822	.413
	Income	1.648E-5	.000	.588	5.759	.001*
	Primary education	-.046	.249	-.024	-.185	.854
	Secondary education	-.575	.322	-.260	-1.785	.078
	Tertiary education	.941	.644	.138	1.460	.148
	Hours working on the farm for dairy goat	.130	.058	.222	2.252	.027*

a Dependent Variable: Adoption index
*Significant statistical variables

Results of the full multiple regression model coefficients for socio-economic and technology transfer factors indicated that R-square = .365 indicating that both the socio-economic factors and technological factors contribute approximately 37% of variable to the adoption index.

2 Discussions of Full Regression Analysis

The full regression identified eight factors which positively influenced the adoption index. The full regression analysis identifies gender as significant statistically, which was not previously identified in the socioeconomic analysis .It also identifies Individual methods as negatively influencing adoption index. These factors in order of importance are: 1) income, 2) mass media 3) gender, 4) time in hours, 5) tertiary education, 6) age 7) group method 8) availability of information and 9) availability of extension workers.

In conclusion, socio-economic factors of income, gender, and time in hours and technology transfer factors of mass media were found to be positive and significant statistically. Secondary education and individual methods of training were found to be negative and significant statistically on the adoption index. The full regression analysis is statistically significant at 5% significance level since the F-value is 3.628 and p-value is .0001 indicating that the combination of socio-economic factors and technological factors significantly influenced the adoption index as shown in table 24.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter outlines the summaries, conclusion and recommendations related to the study.

5.1 Summary of Findings

This research was aimed at investigating how socio-economic and technology transfer factors influenced the adoption of dairy goats among smallholder farmers in Nakuru North, Muranga North, and Meru central districts of Kenya. Socio-economic factors included gender of household head, age of household head, and educational level of household head, total annual farm income, and time spent on the farm. Technology transfer factors included technology transfer methods (mass, group, individual), technology transfer agents' educational level and experience and information sources and availability.

Based on the above purpose, the following objectives of the study were investigated..

1. To describe the characteristics of dairy goat farmers in Nakuru North, Murang'a North, and Meru Central districts of Kenya.
2. To characterize dairy goat technologies promoted to farmers in Nakuru North, Murang'a North, and Meru Central districts of Kenya.
3. To assess the influence of farmers' socio-economic factors on adoption of dairy goat technologies among smallholder farmers in three districts Nakuru North, Murang'a North, and Meru Central districts of Kenya.
4. To examine the influence of technology transfer factors on adoption of dairy goat technologies among smallholder farmers in Nakuru North, Murang'a North, and Meru Central districts of Kenya.
5. To explore the influence of farmers' combined socio-economic and technology transfer factors on adoption of dairy goat technologies among smallholder farmers in Nakuru North, Murang'a North, and Meru Central districts of Kenya.

Future prospects in the livestock sub-sector are tied significantly to technology promotion, marketing and animal health services interventions for smallholder farmers to increase food security and improve their living standards. They require adoption of productive and sustainable technologies exemplified in the improved dairy goat. There are many factors that affect farmers' decisions making process in the adoption of diary goats. In

line with the Millennium Development Goals (MDG), which includes resolving the constraints of poverty and hunger, there is need for effective adoption of technologies.

Results of the study identified nine factors which positively influenced the adoption factors in order of importance these are: 1) income, 2) mass media 3) gender, 4) time in hours, 5) tertiary education, 6) age 7) group methods 8) availability of information sources and 9) availability of extension workers. Individual methods and secondary education were found to influence adoption negatively. However, socio-economic factors like income, gender, and time in hours, and technology transfer factor of mass media were found to be positive and significant statistically. Secondary education and individual methods of training were found to be negative and not significant statistically on the adoption index. A combination of socio economic and technology transfer factors significantly influenced the adoption index of dairy goats since $F = 4.031$ at 0.05 level of significance. Therefore the hypothesis that the there is no significant statistical influence of socio-economic and technology transfer factor on adoption of dairy goats in Nakuru North, Muranga North and Meru central districts of Kenya is rejected.

