FACTORS AFFECTING ADOPTION OF CROSSBRED GOAT TECHNOLOGY BY FARMERS IN SOUTHEAST KADEM LOCATION, NYATIKE DIVISION OF MIGORI DISTRICT - KENYA

BY

CHARLES OKECH ODHIAMBO

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DECLARATION AND RECOMMENDATION

DECLARATION

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

Sign: _____ Date: 03/08/2006.

Charles Okech Odhiambo

RECOMMENDATION

This thesis has been submitted to the Graduate School for examination with our approval as University Supervisors:

Sign: _____ Date: 4/8/2006

Prof. C. A. Onyango

Department of Agricultural Education and Extension

Sign: _____ Date: 7/8/2006

Dr. M. O. Udoto

Department of Agricultural Education and Extension

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DEDICATION

To my LORD – and - Saviour, Jesus Christ, the LORD of Lords and KING of Kings who, not only knew me before my conception and predestined me for this course, but has also preserved my life; giving me strength to do all things through Him (Philippians 4: 13). Him alone exalts the lowly and abases the exalted, showing mercy from generation to generation to such as fear Him, and delivering them with a mighty and outstretched arm as He scatters the proud in the imagination of their hearts (Luke 1: 50 - 53). Surely, this has been your doing Oh LORD. Glory and honour be unto you now and forever more, AMEN!

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ABSTRACT

Macalder Sheep and Goat Station was established in 1981 to provide Kenya's Western rural smallholder farmers with crossbred sheep and goat breeds. Adoption of crossbred goat technology developed at the Station has been low since then. This ex – post facto survey sought to establish the technology adoption level and the factors that could explain this in Southeast Kadem Location of Nyatike Division, Migori District - Kenya. A structured questionnaire was used to solicit primary data from 120 smallholder goat rearing household heads obtained by proportional random sampling. Frequencies, percentages, means and standard deviations were used to organise and describe the data. Pearson's chi - square, ANOVA, Least Squared Difference Test, and Pearson's product moment correlation test were used to test hypotheses at 5% level of significance using Statistical Package for Social Sciences (SPSS). The study established that the crossbred goat technology adoption level was 23.3%, with numbers of crossbred goats kept and the frequency of acraicide spraying differing for each of the sub – locations of the study. Gender, educational level and technology cost had no significant influence on adoption of the technology and technology practices. Age, farm size, knowledge and skills in goat rearing, compatibility of the technology with existing farm practices and values, and livestock extension contact, did not have any significant influence on technology adoption, but significantly influenced dipping, spraying, supplementation, inbreeding control, proper housing, and the attention given to kidding does. It was concluded that gender, educational level, and technology cost, have no relationship with the adoption of the technology and technology practices. Age, farm size, knowledge and skills in goat rearing, extension contacts, and compatibility of the technology with existing farm practices and values, have no relationship with technology adoption, but are related to the adoption of the practices. It was recommended that the Station's objectives be redesigned to incorporate local farm practices and values, more on – station and on – farm demonstrations be done; further studies on the technology adoption should consider the influence of capital, credit and market access, and why farmers from afar are interested in goats from Macalder Station.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

ACTS	African Centre for Technology Studies
ASAL	Arid and Semi Arid Land
CIMMYT	International Maize and Wheat Improvement Centre
Demos	Demonstrations
DLPO	District Livestock Production Officer
DM	Dry Matter
FAO	Food and Agriculture Organisation of the United Nations
GDP	Gross Domestic Product
GoK	Government of Kenya
IDRC	International Development Research Centre
IFAD	International Fund for Agricultural Development
IITA	International Institute of Tropical Agriculture
ILCA	International Livestock Centre for Africa
ITAS	Intermediate Tropical Agriculture Series
KARI	Kenya Agricultural Research Institute
KDPG	Kenya Dual Purpose Goat
LM	Lower Midland Zone (See LM_3 and LM_4)
LRCDP	Lake Region Community Development Programme
NALEP	National Agriculture and Livestock Extension Programme
NARO	National Agricultural Research Organisation
NyaLiFA	Nyatike Livestock Farmers Association
OAU	Organization of African Unity
PDLP	Provincial Director of Livestock Production
SAGDP	Sheep and Goat Development Project
SPSS	Statistical Package for Social Sciences
SR- CRSP	Small Ruminant - Collaborative Research Support Programme
SR- NET	Small Ruminant Research Network
UNDP	United Nations Development Programme
WCGALP	World Congress on Genetics Applied to Livestock Production

CHAPTER ONE
INTRODUCTION

1.1 Background Information

The sheep and goat industry plays a significant role in the economic and social lives of millions of Kenya's smallholder livestock farmers living in the rangelands (80% of Kenya's land area). In these regions, and especially in the rural areas, it is a source of red meat, milk, wool, skins and to some extent mohair (Mucuthi, Munei & Sharma, 1994). At the national level, it contributes about 30% of the red meat consumed (GoK, 2000a). The population of sheep and goats in Kenya as of 2001 stood at approximately 18.6 million, with 7.6 million and 11.0 million sheep and goats, respectively (GoK, 2001).

Traditionally, Kenya's economy has been agrarian; hence agriculture has been the basis of most development efforts by the Kenya Government since independence. Much of the arid and semi – arid lands (ASALs) are inhabited by the agro - pastoralists or pure pastoralists, who practise traditional livestock rearing, emphasising on livestock numbers rather than productivity (GoK, 2000a). In these regions, the harsh environment and the low economic status of the pastoralists make it more economically viable to keep sheep and goats than other types of livestock (Mucuthi *et al.*, 1994). In light of this and of the potential of sheep and goats in improving the livelihoods of the rural population, the government jointly with FAO/ UNDP initiated and implemented a National Sheep and Goat Development Project (SAGDP) between 1972 and 1984 (FAO, 1985). Since then the project, which has led to a great improvement in the industry, has been funded solely by the government (GoK, 2000a).

In the course of the Project implementation, several Sheep and Goat Multiplication Stations were started to provide good breeding stock. One of these is Macalder Station in Southeast Kadem Location, Nyatike Division - Migori District, where this study was conducted. It was started in 1981 to upgrade the indigenous "Small East African Goats" by crossing with Boer bucks and provide the crossbred goat technology to smallholder farmers at a subsidised price. The study investigated the adoption level of the crossbred goat technology developed by the Station and the factors that could be responsible for it.

Macalder Station occupies 400 hectares of the 1,552 hectares Macalder Holding Ground. The holding ground is part of the 2,471.2 hectares government trust land (GoK,

1997). The Station's carrying capacity is 0.8 animals per hectare (i.e. 4 animals in 12.5 acres or 4 animals in 5 hectares). The animals referred to here are the small stock. It lies on latitude 0°58'S and longitude 30°18'E in a transitional LM_3 to LM_4 Zone at an altitude of 1218 meters above sea level. Rainfall is bimodal, with an annual mean of 600 - 700 mm. The first season comes between April and June, with a peak in May; and the second season between October and November, with November as the peak. Temperatures range from 25°C to 33°C, averaging 29°C, with day temperatures being generally high while nights are cold. Soils are predominantly *Luvisols* with *Acacia spp.* (shrubs) and *Hyperrania spp.* (grass) being dominant (GoK, 1997).

Nyatike Division has 65,502 people, with Southeast Kadem location having 9,142 people (GoK, 1999a). Livestock production is the major economic activity, with goats being very common (GoK, 1997). Due to this enormous potential, the Station was started to supply improved breeding goat to farmers of Nyanza and Western Provinces of Kenya for upgrading their flocks (FAO, 1985). The Station has over the years sold the crossbred goat at subsidised costs to farmers. It has also participated in extension activities (GoK, 2000a). Secondary data obtained from the Station indicated that the crossbred goat technology adoption in the study area has remained low over the years. Sales for the period 1987 - 2002 showed that the adoption level stood at 27.59% for Nyatike Division, while farmers come from as far as Central, Eastern and Western Provinces for the crossbred goat from the Station (Bennett, 1984; GoK, 2002a). This low adoption level tends to indicate that the Station is not meeting the objectives for which it was established. This research, therefore, intended to investigate the possible factors influencing adoption of the crossbred goat technology among smallholder goat – rearing households in Southeast Kadem location of Nyatike Division, Migori District. In Southeast Kadem, it covered smallholder goat farmers within Nyatike Sub – location (housing Macalder Sheep and Goat Multiplication Station), Owich Sub – location and Mikei Sub – location.

1.2 Statement of the Problem

Adoption of crossbred goat technology by farmers in Southeast Kadem location has been low, with little change in farmers' livelihoods since Macalder Station's inception in 1981 (Bennett, 1984; GoK, 2000a; GoK, 2002a). The low adoption level of crossbred goat technology in this location of Nyatike Division, Migori District seem to beat the

government's concerted efforts overtime to encourage farmers to utilise the technology generated from the station to improve the quantity and quality of their goat population as a means to improve their livelihoods. This study, therefore, sought to investigate the factors that have influenced the adoption of crossbred goat technology developed at the station, with a view to giving a possible explanation for the observed low technology adoption and recommendations for its improvement.

1.3 Purpose of the Study

This study sought to investigate the factors that have influenced the adoption of crossbred goat production technology in the study area, in order to establish why the adoption levels remain low since the Station's establishment in 1981.

1.4 The Objectives of the Study

i. To establish and compare the levels of adoption of crossbred goat technology among farmers in the three sub – locations of Southeast Kadem Location.

ii. To determine the extent to which farmers' personal characteristics are related to the adoption of crossbred goat technology.

iii. To determine the extent to which farmers' socio – economic characteristics are related to the adoption of crossbred goat technology.

iv. To determine the level of farmers' knowledge and skills in goat rearing and its influence on the adoption of the crossbred goat technology.

v. To establish the relationship between the cost of crossbred goat technology and its adoption among smallholder goat farmers in Southeast Kadem Location.

vi. To determine the extent to which the crossbred goat technology is compatible with existing farm practices and values and its relationship with the adoption of crossbred goat technology among smallholder goat farmers in Southeast Kadem Location.

vii. To establish the level of farmers' contact with livestock extension services and its influence on the adoption of crossbred goat technology.

1.5 Hypotheses

H_01: There is no statistically significant difference between farmers' adoption levels of the crossbred goat technology in the three sub – locations of Southeast Kadem Location.

H_02: Farmers' personal characteristics have no statistically significant relationship with the adoption of crossbred goat technology.

H_03 Farmers' socio – economic characteristics have no statistically significant relationship with the adoption of crossbred goat technology.

H_04: The level of farmers' knowledge and skills in goat rearing has no statistically significant influence on the adoption of crossbred goat technology.

H_05: The cost of crossbred goat technology has no statistically significant relationship with its adoption among the smallholder goat farmers in southeast Kadem Location.

H_06: Compatibility of the crossbred goat technology with existing farm practices and values has no statistically significant relationship with its adoption among smallholder goat farmers in Southeast Kadem Location.

H_07: Farmers' level of contact with livestock extension services has no statistically significant influence on the adoption of crossbred goat technology.

1.6 Significance of the Study

The study will add to existing literature for researchers on the adoption of livestock – based technologies, which is not as rich as that on the adoption of crop – based technologies. It will also increase the existing wealth of knowledge on crossbred goat technology developed at Macalder Sheep and Goat Multiplication Station for researchers, farmers and the general public. The study will also provide insight for researchers, policy makers, extension agents, farmers and the general public into the performance of the National Sheep and Goats Development Project in Kenya, especially after the other implementing partners pulled out in 1984.

Based on the study findings, especially on the level of adoption of the crossbred goat technology, and the factors responsible for this, the study has made key recommendations which will prove useful to the policy makers in redesigning Macalder Station's objectives in order to be more accommodative of the existing farm practices and socio – cultural values of the local community, which seems not to have benefited much from the technology

developed at the Station. The recommendations will also be useful to the implementers (the Station management), who will now be more focused, considering the extension gaps identified, and the need to be more accommodative of the unique geographical and socio – cultural and economic dispositions of the sub – locations of the study, bearing in mind the staff shortages currently being experienced by various government departments.

The documentation of the study's findings and the recommendations made will also be useful in creating more awareness on the crossbred goat technology and technology practices among the smallholder goat farmers in Southeast Kadem location and beyond, which will certainly lead to an improvement in the level of adoption of the same. Finally, the recommendations made from this study, will be useful to researchers as the basis of further studies on crossbred goat technology, considering other factors not included in this study and a different and wider geographical location for such studies.

To achieve these objectives, the study findings and recommendations will be published in refereed journals, presented in workshops, discussed with officials from the Ministry of Livestock and Fisheries Development at the national, provincial and district levels, management of Macalder Sheep and Goat Station and CBOs operating in the study area, and translated into simplified and farmer – focused extension leaflets that will then be distributed to the farmers through the livestock extension personnel in such fora as field days, on – farm demonstrations and agricultural shows.

1.7 Assumptions

i. That the government policy at the time of the study was favourable to the adoption of the crossbred goat technology by smallholder goat farmers in the study area.

ii. That farmers' health status before and at the time of the study was not a hindrance to the adoption of crossbred goat technology by smallholder goat farmers in the study area.

iii. That the existing security and security of land tenure in the study area was adequate and satisfactory at the time of conducting the study.

1.8 Scope

This study was conducted in Southeast Kadem Location of Nyatike Division, Migori District, Kenya; drawing primary data from smallholder goat rearing household heads (with at least 2 goats) selected by proportional random sampling from Owich, Nyatike, and Mikei Sub – locations of the Location (Appendix A). It looked at how selected household factors, technology factors and institutional factors influenced or related to the adoption of crossbred goat technology among the sampled households, while bearing in mind that there are other factors which directly or indirectly interacted with the factors studied to influence the technology adoption. Secondary data was also obtained from Macalder Sheep and Goat Station, Nyatike Divisional Agriculture and Livestock Production Offices, as well as Migori District Livestock Production Office.

1.9 Definition of Terms

Breed: A breed of animal is a group of animals of the same species with similar appearance and qualities, and is usually a product of several years of selection. Examples include the "Small East African Goat", Galla, Toggenburg and Boer.

Boer Buck: A buck is a mature male breeding goat. A Boer buck is a specific male breeding goat originally from South Africa, typified by a white body with brown head and belly. It is a fast - growing meat – goat attaining mature weight earlier than most native goat breeds. It is commonly used in upgrading programmes.

Crossbred Goat: A crossbred animal results from the mating of two pure breeds of the same species. In this study, it refers to a cross between the "Small East African Goat" breed (female) and the Boer breed (male). Thus, it is an improved goat, a product of several years of a successful crossbreeding programme, allowing the cross adequate time to stabilise in the particular environment before offering to the farmers for further improvement of their own local flock. This explains why it was deemed a technology.

Extension Service: This is a service offered to farmers, involving the transfer of new ideas, knowledge, skills or innovations to improve the farmers' livelihoods. It is in most cases the main source of agricultural information enabling the farmers to be able to acquire the knowledge necessary in order to make appropriate and informed decision on whether or not to adopt a new technology. In this study, passing of the crossbred goat technology through livestock extension services was perceived as critical in the

smallholder goat farmers' decision to adopt the crossbred goat technology, and hence improved livelihoods.

Small East African Goat: This is one of the most successful domestic stocks in the ASALs. It is a local breed of goat popular and found all over East Africa, having a variety of colours, ranging from pure white to pure black, with various intermixes of roan and speckled brown. It is well adapted to the local conditions of the region, but is slow – growing, late – maturing, and attains only a small mature size and low mature weight.

Small Stock: This refers to sheep and goats, together recognised as being, among others, the small ruminant animals (animals that chew cud or ruminate).

Technology: This refers to a new idea, skill, practice or innovation introduced to farmers to improve their livelihood through improved productivity. In this study, it refers to the improved breed, the cross between the Boer and "The Small East African Goat" breeds. This is a new technology to the farmers being initially exposed to it, as it is a result of several years of careful selection, crossbreeding and allowing the crossbred goat to reach environmental equilibrium before exposing to the farmers for use in further upgrade the local stock.

Technology Adoption: This is a complex mental process an individual passes through from the time he/she is initial exposed to a new idea, practice, skill, or innovation to the time he/she finally accepts to take it up. It involves the stages of knowledge, persuasion, decision and confirmation. In this study the number of crossbred goats kept and the extent to which the sampled households practiced selected crossbred goat technology practices, was used to measure the level of technology adoption.

Traits: Are observable and heritable characteristics of an animal, such as mature weight or size. In this study, it refers to the superior qualities of the Boer buck and the inferior qualities of the "Small East African Goat."

Upgrading: A breeding programme involving the mating of two unrelated lines of breeds of animals where one has superior traits that are desired, and which traits lack in the other. The resulting breed, acquires traits peculiar and superior to those of either parents. In this study, the Boer buck (superior) was used to upgrade (improve) "The Small East African Goat", producing over time the crossbred goat, whose adoption was under investigation.

CHAPTER TWO
REVIEW OF RELATED LITERATURE

2.1 Introduction

This chapter highlights the major aspects of the literature reviewed by the researcher that are relevant to the study. The reviewed literature covers work on goats in the World, Africa and Kenya (with respect to the National Sheep and Goat Development Project), Macalder Sheep and Goat Station, technology adoption and diffusion, as well as specific factors relating to the adoption of agricultural technologies. The chapter ends with a summary of the literature reviewed and the premises upon which the conceptual framework for the study was developed.

2.2 Overview of the Goat Industry in Africa and the World

All over the world, most small scale livestock farmers live in marginal low rainfall areas where livestock production is the most viable economic activity. Being highly productive in such ecosystems, the animals are a source of protein, energy and income (Steinbach, 1987). In developing countries, probably less than 5% of all marketed milk comes from goats, with rural households owning more than 90% of the goats. The rural households are characterised by poverty, hence low agricultural input and lack of modern management skills for improved productivity (Boyazoglu, Hatziminaoglou & Morand – Fehr, 2005).

According to Oduor (1984), domestication of goats is probably as old as human civilization, but their population in the world has continually varied over time (Nsubuga, 1996). In deed, Boyazoglu, Hatziminaoglou & Morand – Fehr (2005) confirm that the goat was the first animal domesticated to produce for the consumer, and has remained very popular to date with people in the Middle East, the cradle of the first known civilisations (Mesopotamia). The presence of the goat in all sectors of the ancient societies has continued to the present in terms of economy, nutrition and tradition. The world's goat population stood at 764,510,000, while the goat population in Africa was 219,736,000 in 2003 (Boyazoglu, Hatziminaoglou & Morand – Fehr, 2005). About 95% of the goats are in developing countries (Fitzhugh, 1987). Africa contributes 13% of the world goat population, while tropical Africa contributes a third of Africa's goat population (Ademosun, 1994). The rising goat populations in developing countries point to the goat assisting in solving some of the

needs created by the rising human populations (Boyazoglu, Hatziminaoglou & Morand – Fehr, 2005). Generally, the drier regions of the tropical Africa, with a semi – arid climate, a low population density, and lack of an alternative investment, have more goats than the wetter regions (Mrema and Rannobe, 1996).

Lebbie and Mastapha (1985) argued that the goat's formidable resilience and adaptability, prolificacy and modest nutrient demands make it the species of choice in the drier regions of the tropical Africa. The goat is especially adaptable to excessive temperatures, both cold and hot, under feeding, varying altitude levels, long distant trekking and prevalent droughts (Boyazoglu, Hatziminaoglou & Morand – Fehr, 2005). It produces up to 3 times as much milk as sheep (Wilson, 1986).

Goats are mainly reared by small – scale women farmers and children under the traditional extensive system, as an integral, but often not dominant, component of production systems. Goats are very important, being considered sacred in several cultures, producing rich milk and meat, and very useful skin and hair (Boyazoglu, Hatziminaoglou & Morand – Fehr, 2005). They have low maintenance and space requirements in the drier regions of the tropical Africa, yet goats have continued to receive very little attention over the years (Mrema and Rannobe, 1996), compared to the other animal production sectors, such as the cow milk, beef meat, poultry or pig sectors (Boyazoglu, Hatziminaoglou & Morand – Fehr, 2005).

As such, much of the research conducted on goats prior to the 1980s, both basic and applied, was mainly, if not only, published in obscure non – referenced journals and bulletins, which the scientific authorities of the time did not consider serious reading. Nevertheless, the challenges that have faced those involved in goat research, development and socio – economic growth in the past two decades have led to the overall recognition of this long underestimated species, hitherto considered synonymous with under development and poverty. As such, it is increasingly becoming important to re – examine the rearing of the goats in a new light and from a new perspective. In deed, this very dynamic sector may prove to be a new lever for agricultural development in the 21st Century (Boyazoglu, Hatziminaoglou & Morand – Fehr, 2005).

A fact worth appreciating about the goat industry is that the conditions prevailing in this century are multi – faceted and relatively complex. The problems and prospects vary greatly, depending on which part of the world the goat farming activity takes place, since each case would present peculiar cultural, financial or geographical settings. Due to the

complex nature of the goat sector and lack of training of goat farmers and the extension personnel, clear scientific information is difficult to create. Concerted efforts are needed to improve research efficiency and sustainability, give preference to those research goals that will provide answers to the real needs of producers and goat farmers, transfer research results to practice and have an investment policy adopted for the goat sector (Boyazoglu, Hatziminaoglou & Morand – Fehr, 2005).

Boyazoglu, Hatziminaoglou & Morand – Fehr (2005) recognized the fact that the available scientific information is not well adapted to the true needs of the development of the goat sector, making technology transfer difficult and the implementation of experimental results restricted. Their recommendation that more research work is needed in the sociological aspects of the goat production sector in developing countries provided the impetus for this study that intended to make a contribution specially tailored for the needs of the farmer, the extension agent, the researcher, and the policy maker in this highly dynamic sector.

While Ahuya, Okeyo, Mwangi – Njuru & Peacock (2005), Rewe, Ogore & Kahi (2002) and others have made great research contributions to the goat industry, their main focus has been the dairy goat, with little research data available on the development of the meat goat. This study, thus, makes one such needed contribution to the development of the meat goat sector in Kenya.

2.3 The Kenyan Goat Industry

Agriculture in Kenya generates 60% of the total foreign exchange earnings. The livestock sub – sector contributes 42 – 45% of the agricultural GDP (Ahuya *et al.*, 2005). Over 80% of Kenya's land surface is marginal, inhabited by small - scale rural farmers (Mucuthi, Munei & Sharma, 1994). Goats play a big role in the economic and social lives of these farmers, being a source of wealth, status symbol, red meat, milk, wool and skins, and, to some extent, mohair. They are a source of reliable smallholder farm income, energy and protein (GoK, 2000a).

Nationally, the sheep and goat industry contributes about 30% of the meat consumed locally (Gachuiri, Carles & Schwartz, 1986; GoK, 2000a) and 4% of total milk production (Ahuya *et al.*, 2005). There is an upward trend in the population of these animals, with a change from high sheep population some decades back, to a high goat population. The latter

trend could be due to the growing demand, especially for dairy goats since 1990's, and which could be directly attributed to the GoK/ FAO/ UNDP Sheep and Goat Development Project of 1972 - 1984 (GoK, 2000a). The goat population in Kenya stood at 10,871,348, of which 90,826 were dairy goats and 10,780,552 were meat goats, as of 2001 (Ahuya *et al.*, 2005).

Despite the fact that goats have increasingly become important sources of milk, especially to the resource – poor small – scale farmers unable to own dairy cattle, goat farming in the country faces several problems to do with marketing, tenure, infrastructure, range improvement, little farmer investment, time allocation and household labour constraints, and; use of local, low producing breeds (Onim, Hart, Russo, Otieno & Fitzhugh, 1984; Mucuthi *et al.*, 1994; Ahuya *et al.*, 2005). According to Kiwuwa (1986), goats are generally more economical to keep than sheep under the semi – intensive system. And, the indigenous breeds are better adapted to the arid and semi – arid land (ASAL) conditions than the exotic ones (Robertshaw, 1986).

Goats have multi – purpose roles, providing food, generating income or bartered exchange of commodities, directly benefiting the resource poor, small scale farmers. Their small size and early maturity makes them especially suitable for use on small farms as a first step towards wealth creation. As such, Kenya has over the time past made efforts to improve this very important industry. The UNDP funded and FAO executed sheep and goat projects of 1972 – 1984 provided a great boost to the development of the industry, leaving a mark to – date. Nevertheless, the industry is faced with the following challenges (Ahuya *et al.*, 2005):

i. inadequate husbandry

ii. poor supply of inputs like drugs, feeds, and water

iii. poor infrastructure and lack of efficient information networks

iv. poor public policy on the environment, especially on the administration of animal health policies and disease control

v. decreasing size of farm – lands to allow for alternative options that can be exploited economically

vi. insecurity and livestock rustling among pastoral communities

vii. frequent drought and lack of preparedness for such calamities

viii. unavailability of appropriate markets and poor market organization

ix. inadequate supply and availability of the most appropriate breeding stock and lack of adequate knowledge on their management

This study makes a contribution to the industry by looking at how some of the constraints mentioned above, notably inadequate husbandry, poor infrastructure and lack of efficient information networks, poor public policy on the environment, and decreasing farm sizes influenced the adoption of the crossbred goat technology generated at Macalder Station, with a view to finding possible ways and methods of improving the adoption levels.

2.4 The National Sheep and Goat Development Project (SAGDP)

Implemented jointly by the Government of Kenya (GoK), FAO and UNDP between 1972 and 1984, the National Sheep and Goat Development Project (SAGDP) led to the establishment of several Sheep and Goat Multiplication Stations to supply farmers with improved breeding stock (FAO, 1985). Operational stations at the time of the study included Matuga in Kwale, Buchuma in Taita Taveta, Kitengela in Machakos, Marimanti in Tharaka, Top - Farm Naivasha in Nakuru, Ol - Magogo Naivasha in Nakuru, Marindas in Nakuru, Kimose in Koibatek and Macalder in Migori (GoK, 2000a). Though the other partners pulled out in 1984, the government has since continued to support these stations. This is despite the poor performance of the stations, with only 21% of their potential being utilized in 2000 (GoK, 2000a). Considering this dismal performance, one may not understand the rationale for this continued government support to the stations, but the justification lies in the government's recognition of the stations' potential in poverty reduction and food security in the ASAL regions, where rainfed agriculture is not a feasible avenue for triggering sustainable livelihood transformation (GoK, 1999b).

In his summative evaluation report, Bennett (1984) feared that because of their subsidised cost the crossbred animals from the stations could end up being slaughtered, rather than used for breeding. This fact could not be authenticated due to poor post – sales follow – ups by the stations. While Rewe, Ogore & Kahi (2002) blame the poor performance on conflict of interest among collaborators, Bennett (1984) said the objectives were over – ambitious, unrealistic and unattainable. Bennett explained this on the basis of the government's lack of experience in running such a project. He recommended that the stations be reduced to four, concentrated within the Rift Valley and run with more specific, measurable and attainable objectives, upgrading only specific goat breeds.