5.2 Conclusion of Findings

All socio-economic factors were found to singly influence adoption of dairy goats in the three districts. Technology transfer factors were singly not found to be significant statistically except for mass media. However combinations of the factors were found to have significant statistical influence on adoption. It can therefore be concluded that income, gender, time in hours, mass media, tertiary education, group methods, availability of information and availability of extension agents influenced adoption of dairy goats in the three districts. The four factors found to be positive and significant statistically and can be used in the prediction and control in the design of dairy goat program's were income, mass media, gender, and time available to work on the farm. Individual method of technology transfer and secondary education were found to be an important variable since they significantly influenced adoption negatively. These are the factors that need to be addressed in order to improve the design and development of dairy goat projects by policy makers, project managers, implementers, extension agents and all the other stakeholders in order to improve adoption of dairy goats. The designers of dairy goat projects should take into consideration the socio-economic factors and the relevant technology transfer factors in order

to come up with an appropriate extension procedure that incorporates all categories of farmers in order to increase adoption.

5.3 Recommendations

1. Policy makers should put in place policies that ensure availability of affordable credit and subsidies to smallholder farmers since income was found to be the most influential factor in dairy goat adoption. The annual income levels of the farmer should be considered in dairy goat projects.
2. Dairy goats' project designers, developers and implementers should consider the different adopter categories and use appropriate extension methods to reach the different categories of farmers. Mass media was found to influence adoption greatly in the study areas while individual methods were not influential. This therefore calls for categorization of farmers by socio- economic and technology transfer factors in order to join the appropriate dairy goat groups. The information gaps between group members and non-group members can be bridged through mass media education especially on print (handbooks and booklets), audio and audio-video media in English, Kiswahili and the local languages.
3. Since women were found to have adopted more packages than men even though men owned more goats there is need for up scaling of gender mainstreaming in the dairy goat projects by the dairy goat project designers and implementers if female farmers are to contribute sustainably towards dairy goat farming.
4. Dairy goat project designers and implementers need to consider educational levels since it came up as an important aspect of socio economic factors. Farmers need to be categorized into their educational levels before joining groups since secondary education was found to negatively affect adoption.
5. Dairy goat project designers and implementers need to provide a reliable local information source whereby farmers, extension workers and other stakeholders can access information on the dairy goat and dairy goat technologies/packages from both local and international sources. This will encourage younger and elite farmers to enter the dairy goat industry and this will increase the number of dairy goats and products in the study areas.

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APPENDIX A

QUESTIONNAIRE FOR FARMERS ON THE INFLUENCE OF SOCIO-ECONOMIC AND TECHNOLOGY TRANSFER FACTORS ON ADOPTION OF DAIRY GOATS IN SELECTED DISTRICTS OF KENYA

INTRODUCTION; This information is strictly confidential and will only be used for the purpose of this study.
Please answer the questions as accurately as you can remember.
Please fill in the gaps or tick where appropriate.

A General Information

Questionnaire number---------- Date of interview----------

1. District----------

2. Division---------- Name of your group----------

B Socio –economic Profile

3 Gender of household head/ decision maker: 1) Male [ ] 2) Female [ ]

4 Age 1) less 25 yrs [ ] 2) 25 – 35 yrs [ ] 3) 36-45 yrs [ ]
4) 46-55 yrs [ ] 5) 56-65 yrs [ ] 6) over 65 yrs [ ]

5. What is the size of your own farm? 1) Less than 1 acre [ ] 2) 1-2 acres [ ]
3) 2-3 acres [ ] 4) 3-4acres[ ] 5) over 4 acres [ ]

6 What is the size of your rented farm 1) 0-0.5acres [ ] 2) 0.5-1acres
3) 1-1.5acres [ ] 4) 1.5-2acres [ ] 5) over 2acre [ ]

7 What is your average annual income? On- farm: Cash crops kshs. ----------
Food crops kshs-- ---------- Livestock kshs----------
Off –farm: kshs---------- Total kshs----------

8. What is the highest level of education attained?
1) No education [ ] 2) Primary [ ] 3) Secondary [ ] 4) Tertiary [ ]

9. What type of labour do you have on the farm?
1) Family [ ] 2) Hired [ ]

10. How many man/ woman hours do you have working on the farm for dairy goat keeping?
1) Males ----------hrs 2) Females ----------hrs

11 How many man/ woman hours would you require for dairy goat keeping per day?
1) Males ----------hrs 2) Females ----------hrs

C. Adoption of Dairy Goat packages

Where did you get your breeding stock?