Ahuya *et al.*, 2005 confirmed that the UNDP funded and FAO executed sheep and goat projects of 1972 – 1984 provided the first real meaningful effort to develop the goat industry, but on the basis of government stations. Even though the station – based projects failed to meet their objectives due to several technical, logistical and financial constraints, the 40,000 improved goats the country could boast of by 1996 were directly as a result of these efforts, from which further development has led to the country boasting of some 90,000 dairy goats as of 2005 (Ahuya *et al.*, 2005).

One major weakness of the station – based approach to the development of the goat industry in Kenya was that the farmers were not directly involved in designing and executing the projects, making the approach ineffective, unsustainable, expensive and non – cost effective. The fact that they were non – responsive to the farmer's needs calls for new approaches that are based on farmer groups (Ahuya *et al.*, 2005). This study, thus, looked at the factors responsible for the low level of adoption of the crossbred goat technology developed at Macalder Station and, on the basis of the findings, made recommendations that would give the farmer more inclusion into the design and operation of the Station, bearing in mind the socio – cultural, economic and geographical settings of the farmers in Southeast Kadem Location.

2.5 Macalder Sheep and Goat Multiplication Station

Situated in a Government trust land 35 Km. West of Migori Township in Nyatike Sub – location of South East Kadem Location, Nyatike Division - Migori District, Macalder Station is in a livestock zone with goats raised under the traditional extensive production system (FAO, 1985). The Station was started to upgrade "The Small East African Goat" by crossing with Boer bucks, multiplying the cross, and selling it to the farmers at a subsidised price for use in further upgrading programmes involving their own local flock. Being one of the last Stations to be established before donors severed support in 1984; the Station started on a low note, and has progressed poorly since then. For example, while Naivasha (Top Farm and Ol – Magogo) received government funding to the tune of Ksh. 883,145 and sold 127 animals, generating revenue of Ksh. 227,855 to the government in 2000/2001 financial year, Macalder Station received government funding of Ksh. 604,980 and sold only 73 animals, generating revenue of Ksh. 67,970 to the government over the same period (Ahuya *et al.*, 2005). The off take and mortality rates for Naivasha stood at 14% and 13.2%, respectively; while for Macalder these were 21.6% and 32.0%, respectively, implying the

animals at Macalder faced some kind of extinction unless a more deliberate effort is put to restock the Station.

The choice of the Boer bucks for upgrading the hardy, well - adapted "Small East African Goat" was based on its superior reproduction, growth and production traits, besides being native to Africa. It crosses well with "The Small East African Goat", producing fast growing kids that attain heavy adult weights (Kiwuwa, 1986; Nsubuga, 1996). Despite this noble objective, the Station has faced many challenges, with low adoption of the technology among the households in the study area (Bennett, 1984; FAO, 1985; GoK, 2000a). Nevertheless, the government has continued to support the station, viewing it as a basis of sustainable livelihood transformation among the local people. This study will further give the government an opportunity, from the findings and the recommendations, to re – examine its development objectives for the Station so that the farmers could best benefit from it, hence the expected transformational development could be speeded up.

2.6 Communication Theory and Diffusion of Innovations

Wiki books, the Open Content Textbook Collection (2005) reviewed works on diffusion of innovations done mainly by Rogers (1995) and Rogers and Singhal (1996). The collection traced the study of the diffusion of innovations back to the investigations of French sociologist Gabriel Tarde. Tarde attempted to explain why some innovations were adopted and spread throughout a society, while others are ignored. In so doing, he introduced the S – shaped curve and opinion leadership, focusing on the role of socio – economic status.

The fundamental research paradigm for the diffusion of innovations can be traced back to the Iowa study of hybrid seed maize by Bryce Ryan and Neal Gross in 1943. After the Second World War, rural sociologists changed their research focus on human problems among farmers, because new agricultural technologies, such as new pesticides, new farm machines, and hybrid seed maize were developed. It appeared ironical that in the midst of such great wealth of innovations some farmers ignored or resisted the new innovations. This led to several diffusion studies among Rural Sociologists at land – grant universities in the Midwestern United States to find out the causes of adoption of innovations.

Despite the apparently several advantages the hybrid seed maize had over the local seed, Iowa farmers isolated some barriers, which made them not to adopt the new technology. Such barriers only meant that the new technology was relatively expensive for the Iowa

farmers at the time of the Depression. In trying to explain how the hybrid seed maize came to attention and which of the two channels (mass communication and interpersonal communication with peers) led farmers to adopt the new innovation, Ryan and Gross discovered that each channel had a different function. Mass communication was the source of initial information, while interpersonal networks influenced farmers' decisions to adopt. They were, thus, led to understand that the adoption of innovations depends on some combination of well – established inter – personal ties and habitual exposure to mass communication, that the rate of adoption of hybrid seed maize followed an S – shaped curve, and that there were four different types of adopters. They also identified the five major stages in the adoption process, namely: awareness, interest, evaluation, trial and adoption. Later studies only helped to build on these findings, and to polish them up.

2.7 A Theoretical Overview of Diffusion of Innovations

Wiki books, the Open Content Textbook Collection (2005) defined diffusion after Rogers and Singhal (1996) as the process by which an innovation is communicated through certain channels over time among the members of a social system; and an Innovation as an idea, practice or object perceived as new by an individual or other unit of adoption. The diffusion of innovations involves both mass media and interpersonal communication channels. Hence, through sharing communication channels, such as interpersonal communication or mass communication people can get information of an innovation and perceive its usefulness. A typical model of communication comprises five distinct parts, namely: the sender, message, channel, receiver, and effect. The sender can be the researchers or inventors of a technology, the message can be the new idea or product, the channels can be the interpersonal or mass communication, the receivers can be members of a social system, while the effects can be the individual's adoption or social change (Wiki books, the Open Content Textbook Collection, 2005).

Most innovations have an S – shaped adoption rate, hence the adoption rates follow the normal distribution curve that is bell – shaped. Classified on the basis of the degree of innovativeness, adopters are categorised into five different types in the diffusion process (Wiki books, the Open Content Textbook Collection, 2005). Innovativeness is the degree to which an individual is relatively earlier in adopting new ideas than other members of his social system (Rollins, 1993). The five are: innovators or venturesome, early adopters or

respectable, early majority or deliberate, late majority or sceptical, and laggards or traditional (Wiki books, the Open Content Textbook Collection, 2005).

Rollins (1993) defined innovators as those who are venturesome, eager to try new ideas, desiring the risky, and cosmopolites of a society. He argued that early adopters are those individuals respected by their peers, more integrated into the local system, opinion leaders who are localities; while the early majority are those individuals who interact frequently with their peers [and] may deliberate for some time before completely adopting a new idea and follow with deliberate willingness in adopting innovations. Nevertheless, they rarely lead. On the other hand, the late majority are those individuals who adopt new ideas just after the average member of a social system have done so, are sceptical, and need the pressure of peers to motivate adoption. Finally, the laggards are those that adopt an innovation last, are traditional and tend to be frankly suspicious of innovations and change agents. The laggard's attention is fixed on the rear – view mirror (Rollins, 1993).

2.8 The Process of Innovation Decisions

In reviewing Rogers work (1995), Wiki books, the Open Content Textbook Collection (2005) argued that there are five stages involved in the process of innovation decisions. The five include knowledge, attitudes, adoption or decision, implementation, and confirmation. The knowledge stage involves a selective exposure or awareness of news, while in the attitudes stage; people develop a positive or negative attitude towards innovations. In the adoption or decision stage, people decide to adopt or not adopt the innovation, while in the implementation stage; people are in the regular or standard practice regarding the particular technology. Finally, in the confirmation stage, people are comparing and evaluating the practices they are involved in against the technology standards.

The perceived innovation's five characteristics will determine how fast an innovation will be adopted, and it is on the same basis that individuals perceive an innovation as new or useful and decide to adopt it. The five characteristics are an innovation's relative advantage, or the degree to which an innovation is perceived as better than the idea it supersedes, compatibility, complexity, triability, and observability.

2.9 Unit of Analysis on Diffusion Theory

Wiki books, the Open Content Textbook Collection (2005) recognised from Roger and Singhal's work (1996) that the theory of diffusion offers an explanation of how an innovation is spread and why it is adopted at both the micro and macro levels of analysis. The individual is usually the unit of analysis. Nevertheless, it is increasingly becoming evident that an individual organisation can be the unit of analysis. This is because the diffusion theory considers analysis at both the micro – individual and macro – social levels.

The four main elements in the diffusion of innovation process are innovation, communication channels, time, and social system. An individual's innovativeness, or psychological factors, such as communication needs are analysed as micro – independent variables. At the macro – social level, the major assumption the theory makes is that social systems can affect an individual's adoption of a technology. With respect to communication channels, the diffusion of an innovation involves both interpersonal channels (micro) and mass communication channels (macro), hence the diffusion theory ought to be given both micro – individual and macro – social analysis.

2.10 Diffusion Research Streams

Wiki books, the Open Content Textbook Collection (2005) in reviewing the work by Rice and Webster (2002) classified diffusion research and models into three categories, namely, the diffusion of innovations, the media choice, and implementation of information system. The "diffusion of innovations" studies focus on characteristics of an innovation and the role of communication channels in adopting the innovation. The "media choice" studies stress the interaction between individual characteristics and social influences in choosing some innovations, while the "implementation" studies argue that the variables, such as technology design or ease of use will affect media use.

According to Rollins (1993), adoption of new ideas and practices is affected by at least five factors, namely:

i. the type of decision involved in adoption
ii. the perceived attributes of the innovation
iii. the communication channels
iv. the nature of the client system, and
v. the extent of the practitioner's effort

It is the extension practitioners who facilitate the adoption of new ideas and practices, or influence the rate of diffusion and adoption of innovations, hence the need for them to understand the unique characteristics of the clientele system (Rollins, 1993). From the work of Rogers and Shoemaker, Rollins argue that several independent variables were related to innovativeness as the dependent variable, and from the findings, the independent variables were then grouped into three categories of generalisations, namely: the socio – economic status, the personality variables, and the communication behaviour. The socio – economic generalisation states that earlier adopters are no different from late adopters in age; personality generalisation states that earlier adopters have greater empathy than later adopters, while the communication behaviour of an earlier adopter includes more contact with change agents than that of a later adopter (Rollins, 1993).

The diffusion tradition, however, faces criticism from some scholars that argue that in explaining the variables influencing the adoption of an innovation, it has classified people according to their demographics, thereby making it fail to explain why and how people adopt certain technologies (Wiki books, the Open Content Textbook Collection, 2005).

2.11 Case Studies on Adoption of Livestock Technologies

Adoption of technology is often an outcome of a complex, but continuous process. It usually involves an individual farmer's subconscious evaluation of several factors and alternatives, with the farmer's and technology's attributes greatly determining the farmer's decision to or not to adopt the technology offered. The adoption process starts with an acceptance of an idea or concept, and finally ends up with full – scale adoption; but which may take variable length of time (Migwi, Gamba, & Onyango, 2002).

IFAD (2003) recognised that several factors contribute to growth in agricultural productivity, but technology is the most important. The rate of adoption of a new technology depends largely on the degree of risk and the level of uncertainty that goes with it, but is particularly influenced by the capital requirements, agricultural policies, and the socio – economic characteristics of framers (IFAD 2003). Generally, the risk – averse farmers are reluctant to invest in technologies they have little first – hand experience in. In this regard, weather variability is a very important risk factor in rainfed agriculture. The nature of the farming enterprise may also affect adoption, either positively or negatively,

depending on its relative contribution to the farm income, hence profitability is the most important determinant of the rate of adoption and diffusion (IFAD, 2003).

Studies among sheep owners in Iraq showed that the production system, availability of extension service and flock sizes are the three most important factors affecting the adoption of feed blocks (IFAD, 2003). Non conducive property rights, especially rights over ownership of land and tress; high labour requirements, long times involved in both hedgerow establishment and returns from adoption, above – and below – ground competition between crops and trees for resources, and non adaptability of some of the leguminous trees and shrubs were found to hinder adoption of alley farming in Cameroon, Nigeria and Bennin (IITA, 2003).

While examining the provision of feedback on pig production technology by farmers in Kwara State, Nigeria, Oladele (2002) observed that control of mange and ecto – parasites was the most widely adopted. This, he attributed to the fact that serious loss can occur as a result of infestation by ecto – parasites. Use of improved feeding was the second widely adopted technology, because feeding is a strong determinant of output in livestock systems. Technologies on deworming and vaccination were highly adopted owing to the effect of worms and diseases on livestock, with respect to losses. Upgrading of indigenous breeds to Nigerian hybrids was the least adopted technology as many pig farmers involved in the research had started with hybrids.

IITA (2003) underscored the importance of suitable policy in the acceptance of promising agro –forestry technologies, stressing that suitable policy cannot be ignored in the quest for sustainability in natural resource management and agricultural development in Africa, south of the Sahara.

In this study, the role played by government policy, land tenure rights, health status of a household, capital, credit and marketing were appreciated, but were never studied. Household head's gender, age, educational level, farm size, and knowledge and skills in goat rearing, were considered from the perspective of the farmer – related factors that could influence adoption. The technology's cost and compatibility with existing farm practices and socio – economic and cultural values and practices were considered critical technology – related factors; while farmer's contact with livestock extension was studied as an institutional factor that could critically influence adoption.

2.12 Factors Relating to Adoption of Crossbred Goat Technology

The specific factors related to the adoption of crossbred goat technology that are discussed in this study include the household head's gender, age, highest level of formal education, and farm size. Others include the cost of purchasing the crossbred goat technology, the compatibility of the technology with existing farm practices and values, and the farmers' level of contact with extension.

2.12.1 Gender

Roles and responsibilities of household heads as either male or female may affect technology adoption either positively or negatively (Ntege - Nanyeenya, Mugisa - Mutetikka, Mwangi & Verkuijl, 1997). In many parts of the developing world, rural women play a significant role in agricultural production, performing most of such reproductive roles as feeding the family, fetching water and firewood, cooking and cleaning the children. Other factors held constant, extension services are more efficiently utilised by female than male farmers. This is because of the critical role women play in agriculture – in household food production, marketing, post – harvest activities, livestock production, and several pre – and post – harvest tasks. Besides, they provide the bulk of the agricultural labour – force in many countries (World Bank, 2001a).

In Kenya, women provide over 80% of the agricultural labour (GoK, 2000b), performing such roles as planting, weeding, harvesting and marketing of the produce. Consequently, when a new innovation is associated with roles a community perceives to be for women, it will probably attract few men, hence, possibility of low adoption by male – headed households. The World Bank recommends that in implementing livestock projects, it is worth noting that women are generally concerned with raising small stocks and in processing activities, while men are responsible for large animals and marketing of the produce (World Bank, 2001b).

Budak, Darcan & Kantar (2005) considered the role of women in the labour distribution, decision making, reasons for rearing small ruminants and the importance of extension service as an information source among 100 women in 10 villages in the Taurus Mountains, turkey. The study showed that in 94.0% of the farms studied, the women and female children did milking; with women and girls also making cheese and yoghurt. Women and girls contributed 52% and 19.0%, respectively of the total labour involved in cleaning the sheep and goat barns. The study also observed that women and girls tended to be more

involved in labour than technical services, while men were more involved in and made decisions regarding activities that are technical and require money, such as vaccination.

Studies on the Kenya Dual Purpose Goat (KDPG) of the Small Ruminant – Collaborative Research Support Programme (SR - CRSP) showed that meaningful progress was realised with the Samia Women's Dairy Goat Project simply because in that community, goats and poultry were regarded as women's animals (Valdivia, 2001). The same study revealed that men in the particular community preferred capital intensive technologies, while women chose technologies that were extensive and related to food crops, such as tethering goats and feeding them sweet potato vines.

In her study of adoption of wheat technologies, Ndiema (2002) found that males made most of the decisions regarding technology adoption. This is expected because technology adoption involves commitment of resources, most of which are male – controlled in most parts of Kenya. The study further revealed that despite 72% of the study farmers being males, there were more female adopters (81%) than male adopters (71%). This is against the expected male dominance over resource and decision – making.

Okuro, Murithi, Verkuijl, Mwangi, Hugo de Groote & Macharia (2002) found gender to significantly influence adoption of maize production technologies. Wanyoike, Karugia & Kimenye (2002) recommended that extension services should address gender disparity against women in their strengthened efforts to pass over quantitative information about the benefits of fodder trees. Accordingly, in this study, the relationship between gender of the household head and crossbred goat technology adoption was investigated.

2.12.2 Age and Experience

The chronological age of a farmer can generate or erode his/ her confidence regarding certain technology practices and hence, greatly influence adoption in the sense that, with age the farmer becomes more or less prepared to take the risks associated with trying out a new technology (Ntege - Nanyeenya *et al.*, 1997). With age comes the experience and skills in a particular technology, but where education and energy are required, younger farmers are more likely to adopt a technology (Ndiema, 2002).

Ndiema found age not to significantly influence adoption of use of fertilizer, improved seeds and chemicals even though a third of the wheat farmers in her study area were younger (aged 15 - 45 years). She attributed this to the fact that the young farmers are

energetic and enthusiastic to adopt the technologies. Irungu, Mbogoh, Staal, Thorpe & Njubi (1998) found age to be very closely related to the farmer's farming experience.

Weinberg (2004) in his study of the adoption of new computer technologies found that young workers are better able to adapt to new technologies. He argued that while economists use vintage human capital models to conclude that young workers are the primary adopters and beneficiaries of new technologies, research has indicated that technological progress in general, and computers in particular, are biased toward skill. He found that among college graduate men, young workers adopted computers most intensively, while at lower levels of education, more experienced workers are most likely to use computers. In this study, the relationship between the household head's chronological age and crossbred goat technology adoption was investigated.

2.12.3 Educational Level, Knowledge and Skills

Education, formal and non - formal, is paramount in creating awareness, understanding, experience and exposure to new ideas, skills and information. This leads to self competence and an understanding of the principles of the technology to be adopted, increases managerial competence and is a prerequisite in the decision making stage of the adoption process. It empowers the farmer to make the right decision when faced with a variety of alternative technologies and be an effective manager of the same once adopted (Ndiema, 2002).

In her study, Ndiema (2002) found that 59.3% of the wheat farmers had either secondary or tertiary education, while 40.7% had some primary education or none; yet, unexpectedly, only 20.02% of them adopted the wheat production technologies. She, however, found that education level significantly influenced fertiliser – and improved seed – use in wheat production in agreement with the existing literature. Godoy, Franks & Claudio (1998) observed that education played a more prominent role in influencing adoption of modern agricultural technologies among relatively autocratic indigenous villages in Bolivia, concluding that conventional determinants of new farm technologies may need reappraisal in more autocratic settings.

Ntege - Nanyeenya *et al.*, (1997) found that formally educated farmers were more likely to adopt the Longe 1 maize technology by a factor of 4.3 than their illiterate counterparts. Wanyoike *et al.*, (2002) also found farmers' educational level to significantly influence adoption of Calliandra in all farms under their study, concluding that better

educated farmers are more likely to learn about new technologies sooner than their lowly educated counterparts. This conforms to the findings by Irungu *et al.* (1998) that education level significantly contributes both to the probability and level of adoption of maize production technologies.

Weinberg (2004) found that among the less educated workers, existing knowledge could be important for learning new technologies, especially if it is related to the one it is intended to replace. In this study the relationship between the crossbred goat technology - adoption and the household head's highest level of formal education and his knowledge and skills in goat rearing was investigated.

2.12.4 Farm Size

Farm size is an indicator of wealth and could also be an indicator of a farmer's social status and influence in any community (Ntege - Nanyeenya *et al.*, 1997). Farm size is expected to have a positive relationship with the adoption of improved crop cultivars and fertilizer (IFAD, 2003). Generally, any form of agricultural technology requires land, hence, the larger the farm size, the more likely a farmer is to try out a new technology. It is on his/her piece of land that the farmer will try out a new technology. Those technologies that require less financial commitment will be adopted more quickly than those that require much financial commitment (Adams, 1982).

Bebe, Udo, Rowlands & Thorpe (2003) found that dairy farmers in the Kenyan highlands responded to diminishing farm sizes by intensifying their dairy enterprises, through semi – zero grazing and zero – grazing activities. Nevertheless, whereas Ndiema's findings (2002) that farm size significantly affected adoption of fertiliser use in wheat production seem to be consistent with most, but not all the literature on technology adoption. This explains why in the same study, she found farm size to be independent of use of improved seeds and chemicals. In this study, an effort was made to relate farm sizes to farmers' adoption of the crossbred goat technology. This was used to describe the characteristics of the technology adopters.

2.12.5 Cost of Crossbred Goat Technology

The probability that a farmer adopts a new technology may be a function of the technology characteristics. Generally farmers tend to adopt technologies whose

characteristics promise a higher utility than those of the ones they are intended to replace. Accordingly, the technology's initial cost may be an incentive or a disincentive to the farmers' decision to adopt or not adopt the new technology. This is especially so for the poor small – holders with scarce capital available to them (Batz, Peters & Thorpe, 1999).

Whereas education would be important in changing farmers' misconceptions regarding a technology, farmers generally need some kind of inducement in order to adopt a particular technology. More often than not, this inducement has to take the technology's purchasing cost into consideration, hence some kind of cost – sharing (Sheriff, 2005). Thus, if the households perceive the cost of this technology as high, probably due to their generally low economic status, even if Macalder Station sells the crossbred goat technology at a subsidised cost, the households may not go for it unless it has some very readily observable and tangible advantages over the technology it is intended to replace – the local goat (Adams, 1982), or is perceived as relevant to an individual farmer's field (Sheriff, 2005).

Batz *et al.*, (1999) found that farmers adopted zero - grazing dairy technology if its characteristics promised a higher utility relative to the traditional technology. Okuro *et al.* (2002) pointed out that certain technology – or production – related factors may cause farmers' failure to adopt certain technologies. Gitari, Ransom & Friesen (2002) found that the high cost of inorganic fertilizers was a major drawback to its adoption. In this study, the perceived cost of purchasing the crossbred goat technology relative to the cost of local goat was related to technology adoption.

2.12.6 Compatibility with Existing Farm Practices and Values

If a technology is viewed by farmers as being too complex and too costly, such that it is not within their ability to manage, and is not commensurate with their income and financial potentials, the farmers may fail to adopt it even if research has proved it to be having numerous advantages over the one it is meant to replace. A study with Australian sheep farmers revealed that the order in which the farmers adopted technologies was practically the same in different areas such that a logical relationship existed between the adoption of one practice and that which immediately followed. This was explained by the fact that by adopting one practice the farmers were committed to adopt others (Adams, 1982).

2.12.7 Farmers' Contact with Livestock Extension Services

Adoption of most agricultural technologies is greatly influenced by the farmers' access to agricultural extension services, which provides the main source of agricultural information (Ntege - Nanyeenya *et al.*, 1997). In his study, Misiko (1976) found that lack of guidance to the majority of the farmers could explain why most farmers were not following recommended agricultural practices. He concluded that the greater the amount of contact the farmers had with agricultural extension agents, the more they are likely to adopt new technologies. Thus, farmers need to know the technologies and have the possibilities, opportunities and incentives to use the innovations.

Okuro *et al.* (2002) found that extension service provision significantly influenced adoption of maize production technologies. This is in agreement with the findings by Wanyoike *et al.*, (2002) that extension and participation in on - farm trials have a positive and significant influence on the adoption of improved fodder trees. Tuitoek, Owido, China & Wanjama (2002) found that farmers who did not attend the '*Barazaa*' or demonstrations and who were not adopting the water harvesting technologies for domestic and livestock use gave lack of information about the demonstrations or the technologies as part of their reason for non- adoption. The same study attributed early adoption of the technologies to the trainings that farmers received from extension staff during the '*Barazaa*' or demonstrations, further strengthening the immense contribution of contact with extension to technology adoption.

A study involving 149 sheep owners in Iraq showed that 94% of the farmers who had attended field demonstrations had used feed blocks at least once, with the adoption rate being 36% among the farmers who had attended field days. On the other hand, only 4.2% of the farmers who had not participated in field demonstrations adopted the feed block technology (IFAD, 2003).

In most developing countries, extension service is largely provided by the public sector, faced with problems of monetary deficits, gender disparity that favours men even though women play a great role in animal production, and low extension coverage (Budak, Darcan & Kantar, 2005). In their survey involving ten villages in the Taurus Mountains with 100 women, Budak, Darcan and Kantar (2005) concluded that extension contacts farmers who are relatively rich, with respect to farm size and innovative farm managers. The study also concluded that cultural constraints greatly hinder extension, with majority of extension workers being men. The study concluded that women's talent, educational level and needs should be given top priority while developing extension programmes and materials; and that

to reach more women farmers, more female extension workers should be trained and their visits to the farmers supported.

In this study, contact of goat – rearing households with livestock extension services was established and its influence on the adoption of crossbred goat technology investigated.

2.13 Summary of Literature Reviewed

Owing to the immense contribution of the small stock industry to the livelihood of smallholder rural livestock households, the Kenya government has continued to fund Sheep and Goat Stations long after donors withdrew funding. Nevertheless, adoption of the crossbred goat technology by smallholder goat rearing households of Southeast Kadem Location, which also houses the Station, has remained low over the years since the Station's inception in 1981. Theories of technology adoption and diffusion could be used to explain this and give suggestions for improving the adoption level.

Theories of technology adoption and diffusion recognize that adoption is a complex, but continuous process that takes place over a long period of time, starting with an acceptance of an idea or concept, and finally ending up with full – scale adoption; but which may take variable length of time (Migwi, Gamba, & Onyango, 2002). Although early adoption and diffusion studies were based on hybrid seed maize and fertiliser technologies, hence the enthusiasm to study adoption of crop – based technologies (Misiko, 1976; Ndiema, 2002), there is sufficient evidence that whether it is adoption of agroforestry, pesticide, piggery, improved water harvesting and storage, computer or zero – grazing technologies, the adoption process proceeds in quite the same manner, with most innovations having an S – shaped adoption rate that follows the normal distribution curve that is bell – shaped (Wiki books, the Open Content Textbook Collection, 2005).

On the basis of the degree of innovativeness, adopters are usually categorised into five different types in the diffusion process. The five that neatly fit within the normal distribution curve are: innovators or venturesome, early adopters or respectable, early majority or deliberate, late majority or sceptical, and laggards or traditional (Rollins, 1993; Wiki books, the Open Content Textbook Collection, 2005). In this study, farmers were categorised into adopters and non – adopters, since the study looked at the adoption level and not rate.

Whereas a great wealth of knowledge on adoption of crop – based technologies exists, there is comparatively less work done so far to establish and document the adoption

process, level and rate of livestock – based technologies. This study aims to provide one such information. Most agricultural innovations are technical, ranging from simple to modified farm practices and completely new technology. In this study, crossbred goat technology was considered a new idea perceived as technical by the farmers. Its spread may have been greatly influenced by the extension agents' attitude and competency in passing the information to the farmers.