12 Does 1) Farmer [ ] 2) Organization (specify) ----------

13 Bucks 1) Farmer [ ] 2) Organization (specify) ----------

14 What was the cost of the breeding stock? Does Kshs 1) Less than 40000 [ ]
2) 4,000-7,000 [ ] 3) 7,000-10,000 [ ] 4) over10, 000 [ ]

15 Cost of Bucks Kshs 1) Less than 4000 [ ]
2) 4,000-7,000[ ] 3) 7,000-10,000 [ ] 4) over 10,000 [ ]

16 What breeds are Does 1) Local (specify) ---------- 2) Crosses (specify) ----------

3) Pure breed (specify) ---------- 4) others (specify) ----------

17 What breeds are Bucks 1) local (specify) ---------- 2) Crosses (Specify) ----------

3) Pure breed (specify) ---------- 4) others (specify) ----------

18. How many kiddings do you get in one year? 1) Nil 2) [ ] 3) [ ]

19 Number of twinning per year? 1) Nil 2) [ ] 3) [ ]

20 What do you do with the male kids? 1) Rear for sale [ ]

2) Rear for Breeding [ ] 3) Pass Back to Programme [ ] 4) others (specify) ----------

21 How much do you sell Does Kshs 1) Less than 4000 [ ]

2) 4000-7000 [ ] 3) 7000- 10000 [ ] 4) over 10000[ ]

22 How much do you sell Bucks Kshs 1) Less than 4000 [ ]

2) 4000-7000 [ ] 3) 7000-10000 [ ] 4) over 10000[ ]

23 What do you feed your goats on? 1) Grass/ Napier [ ] 2) Tree forage [ ]

3) Grass + Tree Forage [ ] 4) Sweet potato vines [ ] 5) others specify----

24 How many acres of forage do you have? 1) Nil [ ] 2) Less than ¼ [ ]

3) ¼ - ½ [ ] 4) ½ - 1 [ ] 5) over 1 acres [ ]

25 Do you conserve any forage? 1) Yes [ ] 2) No [ ]

26 If yes, which types? 1) Hay [ ] 2) Maize Stover's [ ] 3) Silage [ ]

4) Total mixed ration [ ] 5) others specify----------

27 Do you have a milking table? 1) Yes [ ] 2) No [ ]

28 Do you use milking jelly? 1) Yes [ ] 2) No [ ]

29 Do you check for mastitis? 1) Yes [ ] 2) No [ ]

30 How much milk do you get per day in litres? 1) Less than ½ [ ]

2) ½-1 [ ] 3) 1-1½ [ ] 4) 1 ½-2[ ] 5) over 2 litres [ ]

31 How much do you consume in litres -------sell in litres --------Price in Kshs. --------

32 Do you experience any marketing problems? 1) N/A [ ] 2) Yes [ ] 3) No [ ]

33 Specify the problem above? ----------

34 What type of housing do you keep your animals in? 1) No goat housing [ ]

2) Semi permanent housing [ ] 3) permanent housing [ ]

35 Which livestock system do you practice on your farm? 1) Zero grazing [ ]

2) Semi zero grazing [ ] 3) Tethering [ ] 4) others specify ----------

36 Do you have enough water for your animals? 1) Yes [ ] 2) No [ ]

37 Which dairy goat diseases do you mainly experience? ----------

38 Who treats the goats for you? 1) N/A [ ] 2) Self [ ] 3) Group Vet [ ]

4) Private Vet [ ] 5) Government Vet [ ] 6) Traditional Vet [ ]