Thus, it was important in this study to investigate the households' contact with the livestock extension as an important institutional factor, recognizing that extension is itself a government service providing the main source of information regarding innovations to smallholder farmers in rural settings. Other important institutional factors that could influence technology adoption include availability of capital or credit and accessibility to markets and marketing facilities. The influence of availability and amount of capital, availability, level and source of credit, and of market structure, access and prices on the adoption of the technology would probably justify another study.

Based on the literature reviewed, several factors could possibly influence the level and rate of technology adoption among rural households and can be broadly categorised into three: Those that have to do with the farmer, those that have to do with the technology itself and, the institutional factors. The farmer's perception of the technology influenced by his values, beliefs and attitudes, and objective assessment of the technology's technical characteristics, is the most important farmer – based factor. Other personal characteristics such as farmer's background, social status, affiliations to social or co – operative organisations, and attitudes may also influence innovativeness. This study investigated the relationship between technology adoption and selected farmers' personal characteristics of gender and age, socio – economic characteristics of education level and farm size, and knowledge and skills in goat rearing.

An innovation's technical characteristics could also influence its adoption, hence, in this study, the relationship between technology adoption and its perceived cost relative to that of the local goat, and its compatibility with existing farm practices and socio – cultural values was investigated.

The hypotheses developed from the literature reviewed for this study could, thus, be summarized as those relating the crossbred goat technology adoption to the household head's gender, age, highest educational level, farm size, and knowledge and skills in goat rearing. Others related the technology adoption to the cost of purchasing the technology, the compatibility of the technology with existing farm practices and values; and the farmers'

contact with livestock extension. Thus, it was postulated, first, that farmers' personal and socio - economic characteristics, as well as knowledge and skills in goat rearing could have a positive or negative influence on the adoption of crossbred goat technology. Secondly, that the technology's characteristics of perceived cost and compatibility with existing farm practices and socio – cultural values could have a positive or negative influence on the adoption of crossbred goat technology; and finally, that farmers' level of contact with livestock extension could have a positive or negative influence on the technology adoption.

2.14 The Conceptual Framework

The conceptual framework developed for this study was adapted after that used by Ndiema (2002). Its development was largely guided by basic theories of adoption and diffusion as illustrated by Rollins (1993), IFAD (2003) and Wiki books, the Open Content Textbook Collection (2005). Based on the theories and case studies of factors influencing adoption of livestock technologies (IFAD, 2003), the factors considered in this study as influencing the level of technology adoption among rural households were broadly categorised into three. These are factors that have to do with the farmer, the technology itself and, the institutional factors. The critical variables in this conceptual framework are presented in Figure 1. The dependent variable was technology adoption, while the independent variables were those factors that have to do with the farmer, the technology and institutions. Nevertheless, there were a set of factors which were assumed in this study, but which directly or indirectly interact with the independent variables to influence technology adoption. This group of factors were here called extraneous variables.

The study took notice of the fact that Macalder Station had been in existence in Southeast Kadem Location of Migori District since 1981, and so several factors could have over time, independently or jointly, influenced farmers positively or negatively, to adopt or not adopt the crossbred goat technology developed at the Station. Thus, farmers' adoption of the crossbred goat technology developed at Macalder Station could have been influenced directly or indirectly by one or more factors. Hence, whereas there are farmers who had crossbred goats, certain government policies, institutional factors, health of the household, land tenure and general security dictated to a certain extent, the level of crossbred goat technology adoption and the type and extent of technology practices generally being adopted by farmers in the study area. In addition, the farmers' own personal characteristics such as age, gender, farm size, knowledge and skills on goat rearing and educational level would also

contribute, to an extent, to the level of technology adoption as well as the type and extent of technology practice being adopted by farmers in the study area. The cost of purchasing the crossbred goat technology, the compatibility of the technology with existing farm practices and values, and the level of farmers' contact with livestock extension services would also independently or jointly influence the technology adoption.

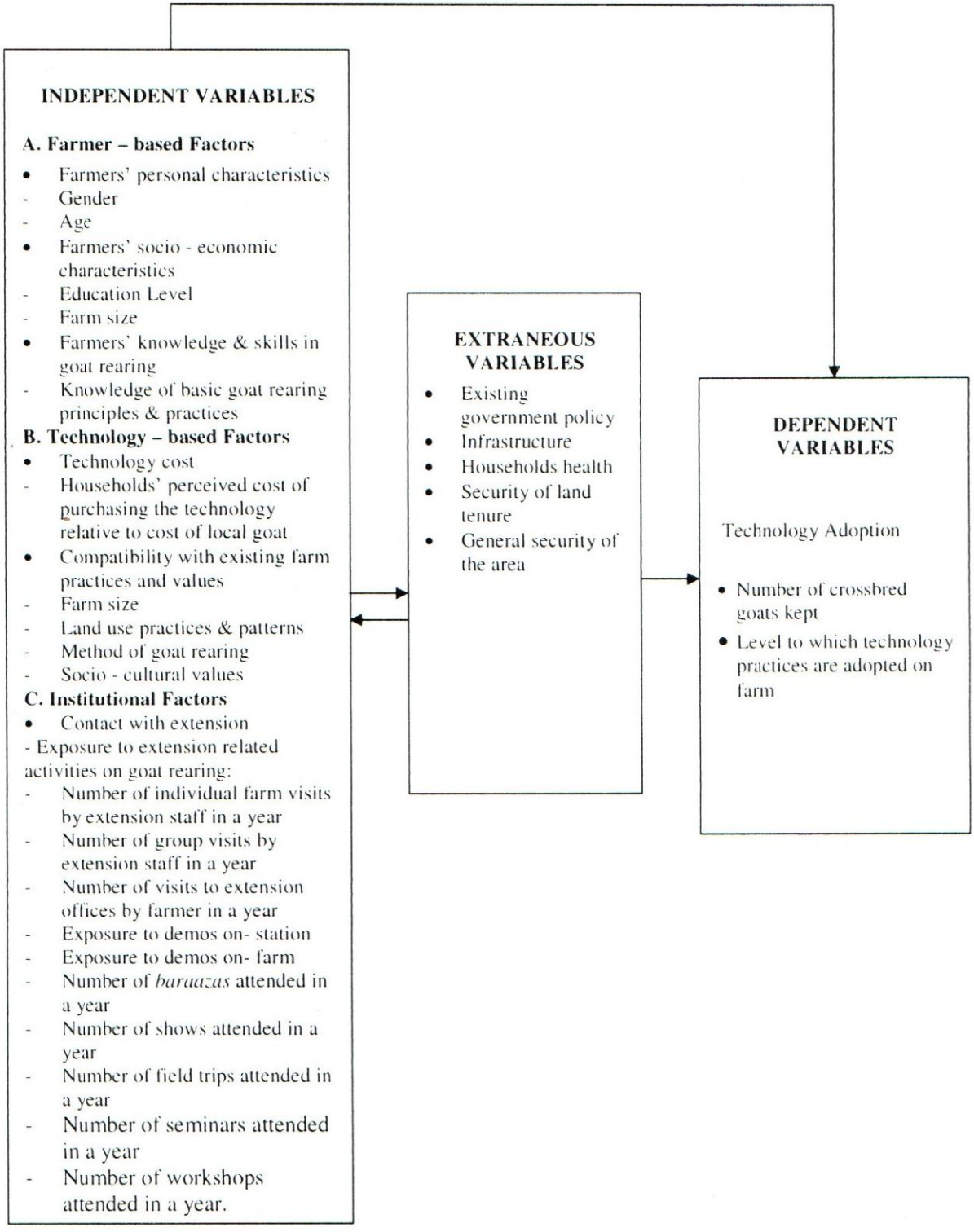


Figure 1: The Conceptual Framework Showing Factors Affecting Adoption of Crossbred Goat Technology by Farmers

CHAPTER THREE
METHODOLOGY

3.1 Introduction

In this chapter, the procedures that were used in the study including the design, research type and instrumentation are discussed. It also describes the study location, population, sample, sampling procedure and data collection methods. The chapter ends with a summary of data analysis procedures.

3.2 Research Design

The research design for this study was ex – post facto survey. An ex – post facto survey involves examining by use of questionnaires and interviews the effects of a naturalistically occurring treatment after its occurrence (Kathuri and Pals, 1993). Mugenda and Mugenda (1999) describe a survey as an attempt to collect data from the study population with a view to determining the current status of the population regarding certain variables (status study). This study was an ex – post facto survey as it involved studying the adoption levels in the three sub – locations of the study area and factors that could be responsible for this among households in the study area since the inception of the station in 1981. This was done without any manipulations by the researcher before, during or after the study. Thus, the researcher did not introduce any treatment among the study subjects before, during or after the study, but used a structured questionnaire to gather household data relating to the opinions, attitudes, perceptions, adoption or non adoption of the crossbred goat technology, with a view to finding a possible explanation for the adoption status.

3.3 Study Location

The study was conducted in Southeast Kadem Location, Nyatike Division, Migori District of Nyanza Province, Kenya. In Southeast Kadem Location, the study covered the three sub – locations of Nyatike, Owich and Mikei (Appendix A). This location was chosen for the study, being in the Station's mandate area in a goat rearing region, and having three sub – locations each with some unique physical and socio – economic features differentiating them.

Nyatike Sub – location is purely a rangeland typified by flat grassland and acacia shrubs, and often flooding during the rainy season. Although the Sub – location was very popular for its active gold mining between the 1950s and early 1980s, what remain today are gold ruins, with very rudimentary gold mining activities in localised pockets of the Sub – location. It is the largest of the three sub – locations of study in terms of area, having the highest number of goats, but the least densely populated. The predominant economic activity in this Sub – location is livestock rearing. The entire Sub – location is in a government holding ground, with the inhabitants being settlers from other parts of Nyanza Province who had come into the area during the peak of the once popular gold mining activities. Thus, most of the households in this Sub – location have small land parcels on a lease hold, with much of the land being grazing land in the government holding ground (trust land).

Owich Sub – location is rather hilly, with two main permanent rivers and several seasonal streams. The soils here are of the loamy clay, often forming gullies during the rainy season. It borders Uriri Division, hence enjoys a higher and more reliable rainfall regime than the rest of the study area. The vegetation is typical of savannah bush land and grassland. It has a fairly rich agricultural potential, with the farmers being somehow agro – pastoralists, growing maize, sorghum, beans and finger millet, as the main food crops and tobacco as the main cash crop, and keeping livestock on small scale. In terms of area, it is smaller than Nyatike, but is more or less the same size as Mikei. It has a population density much higher than Nyatike, but the total human population compares very closely to that of Nyatike due to its hilly terrain. It enjoys a fairly cooler micro climate compared to the rest of the study area. Majority of the farmers here are natives and settlers from other parts of Migori District, with full security of tenure to either the ancestral or purchased land.

Mikei Sub – location compares very closely with Owich in terms of area, but has the highest human population. It is typified by gentle slopes with undulating plateaus. It borders Suba – West Division of Migori District, hence the upper parts have a more or less savannah vegetation and grassland type of vegetation, receiving comparatively more rainfall compared to the lower parts which border Nyatike Sub – location. The vegetation in the upper parts ameliorates the temperatures, compared to the lower parts typified by grassland and acacia shrubs. This Sub – location has comparatively more gold mining activities than the rest, due to discoveries of fresh gold mines in certain parts in the recent past. Thus, though the inhabitants are mixed farmers keeping livestock and growing crops, both are mainly done at the domestic level, while gold mining is considered the main economic activity. Due to the thriving gold mining activity here, small trading centres are fast sprouting, with the Sub –

location experiencing the highest school drop – out and HIV/AIDS rate compared to the rest of the study area owing to availability of cheap money. The main subsistence crops grown include maize, sorghum, and beans, while cassava is grown both as a food and cash crop. The sub – location houses a local CBO, Lake Region Community Development Programme (LRCDP), which has made great strides in malaria and HIV/AIDS control in addition to supporting education and other health initiatives in the region. Majority of the households in the upper parts (natives or settlers from other parts of Migori District) enjoy security of land tenure to their inherited or purchased land parcels, but most of those in the lower parts of the Sub – location are settlers from other parts of Nyanza Province who came during the active gold mining days. Consequently, only a few of them have titles to their land parcels, but majority are on leasehold in the government trust land, hence have no title deeds.

Thus, Nyatike can be said to be predominantly a rangeland livestock rearing Sub – location, while Owich is a cooler mixed farming Sub – location with rich soils and savannah bushland and grassland, whereas Mikei is a mixed farming Sub – location with renewed gold mining activities. By conducting the study in this location with three distinct Sub – locations, the study findings are bound to have a more wider applicability than if it were concentrated in an area with homogenous vegetation and economic activity.

3.4 Population

The target population comprised heads of smallholder goat – rearing households in Southeast Kadem location with at least two (2) goats. In the study area, animals are culturally owned by household heads, mostly men, except where the woman is the bona – fide household head. This holds true even for goats that are mainly taken care of by boys and girls and women. Migori District had 115,526 households with 516, 954 persons and 109,070 goats. Nyatike Division had 14,768 households with 35,730 goats (GoK, 2003). Southeast Kadem location of Nyatike Division had 2,077 households, with 509 households in Nyatike, 587 households in Owich and 981 households in Mikei Sub – locations, respectively (GoK, 1999a). Records from the District Livestock Production Office indicated that 70% of the households in Nyatike Division are smallholder goat keepers with at least two (2) goats. Thus, the target population for the study was heads of 1,454 smallholder goat rearing households (70% of 2,077), comprising 356 household heads from Nyatike, 411 household heads from Owich, and 687 household heads from Mikei sub – locations.

3.5 Sampling Procedure and Sample Size

A comprehensive list of heads of goat rearing households in the study area was obtained from the Divisional Livestock Production Office in Nyatike. A sample of 120 household heads obtained by proportional random sampling was used in this study. This number of household heads was deemed adequate since Kathuri and Pals (1993) recommended a minimum sample size of 100 for a survey research. Proportional sampling was done to obtain the 120 household heads in the ratio in which they are naturally present in each of the three (3) sub – locations to ensure the sample obtained was representative of the entire location. Within each sub – location, simple random sampling was used to pick the household heads for inclusion into the study.

The 1,454 smallholder goat rearing households in Southeast Kadem Location of Nyatike Division were in the ratio of 1.00:1.15:1.93, or approximately 1:1:2 for Nyatike, Owich and Mikei sub – locations, respectively. Hence, the desired sample needed also to be in this ratio for each of the three (3) sub – locations, respectively. This meant 30 household heads for Nyatike Sub – location, 30 household heads for Owich, and 60 household heads for Mikei Sub – location, respectively (Table 1). The numbers 30: 30: 60 household heads for Nyatike, Owich and Mikei Sub - locations, respectively conformed to Kathuri and Pals (1993) recommendation of 20 - 50 cases for each minor sub – group for a survey research.

Random sampling using a table of random numbers was used to pick the 30 household heads for Nyatike Sub – location, 30 household heads for Owich and the 60 household heads for Mikei Sub – location, respectively. This was done in order to give each household head in each of the three sub – locations an equal opportunity of inclusion into the sample, such that the inclusion of any one household head into the sample does not in any way deny any other household heads a chance of inclusion into the sample.

Table 1:
Sample Size for the Study

Sub- location	Number of Household Heads	Sample Size
Nyatike	356	30
Owich	411	30
Mikei	687	60
Total	**1,454**	**120**

Source: Adapted from GoK (1999a). Kenya National Population and Housing Census, 1999 and GoK (2003). Second Quarter Report, Migori District Livestock Production Office.

3.6 Instrumentation

Structured questionnaire (Appendix B) was used to obtain primary data from the sampled smallholder goat – rearing household heads. The questionnaire had items capturing interval, ordinal and nominal data as per the study objectives, for both descriptive and inferential statistical analyses. In addition, a survey note book was used to capture any unique and additional information volunteered by the respondents or observed either during the preliminary visits or the actual survey. This information was useful in describing the study area, characteristics of the technology adopters and non adopters, and in offering an explanation for some of the study findings.

The structured questionnaire comprised six (6) sections. Section A was designed to obtain information relating to the household characteristics, including the sub – location of the study, household category as either adopter or non adopter, gender, age, highest educational level, farm size, and land ownership mode. This section solicited nominal, categorical and interval type of data. Section B obtained data on land use patterns and practices, goat rearing method and, uses of both local and crossbred goats in line with the socio – cultural values. It solicited interval, categorical and ordinal data on compatibility of the crossbred goat technology with existing farm practices and values. Section C solicited data on the household contact with livestock extension. It generated categorical data on the households' frequencies of contact with livestock extension over the year 2003. Section D comprised items measuring the household heads' level of knowledge and skills in basic goat rearing principles and practices. The items solicited ordinal data, ranging from agree to disagree. Section E captured interval and categorical data on crossbred goat technology adoption. Apart from soliciting data on the number of goats kept, the number of local goats kept, and the number of crossbred goats kept; it had items designed to capture the households' level of adoption of the crossbred goat technology practices with respect to

housing, nutrition, health and breeding management. The last section, F, comprised four questions soliciting interval data on the households' perceived cost of the technology relative to that of the local goat (Appendix B).

3.6.1 Validity

To ensure the instrument accurately measured the variables of interest to the study, each of the items in the questionnaire was discussed with the peers, research supervisors, and other lecturers in the department of Agricultural Education and Extension of the University, in relation to the study objectives. Attention was given to how each of the specific study objectives was captured in the questionnaire, and modifications made as deemed necessary.

3.6.2 Reliability

To ensure consistency of the questionnaire, it was pretested using a random sample of twenty (20) heads of goat – rearing households in Karungu Division. The Division was chosen for the pretest since it is in the Station's mandate area, with similar agro – ecological conditions as the study area, and in a livestock – rearing zone with goats as the major livestock type. The number twenty (20) for the pretest was taken because it is the smallest number that can yield meaningful results on data analysis in a survey research (Kathuri and Pals, 1993). The pretest data was then subjected to the split – half analysis technique as given by the Cronbach's alpha formula of:

$\alpha = N.r / 1+ (N-1) r$, where

N= the number of items,

r = the average inter – item correlation among the items.

The advantage of the split – half technique over the test – retest method is that it eliminates the chance error arising from different test conditions (Mugenda and Mugenda, 1999). The advantage of the Cronbach's alpha analysis procedure is that it gives both inter – and intra – item correlationships between the two halves. A reliability coefficient of at least 0.7 was considered reasonable and acceptable in this study (Santos and Reynaldo, 1999). A reliability coefficient of 0.83 was obtained upon analysis of the pretest data and, being higher than 0.70, only minimum modifications recommended by the research supervisors were made before the actual data collection commenced.

3.7 Data Collection

The researcher used the Letter of Approval from the Graduate School of Egerton University and the Research Permit from the Ministry of Education, Science and Technology (Appendix C) in order to get assistance from both the Provincial Administration and the District and Divisional Agricultural and Livestock Production Offices, as well as Macalder Sheep and Goat Station. With the assistance of the extension staff of both the Ministries of Agriculture, and Livestock and Fisheries Development, the researcher obtained the sampling frame. And, with the assistance of the appointees of the local village elders and Lake Region Community Development Programme (LRCDP), a local community - based organisation, the researcher got access to each of the households selected for inclusion into the study.

Due appointments were made with the household heads during preliminary visits, when the purpose of the study was carefully and clearly explained and an informed consent sought for including the household heads into the study. In each household, effort was made to ensure that only the household heads were interviewed for uniformity in the source of data obtained. The preliminary visits and appointments made with the household heads ensured that none of the household heads was found absent after two successive visits to the particular households. Consequently, no household considered for this study was skipped.

The researcher administered the questionnaire face – to – face with each household head, clarifying items in the instrument, which may not have been clear to them and carefully recording the responses. The data obtained from the questionnaire administered to the household heads, and the survey note book with information observed or volunteered by the study respondents formed the primary data. Secondary data included reports, and records obtained from the District and Divisional Agricultural and Livestock Production Offices, and Macalder Sheep and Goat Multiplication Station.

3.8 Data Analysis

Data were analysed using the Statistical Package for Social Sciences (SPSS) for Windows, Version 11.5, based on the study's objectives and hypotheses. All the seven (7) hypotheses of the study were tested and results presented at $p < 0.05$. Responses to each category of items in the questionnaire were coded and scored for purposes of data entry. Each score was then assigned a specified weighting for meaningful interpretation as per the

study objectives and scales of measurement of the data collected. Descriptive statistics, including frequencies, minimum and maximum values, means, standard deviations, and percentages were used to organise and describe the data. Inferential statistics including Pearson Chi – square test, ANOVA and Least Squared Difference tests, as well as Pearson's product moment correlation test of significant differences were used to analyse the data and to project the findings from the sample to the study population, as per the specific study objectives and hypotheses as shown in Table 2.

Table 2:
Summary of Data Analysis Procedures

Hypotheses		Independent Variables	Dependent Variables	Statistical Analysis
H_o1	There is no statistically significant difference between farmers' adoption levels of the crossbred goat technology in the three sub - locations of Southeast Kadem Location.	• Unique household socio - economic features in each Sub – location.	• Technology adoption.	• Descriptive statistics (Means, Frequencies, percentages and standard deviations). • One - Way ANOVA, • Least Squared Difference Test for post – hoc analysis.
H_o2	Farmers' personal characteristics have no statistically significant relationship with the adoption of crossbred goat technology.	• Gender of Household head. • Age of Household head.	• Technology adoption.	• Pearson's Chi - Square test for Gender. • Pearson's product moment correlation analysis for Age.
H_o3	Farmers' socio - economic characteristics have no statistically significant relationship with the adoption of crossbred goat technology.	• Household head's Education level. • Household head's Farm size	• Technology adoption.	• Frequencies, • Pearson's Chi - Square test for Educational level, • Pearson's product moment correlation analysis for Farm size.

H_o4	The level of farmers' knowledge and skills in goat rearing has no statistically significant influence on the adoption of crossbred goat technology.	• Knowledge of basic goat rearing principles & practices.	• Technology adoption.	• Percentages. • Frequencies. • Pearson's product moment correlation analysis.
H_o5	The cost of crossbred goat technology has no statistically significant relationship with its adoption among smallholder goat farmers in Southeast Kadem Location.	• Perceived cost of the technology relative to that of local goat.	• Technology adoption.	• Pearson's Chi - square test.
H_o6	Compatibility of the crossbred goat technology with existing farm practices and values has no statistically significant relationship with its adoption among smallholder goat farmers in Southeast Kadem Location.	• Farm size. • Land use. • Area of land under pastures/ browses relative to other land use practices. • Method of goat rearing. • Socio - cultural values.	• Technology adoption.	• Frequencies. • Percentages. • Pearson's product moment correlation analysis.

$H_0$7	Farmers' contact with livestock extension has no statistically significant influence on the adoption of crossbred goat technology.	• Number of individual farm visits by extension staff in a year. • Number of group visits in a year. • Number of visits to extension offices by farmerin a year. • Exposure to demos on - farm. • Exposure to demos on - station. • Number of *baraaza* attended in a year. • Number of shows attended in a year. • Number of field trips attended in a year. • Number of Seminars attended in a year. • Number of Workshops attended in a year.	• Technology adoption.	• Frequencies, • Percentages, • Pearson's product moment correlation analysis.

CHAPTER FOUR
RESULTS AND DISCUSSIONS

4.1 Introduction

This Chapter presents the results and discussion of the findings based on the objectives and hypotheses stated in Chapter one. The first section of the Chapter gives a description of the socio – economic and demographic characteristics of the smallholder goat farmers in the study area. This is followed by a more focused definition of crossbred goat technology adoption on the basis of the study, the establishment of the adoption level on the basis of technology adoption so defined; and categorisation of the smallholder goat farmers into adopters and non adopters on the same basis. Thus, study findings are presented by use of descriptive statistics first, followed by inferential statistics on the basis of the hypotheses under test. Each of the seven hypotheses is re stated followed by a presentation of the findings, which are compared with existing literature. Based on the results of the test, the results are discussed, with the hypothesis under test being accepted or rejected.

4.2 Socio – economic and Demographic Characteristics of Farmers in the Study Area

This section presents a description of the variables that were used to define the subjects of the study. These included: household characteristics, land use patterns and practices, land ownership mode, and goat rearing methods.

4.2.1 Household Characteristics

Table 3 shows the gender categories of the farmers under study. From this table, it is clear that more female farmers 52.5% participated in the study than the male ones.

Table 3:
Gender Categories of the Household Heads (n = 120)

Gender of Household Head	Frequency	Percent
Male	57	47.5%
Female	63	52.5%
Total	**120**	**100.0**

Source: Survey data, 2004.

Table 4 gives a summary of the household heads' ages, farm sizes; the total number of goats, local goats and crossbred goats kept.

Table 4:
Household Characteristics - Age, Farm Size and Goat Numbers (n =120)

Characteristic	Minimum	Maximum	Mean
Age (years)	16	74	38.90
Farm Size (acres[3])	0.1	30	7.37
Total No. of Goats Kept	2	60	6.38
No. of Local Goats Kept	0	60	5.96
No. of Crossbred Goats Kept	1	6	1.75

Source: Survey data, 2004. **Key:** No. = Number.

As shown by Table 4, the youngest farmer was aged 16 years, whereas the oldest was 74 years old (M = 38.90 years), hence most of the study farmers were generally young. The total number of goats kept ranged from 2 to 60 (M = 6.38 goats), while that of the local goats kept ranged from zero to 60 (M = 5.96 goats). The numbers of crossbred goats kept ranged from 1 to 6 (M = 1.75 goats). The farm sizes ranged from 0.1 to 30 acres[3] (M = 7.37 acres).

4.2.2 Land use Patterns and Practices by Location, Gender and Education

The trend in land use patterns and practices among the study farmers is shown by Table 5.

Table 5:
Land Use Patterns and Practices 2002 - 2004 (n =120)

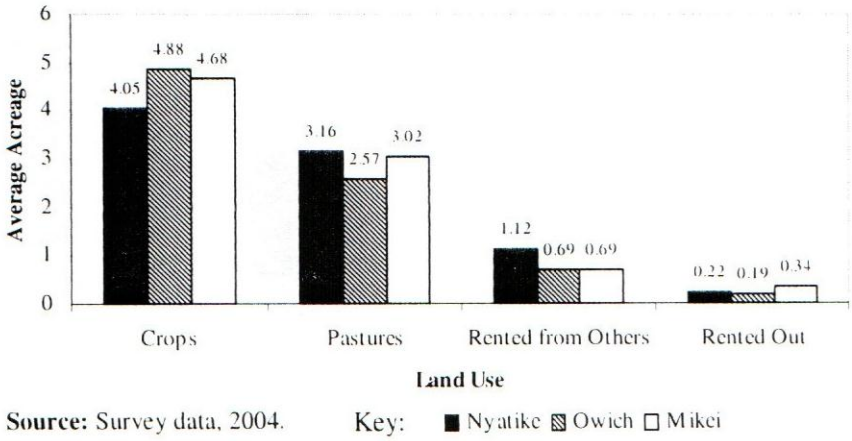
Parameter	Land Use Patterns and Practices											
	Acres under crops			Acres under pastures			Acres rented from others			Acres rented to others		
	'02	'03	'04	'02	'03	'04	'02	'03	'04	'02	'03	'04
Min. (Acres[1])	0	0	0	0	0	0	0	0	0	0	0	0
Max. (Acres[1])	21	21	21	14	14	28	8	8	8	3	3	3
Mean (Acres[1])	4.61	4.54	4.31	2.78	2.81	3.01	0.72	0.72	0.13	0.18	0.25	0.31

Source: Survey data, 2004.