39 Is treatment available? 1) N/A 2) Yes [ ] 3) No [ ]

40 Is treatment affordable? 1) N/A 2) Yes [ ] 3) No [ ]

41 Do you vaccinate your animals 1) N/A 2) Yes [ ] 3) No [ ]

42 How many dipping/ spraying do you do monthly? ----------

43 Do you hoof trim? 1) Yes [ ] 2) No [ ]

44 Do you dehorn? 1) Yes [ ] 2) No [ ]

45 Do you deworm? 1) Yes [ ] 2) No [ ]

D Extension Methods

46 Do you belong to any group? 1) Yes [ ] 2) No [ ]

47 If not give reasons ----------

48 Who do you consult for advice when you have a problem on the farm?

1) Government officer [ ] 2) Farmer [ ] 3) Private Officer (specify) --------

4) Universities (specify) ---------- 5) others (specify) ----------

49 How often does the extension worker visit you? 1) No visits [ ] 2) Weekly [ ]

3) Monthly [ ] 4) Twice a year [ ] 5) Once a year [ ] 6) others specify------

50 Are extensions workers available on demand? 1) Yes [ ] 2) No [ ]

51 Have you received any dairy goat trainings? 1) Yes [ ] 2) No [ ]

52 If yes to (51) above where were you trained? ----------

53 How long did the training take? ----------

54 Which method of teaching would you prefer? Tick one from each group below.

A) Mass Media		**B) Group**		**C) Individual**	
1. Print (written) Media	[ ]	1. Demonstrations	[ ]	1. Farm visits	[ ]
2. Audio (Listening) Media	[ ]	2. Group meetings	[ ]	2. Office calls	[ ]
3. Audio- visual media	[ ]	3. Field days	[ ]	3. Letters	[ ]
4. Visual (seeing) Media	[ ]	4. Tours and visits	[ ]	4. Informal contacts	[ ]
5. Others (specify) ---------		5. Others (specify) ----------		5. Others (specify) --------	

Which of the above methods assists you most in each of the adoption process stages below?

55 Knowledge (learning about the dairy goat keeping) ----------

56 Persuasion (understanding the value of the dairy goat keeping) ----------

57 Decision making (deciding to keep the dairy goat keeping) ----------

58 Implementation (Actual keeping of the dairy goats) ----------

59 Confirmation ----------

E. Adoption of Dairy Goats

60 How did you learn about dairy goat keeping? 1) Farmer [ ] 2) Government officers [ ]

3) Institution (specify) ---------- 4) Private workers (specify) ----------

61 How many goats do you have? ----------

62 How many among them are dairy goats? ----------

63 For how long have you been keeping the goats? ----------

64 Which among the seven extension packages do you practice? ----------

1) Breeding [ ] 2) Improved Housing [ ] 3) Milking [ ]

4) Kid rearing [ ] 5) Feeding [ ] 6) Good husbandry Practices [ ]

7) Health [ ] 8) Records keeping [ ]

65 In case you don't practice all of them why don't you practice the others?----------

---

66 Who does the work in each of the following extension practices?

Enter 1) for men and 2) for women and 3) if both.

1) Breeding [ ] 2) Improved Housing [ ] 3) Milking [ ]

4) Kid rearing [ ] 5) Feeding [ ] 6) Good husbandry practices [ ]

7) Health [ ] 8) Records keeping [ ]

F. Information and documentation.

67 Where do you get information on the following dairy goat practices?

Enter 1), 2), 3), 4), or 5) in the spaces below and specify.

1) Government officers. 2) Private Officers. 3). Universities.