Table 5 shows that overall, more land was put under crops in 2002 than any other year (M = 4.61 acres), while more land was under pastures and browses in 2004 (M = 3.01). Generally, the farmers rented more land from others than they rented out, indicating some land inadequacies in the area. This is because most of the land in Southeast Kadem Location is government trust land, with majority of the farmers being settlers from other parts of Migori District or Nyanza Province.

Figure 2 shows land use patterns and practices in each of the three Sub - locations of Southeast Kadem Location. As shown in Figure 2, Nyatike Sub - location had the highest land acreage under pastures and browses (M = 3.16 acres). Most of this, however, was government trust – land that was used by the settlers for grazing. This is why Nyatike farmers had the highest land acreage rented from others (M = 1.12 acres). The area being more suitable for livestock rearing, it explains why Nyatike had the least land acreage under crops (M = 4.05 acres).

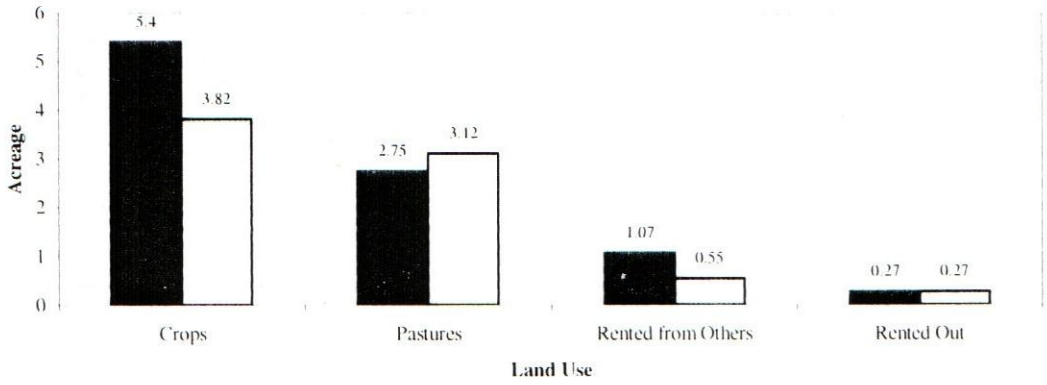
[1] An acre of land is equivalent to about 0.4 hectares.



Source: Survey data, 2004. Key: ■ Nyatike ▨ Owich □ Mikei

Figure 2: Land use by Smallholder Goat Farmers in Southeast Kadem Location

The land use patterns and practices by gender categories of the household heads in Southeast Kadem Location are shown by Figure 3. As seen in Figure 3, female – headed households had more land under pastures and browses (M = 3.12 acres), but less under crops (M = 3.82 acres) compared to the male – headed ones (M = 5.40 acres). The male – headed households, however, rented more land from others (M = 1.07 acres) than the female – headed ones (M = 0.55 acres). Given the fairly high poverty and HIV/AIDS prevalence rate in the study area, it is possible that most of the female household heads were widows. In a culture where most of the resources (including land) are owned by the man and not the woman, it is possible that some of the female household heads either could not put all their land resources under crop due to lack of adequate production resources or because they were customarily barred from legally owning the land, hence opted to use much of it for grazing which is often communally done. High poverty levels and lack of capital could explain why most of the female household heads could not afford to rent enough land from others.



Source: Survey data, 2004. **Key:** ■Male □Female

Figure 3: Gender Differences in Land Use Patterns and Practices by the Study Farmers

Table 6 shows the educational status of the study farmers, while Figure 4 shows land use patterns and practices by the various categories of household heads, on the basis of their highest educational level.

Table 6:
Educational Status of the Study Farmers (n = 120)

Household Head's Highest Educational Level	Frequency	Percent
None	10	8.3
Primary	92	76.7
Secondary	18	15.0
Total	**120**	**100.0**

Source: Survey data, 2004.

None of the study farmers had post – secondary education, 8.3% of them had no formal education at all; only 15% had secondary education, while the majority (76.7%) had primary education, as shown by Table 6. The poor education status among the study farmers is a further manifestation of the high poverty level in the area that once thrived in the lucrative gold mining activity that became synonymous with Macalder centre.

Table 7:
Study Farmers' Land Ownership Mode (n = 120)

Household Head's Land Ownership Mode	Number of Farmers	Percent (%)
Purchased	19	15.8
Inherited/ Given	76	63.3
Purchased/ Inherited	9	7.5
Leased	16	13.3
Total	**120**	**100.0**

Source: Survey data, 2004.

The study showed that 66.7% of the study farmers tethered their goats; only 11.7% grazed the goats, while none practised free range or zero – grazing (Table 8).

Table 8:
Goat Rearing Methods among Smallholder Farmers in the Study Area (n = 120)

Rearing Method	Number of Farmers	Percent (%)
Free Range	0	0.0
Grazing	14	11.7
Tethering	80	66.7
Grazing/ Tethering	26	21.7
Zero - Grazing	0	0.0
Total	**120**	**100.0**

Source: Survey data, 2004.

Even though the study showed that none of the farmers practised free range, this may not always be the case. The study was conducted during the rainy season, cropping season. Since most of the farms in the area lack permanent fences, during the cropping season free range is avoided in order to minimise crop damage by livestock, which often leads to conflicts. During this season tethering is preferred as the farmers are engaged in farm activities, while the youth are in school. On the other hand, during the dry seasons, most of the cropland is left fallow and goats are left to free range during the day, and are only gathered in the evenings. In fact sometimes goats stray right into the shopping centres overnight during the dry seasons and may only be the concern of the owners when need to use them arise. This shows the strong socio – cultural bond of the community in the study area, where theft is a rare occurance.

The goats had varied housing structures, ranging from open grounds in the homestead to semi - permanent structures of water - proof roofs. Most of the farmers had poor goat housing structures, with majority of those with semi – permanent goat housing structures being the educated farmers with some form of gainful employment. Goats in Macalder Sheep and Goat Multiplication Station had comparatively better pens, constructed of cedar posts and

chain links, and of water – proof roofs and a bugler – proof gate. The high environmental temperatures and the fairly high poverty level in the area explain why majority of the farmers did not have proper goat housing structures.

4.3 Technology Adoption

This section defines the technology adoption, establishes the adoption level, and reviews the land use patterns and practices among the technology adopters.

Technology adoption was defined in this study as the keeping of crossbred goat. The goat was considered a technology, being the result of many years of a crossbreeding programme involving the local goat and the Boer goat. Accordingly the study farmers who had crossbred goats were referred to as adopters, while those that did not were called non adopters. The study also considered the extent to which the farmers picked up various crossbred goat technology practices of proper housing, nutrition, health, and breeding and production management. What is in this study referred to as crossbred goat technology practices are the general goat husbandry practices, but which due to the high poverty levels in the area the farmers do not often practice, and hence their routine practice has more or less been associated with the crossbred goat technology developed at Macalder Sheep and Goat Multiplication Station. Consequently, for each of the crossbred goat technology practices, the study gave the overall percentage of farmers that practised it, making cognisance of the fact that some of the adopters did not practise all the recommended crossbred goat technology practices. All the study farmers underscored the need for a reliable source of clean drinking water in goat production.

The study found that 28 of the 120 households studied kept crossbred goats, and that the highest number of crossbred goats kept by a single farmer was 6, while that of the local goat kept was 60. Thus, on the basis of numbers of crossbred goat kept, the adoption level stood at 23.3% (Table 9).

Table 9:
Crossbred Goat Technology Adoption Level (n = 120)

Household Category	Frequency	Percent
Adopter	28	23.3
Non Adopter	92	76.7
Total	**120**	**100.0**

Source: Survey data, 2004.

Table 10 shows the percentage of the adopters that kept various numbers of crossbred goats ranging from 1 to 6.

Table 10:
Numbers of Crossbred Goat Kept by the Adopters (n = 28)

No. of Crossbred Goat Kept	No. of Farmers	Percent (%)
1	15	53.6
2	9	32.1
3	2	7.1
4	1	3.6
6	1	3.6
Total	**28**	**100.0**

Source: Survey data, 2004.

Further, Table 10 shows that majority of the adopters had between 1 and 2 crossbred goats, a fact which tends to suggest that either the technology cost was higher than most of the impoverished farmers in the study area could afford, or the farmers had not been able to isolate any relative advantage the crossbred goat has over the local one that it was intended to replace, or somehow extension services had not been very effective in promoting the adoption of the technology among the study farmers.

Most of the crossbred goat technology adopters practised recommended crossbred goat technology practices as did majority of the non adopters, except for fodder conservation, pye – grease use and dipping in acaricides (Table 11).

The generally low adoption of the practice of dipping in acaricides may be due to the fact that the dips branded "government dips" were not functional at the time of the study. It is interesting to note that while none of the adopters used pye – grease to control ticks, a few non adopters did (3.3%). Some of the non adopters who practised the use of pye – grease to control ticks indicated they had been adopters of the technology sometime earlier, and had proved the usefulness of the chemical in those days, hence they preferred to continue in the practise even when they now had no crossbred goats. Their argument was that it was cheaper, yet more effective in tick control than the acaricides that ticks often developed resistance against.

Table 11:
Farmers' Adoption of Crossbred Goat Technology Practices (n = 120)

Crossbred Goat Technology Practice Adopted	Percent of Farmers Practising Technology Practices (n = 120)		Percent of Adopters Practising Technology Practices (n = 28)	
	Yes	No	Yes	No
Goats housed in warm & water – proof pens	86.7	13.3	75.0	25.0
Goats regularly supplemented	40.0	60.0	39.3	60.7
Fodder conserved for use during the dry seasons	2.5	97.5	3.6	96.4
Reliable water source	100.0	0.0	100.0	0.0
Pye – grease used for prevention against ticks & other ecto – parasites	3.3	96.7	0.0	100.0
Goats regularly dipped in acaricides	2.5	97.5	3.6	96.4
Goats regularly sprayed with acaricides	59.2	40.8	64.3	35.7
Goats regularly dewormed	36.7	63.3	42.9	57.1
Kidding Does given maximum attention	85.0	15.0	96.4	3.6
Old & unproductive goats culled	95.0	5.0	96.4	3.6
Inbreeding not allowed	85.0	15.0	85.7	14.3

Source: Survey data, 2004.

4.4 Land Use Patterns and Practices among the Technology Adopters

Land use practices by the technology adopters are shown by Figure 5. As seen in this figure, adopters had more land under pastures and browses (M = 3.91 acres) than non adopters (M = 2.64 acres), and rented more land from others (M = 1.01 acres) than the non adopters (M = 0.73 acres). The fact that the adopters put more land under pastures and browses and rented more land from others to subsidise the little they had shows that they recognised that the high nutritional demand of the crossbred goat relative to the local goat. It also shows that they had recognised the relative advantage the technology had over the local goat.

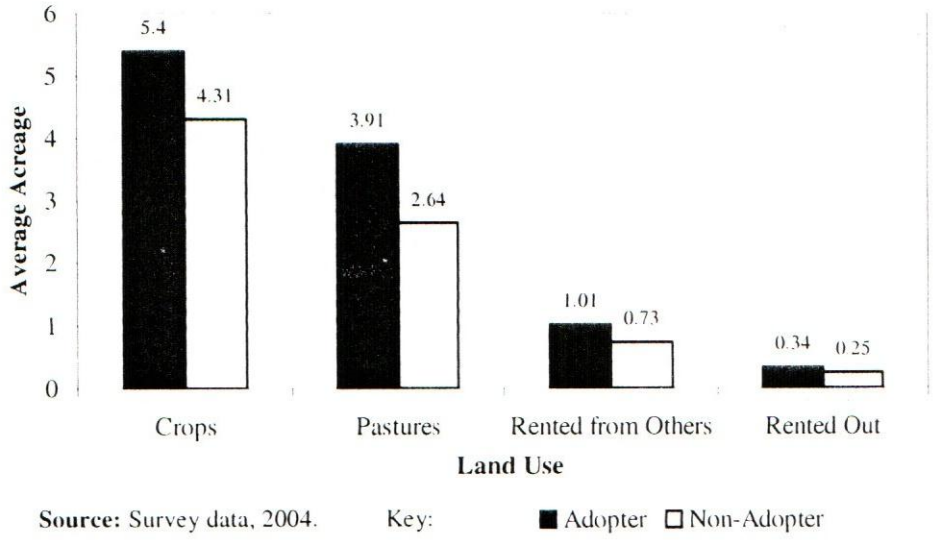


Figure 5: Land Use by Adoption Category among the Study Farmers

4.5 Contacts with Livestock Extension Services

Table 12 shows the adopters' frequency of contact with extension services.