4) Other farmers. 5) Others (specify)

	Where do you get information for each of the following practices	Where would you prefer to get information for each of the practices?
Dairy goat practices		
1. Breeding		
2. Improved Housing		
3. Milking		
4. Kid rearing		
5. Foliage and Nutrition		
6. Husbandry practices		
7. Health		
8. Records keeping		

68 Do you pay for any services? 1) Yes [ ] 2) No [ ]

69 If yes to 68 above Indicate services paid for and amount in Kshs. ----------

71 Do you access any documents on dairy goats? 1) Yes [ ] 2) No [ ]

72 How often do you get the information 1) N/A [ ]

2) Weekly [ ] 3) Monthly [ ] 4) Yearly [ ]

73 What information on the above practices would you like to access? ----------

---

74 Where would you like to get the information from? ----------

75 In what form would you like to access the information?

1) Print (Written) form [ ] specify ----------

2) Audio (Listening) form [ ] specify ----------

3) Audio visual (Listening/seeing) [ ] ---------- 4) visual (seeing) [ ] ----------

76 In general what changes would you like to see made in the current dairy goat teaching methods ----------

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Thank you for your cooperation.

APPENDIX B

QUESTIONNAIRE FOR EXTENSION WORKERS ON THE INFLUENCE OF SOCIO-ECONOMIC AND TECHNOLOGY TRANSFER FACTORS ON ADOPTION OF DAIRY GOATS IN SELECTED DISTRICTS OF KENYA

INTRODUCTION: This information is strictly confidential and will only be used for the purpose of this study.

Please answer the questions as accurately as you can remember.

Please fill in the gaps or tick where appropriate

1. Name of worker (optional) ----------
2. Institute of affiliation----------
3. Name of Area of work----------Size of area of work----------
4. Gender of officer 1) Male [ ] 2) Female [ ]
5. Age ---------- years
6. Educational level ----------
7. Do you have specialized training on goats Yes [ ] No [ ]
8. If yes to (6) above where you trained? ----------
9. How long did you train? 1) Less than 1 year [ ] 2) 1 – 2 years [ ]
   3) 2-3 years [ ] 4) Over three years [ ]
10. When did you start training farmers on dairy goats? ----------
11. How many dairy goat groups do you train? ----------
12. Does your organization produce any documents? Yes [ ] No [ ]
13. How many documents do you produce per year----------
14. What types of information do you document? ----------
15. Who are the beneficiaries of the documents? ----------
16. In what languages are the documents produced? ----------
17. Do you have a breeding program? Yes [ ] No [ ]
18. Which breeds of dairy goats do you breed? ----------
19. Where do you get updated information to deliver to the farmers? A) Government sector [ ]
    B) Private sector [ ] C) Mass media [ ] D) Others specify ----------.
20. In what form do you get the information? A) Mass media type (specify) ----------
    B) Group type (specify-) ----------C) individual type specify ----------
21. What is the approximate total membership of farmers? ----------
    What percentage of farmers in the groups have A) adopted---------- B) not adopted----------
    C) discontinued dairy goat keeping? ----------
22. Which extension methods do you use? Tick one in each group.

A) Mass Media	B) Individual	C) Group
1. Print Media [ ]	1. Farm visits [ ]	1. Demonstrations [ ]
2. Audio Media [ ]	2. Office calls [ ]	2. Group meetings [ ]
3. Audio- visual media [ ]	3. Letters [ ]	3 Field days [ ]
4. Visual Media [ ]	4 Informa contacts [ ]	4. Tours and visits [ ]
5. Others (specify) ----------	5. Others (specify) -------	5. Others (specify) -----

23. Which of the above methods would you prefer to use----------

24. How do you rate the effectiveness of the extension methodologies you have used at each of the adoption process stages below?

Adoption stage	Name of methodology used	Degree of effectiveness			Reasons for rating
		Very effective	Effective	Not effective	
1. Knowledge					
2. Persuasion					
3. Decision making					
4. Implementation					
5. Confirmation					

25. What changes would you suggest to the extension method? ----------

26. Approximately what percentages of farmers practice each of the following practices?

A) Breeding---------- B)Improved Housing---------- C) Milking----------

D) Kid rearing ---------- E) Good Husbandly practices ----------

F) Record keeping ---------- G) Records keeping ----------

27 What would you comment on the adoption level? ----------

28 What gender based problem do you experience in your training? Explain----------

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29 What changes would you suggest to the extension methods to improve adoption ----------

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Thank you for your cooperation.

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APPENDIX C

MAP OF KENYA SHOWING THE STUDY AREAS