Table 12:
Adopters' Contact with Livestock Extension Services in 2003 (n = 28)

Extension Method	Percent of Farmers by Frequency of Extension Service Contact per Year					
	No visits	Once	Twice	Thrice	4 times	>4 times
Individual farm visits by extension staff	96.4	0.0	0.0	0.0	0.0	3.6
Group visits by extension staff	92.9	3.6	3.6	0.0	0.0	0.0
Farmers' visits to Extension Offices	78.6	7.1	3.6	7.1	0.0	3.6
On – farm demonstrations attended	92.9	3.6	0.0	0.0	0.0	3.6
On – station demonstrations attended	67.9	10.7	3.6	3.6	0.0	14.3
Barazaa attended	32.1	17.9	7.1	3.6	3.6	35.7
Shows attended	89.3	3.6	0.0	0.0	3.6	3.6
Field trips attended	100.0	0.0	0.0	0.0	0.0	0.0
Seminars attended	82.1	10.7	0.0	0.0	3.6	3.6
Workshops attended	92.9	7.1	0.0	0.0	0.0	0.0

Source: Survey data, 2004.

Table 12 shows that most of the adopters had very poor livestock extension; hence their decision to adopt the technology may not have been largely influenced by extension service contact. This is because most of the adopters (over 50%) had not received any extension service in the year 2003, except attending *Barazaa*. Majority of the study farmers decried inadequacy of extension personnel, a fact which the agricultural and livestock

personnel agree to, adding that the government's retrenchment programme of the year 2000 had greatly reduced their numbers, making the few that remained in the service less effective in reaching the ever growing number of farmers. Nevertheless, it is encouraging to note that 14.3% of the adopters had attended on - station demonstrations more than four times in the year 2003. This shows that they had recognised the need to get the knowledge and use it even if it meant going for it where it was found, having recognised that the service providers are themselves willing to do their work, but are overwhelmed by the vastness of the area and number of farmers to be reached.

Table 12 further shows that 32.1% of the adopters had not attended any *Barazaa*[2] in the year 2003, while 35.7% had attended more than four times. In a situation of shortage of extension personnel, group and public approaches to extension such as on – farm demonstrations, field days, agricultural shows and *Barazaa* are useful in passing extension packages to as many farmers as possible within the shortest time. In such fora, moreover, the farmers are presented with a much friendlier learning atmosphere. Most of the study farmers (89.3%) had not attended any agricultural shows in the year 2003. The 3.6% and 3.6% who had attended four times and more than four times, respectively, may have attended shows held outside Migori District, since Migori District *Harambee*[3] Show was last held in September, 1999. Both the farmers' attendance of *Barazaa* and agricultural shows further indicate the high interest they had in seeking for and acquiring knowledge that could help them improve their goat productivity, an area in which they would need much support as this is the first step in agricultural technology adoption.

The study found that farmers in the study area benefited most from *Barazaa* over the year 2003. This is possibly because the few extension staff in service had resorted to group extension approaches to effectively reach a high number of farmers within the shortest time possible. An overview of the survey data indicated that Mikei farmers, in particular, had more group extension contacts with livestock extension staff over the period than their counterparts in the other two sub – locations. Secondary data obtained from the District Livestock Extension Offices showed that this was because of the government's on – going focal area

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[2] *Barazaa* is a formal public meeting convened by a Provincial Administration Official, usually a Chief, District Officer or District Commissioner to sensitise the public on government policies and discuss development issues. Such a forum provides opportunities for government extension officers to disseminate recent technologies from research to the public.

[3] *Harambee* is a word very commonly used in Kenya to describe any venture involving pooling of resources. *Harambee* show is one that is not in the official Agricultural Society of Kenya Calendar of shows, hence does not receive any funding from the same. Nevertheless, due to the great role it plays in enhancing agricultural and industrial development, key stakeholders agree to make individual financial and material resources that are then pooled to have the show held.

group extension approach under the National Agriculture and Livestock Extension Programme (NALEP) that had concentrated efforts in the area over the financial year 2003/2004. Extension contacts by gender among the adopters are shown by Table 13.

Table 13:
Extension Contact by Gender among the Technology Adopters in 2003
(n = 28)

Frequency of Extension Contact by Gender	Percent of Household Heads Accessing Specific Livestock Extension Approach									
	Indiv. Farm visit	Grp. Farm visit	Visit to ext. offices	On - farm demo	On - station demo	*Barazaa*	Shows	Field trip	Seminar	Workshop
Male										
No visits	93.3	100.0	86.7	93.3	60.0	33.3	86.7	100.0	93.3	100.0
Once	0.0	0.0	6.7	6.7	20.0	13.3	6.7	0.0	6.7	0.0
Twice	0.0	0.0	0.0	0.0	0.0	6.7	0.0	0.0	0.0	0.0
Thrice	0.0	0.0	0.0	0.0	6.7	0.0	0.0	0.0	0.0	0.0
4 times	0.0	0.0	0.0	0.0	0.0	6.7	6.7	0.0	0.0	0.0
> 4 times	6.7	0.0	6.7	0.0	13.3	40.0	0.0	0.0	0.0	0.0
Female										
No visits	100.0	84.7	69.2	92.3	76.9	30.8	92.3	100.0	69.2	84.6
Once	0.0	7.7	7.7	0.0	0.0	23.1	0.0	0.0	15.4	15.4
Twice	0.0	7.7	7.7	0.0	7.7	7.7	0.0	0.0	0.0	0.0
Thrice	0.0	0.0	15.4	0.0	0.0	7.7	0.0	0.0	0.0	0.0
4 times	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.7	0.0
> 4 times	0.0	0.0	0.0	7.7	15.4	30.8	7.7	0.0	7.7	0.0

Source: Survey data, 2004.

Key: HH = Household; Indiv = Individual;
Grp. = Group; ext. = Extension;
demo = Demonstration.

Generally, the study showed that there was a gender balance in access to livestock extension services in Southeast Kadem Location. Table 13, however, shows that female farmers participated in more group farm visits, on - farm demonstrations, seminars, and workshops than their male counterparts. Again, more female farmers visited livestock extension offices for advice than the male farmers. More male farmers were, however, visited individually by livestock extension staff than the female ones over the period. They also attended more on - station demonstrations, *Barazaa,* and agricultural shows than their female counterparts over the same period.

In most parts of the developing world most extension personnel tend to pass extension messages to men, yet women are the implementers of the technologies, leading to either lack of or slow adoption of technologies. In an area like Southeast Kadem where there is fairly high number of female headed households, it is only befitting that they take a personal initiative to deliberately seek for agricultural information and put it into proper practice for

increased production. So, the fact that the female farmers in the study area chose to go for information on livestock production right from the extension offices shows they seriously wanted to adopt, hence could not risk any dilution in the process of passing on this information to them. Most of the group extension activities as well as on - farm demonstrations involve participation in some farming exercises. Women are known to provide over 80% of the agricultural labour in Kenya (GoK, 2000b), and form majority of sustainable and cohesive social groupings in most parts of the developing world today. The latter fact explains why more female farmers participated in these activities than male ones.

Table 14:
Extension Contact by Adopters' Highest Education Level in 2003 (n = 28)

Frequency of Extension Contact by Education Level	Percent of Household Heads Accessing Specific Livestock Extension Approach									
	Indiv. Farm visit	Grp. Farm visit	Visit to ext. offices	On-farm demo	On-station demo	*Barazaa*	Shows	Field trip	Seminar	Work shop
No Education										
No visits	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Once	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Twice	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thrice	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4 times	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
> 4 times	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Primary										
No visits	100.0	95.5	81.8	95.5	68.2	27.3	90.9	100.0	86.4	90.9
Once	0.0	0.0	4.5	0.0	9.1	13.6	0.0	0.0	4.5	9.1
Twice	0.0	4.5	4.5	0.0	4.5	9.1	0.0	0.0	0.0	0.0
Thrice	0.0	0.0	9.1	0.0	0.0	4.5	0.0	0.0	0.0	0.0
4 times	0.0	0.0	0.0	0.0	0.0	0.0	4.5	0.0	4.5	0.0
> 4 times	0.0	0.0	0.0	4.5	18.2	45.5	4.5	0.0	4.5	0.0
Secondary										
No visits	80.0	80.0	60.0	80.0	60.0	40.0	80.0	100.0	60.0	100.0
Once	0.0	20.0	20.0	20.0	20.0	40.0	20.0	0.0	40.0	0.0
Twice	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thrice	0.0	0.0	0.0	0.0	20.0	0.0	0.0	0.0	0.0	0.0
4 times	0.0	0.0	0.0	0.0	0.0	20.0	0.0	0.0	0.0	0.0
> 4 times	20.0	0.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Source: Survey data, 2004.

Key:
ext. = extension;
Grp. = Group;
HH = Household;
Indiv = Individual;

Table 14 shows livestock extension contact by categories of highest education level of the household heads. From the table, it is seen that generally the highly educated farmers had

more livestock extension contact compared to the less educated ones in the year 2003. This is because education enlightens a farmer and increases his/ her ability to acquire, process, and use information relevant to the technology adoption (Ntege - Nanyeenya *et al.*, 1997).

4.6 Uses of Crossbred Goat Relative to the Local Goat

The study was conducted in an area where the goat has a lot of socio – cultural value. It is commonly used in several social gatherings like funerals, initiation ceremonies, weddings, peace – making, and settling of disputes. The goat acts as a "bank" to most farmers in the study area, in that it is easily sold off to settle any unprecedented financial commitments. The goat is also popularly slaughtered for food where other animals like chicken cannot be used. In cases of stress, like inadequate pasture and browse materials, extended sickness in a family, or where a family is abruptly forced to resettle, it is a common practice in the study area to give a goat to a relative or friend to keep for sometime till the stress is over. Large animals like cows are also given out in such circumstances, but less readily. It is in this light that this study sought to find out whether or not the crossbred goat was compatible with these practices, and to relate this to the adoption of the technology among farmers in the study area.

Accordingly, the study farmers were asked a set of questions regarding how readily they put the local and the crossbred goat to a variety of uses that farmers in the area commonly put the goats to. The farmers' responses are presented in Table 15.

Table 15:
Adopters' Uses of Local and Crossbred Goats (n = 28)

Socio – cultural Uses and Practices	Percent of Farmers Putting Local Goat to the Socio – cultural Uses and Practices			Percent of Farmers Putting Crossbred Goat to the Socio – cultural Uses and Practices		
	Readily	Not Readily	Not at all	Readily	Not Readily	Not at all
Gift to friend/ visitor	15.0	65.0	20.0	7.1	53.6	39.3
Exchange for property	72.5	24.2	3.3	46.4	46.4	7.1
Dowry payment	78.3	20.0	1.7	57.1	35.7	7.1
Settling fines & disputes	17.5	75.0	7.5	10.7	60.7	28.6
Paying for services	33.3	55.8	10.8	17.9	46.4	35.7
Taking to bereaved	49.2	36.7	14.2	14.3	57.1	28.6
Keeping by someone else	30.0	37.5	32.5	10.7	42.9	46.4
Selling to offset dept	78.3	20.0	1.7	53.6	32.1	14.3
Slaughtering for family food	8.3	19.2	72.5	7.1	7.1	85.7
Slaughtering for friend/ visitor	20.8	62.5	16.7	7.1	50.0	42.9
Slaughtering in social gatherings	49.2	45.0	5.8	28.6	50.0	21.4
Slaughtering for skin	2.5	14.2	83.3	0.0	14.3	85.7
For inheritance	74.2	20.8	5.0	60.7	28.6	10.7

Source: Survey data, 2004.

Table 15 shows that most of the study farmers would readily put their local goats in most of the socio – cultural uses and practices, especially exchanging for property, paying dowry, and passing on to children for inheritance. Majority of them (83.3%) would, however, not slaughter the local goats for skin, which they said they would rather purchase from elsewhere than slaughter the goat. Slaughtering a local goat for family food was also a rare occurrence among the study farmers.

Much as the crossbred goat was also put to a number of these socio – cultural uses and practices, the study clearly showed that this was less readily done compared to the local one. For example, only 46.4% of the adopters would readily exchange the crossbred goat for property compared to 72.5 % who would readily do so for the case of local goat. None of the adopters would readily slaughter the crossbred goats for skin, with 85.7% saying they would never do it come what may. A similar number of the adopters would never slaughter the crossbred goat for family food, irrespective of the severity of the famine. These observations tend to suggest that farmers in Southeast Kadem attached a higher value to the crossbred goat compared to the local one. Probably, this is why not so many of them had gone for it.

4.7 Farmers' Level of Knowledge and Skills in Goat Rearing

A farmer's level of knowledge of basic goat rearing principles and practices on goat housing, nutrition, health, marketing, and breeding and production aspects can greatly boost or deter his/ her decision to adopt the crossbred goat technology. The farmer by way of his /

her experience in goat rearing acquires certain knowledge and skills, which are useful in decision making regarding the adoption of the crossbred goat technology. The instrument developed had items to test the technology adopters' level of knowledge and skills in goat rearing, and to relate this with the technology adoption. The farmers' responses are shown in Table 16.

Table 16:
Adopters' Level of Knowledge and Skills in Goat Rearing (n = 28)

Statement on Basic Goat Rearing Principles and Practices	Percent of Farmers		
	Agree	Uncertain	Disagree
Ticks & worms pose the greatest health menaces to goats.	89.3	3.6	7.1
Goats should be dewormed anytime a dewormer is available.	42.9	7.1	50.0
Hand - picking is the most effective tick – control method.	14.3	0.0	85.7
A reliable source of clean water is essential in goat rearing.	100.0	0.0	0.0
Supplementary feeding is uneconomical in goat rearing.	10.7	3.6	85.7
The season of the year when goats give birth does not affect the survival of the kids.	53.6	7.1	39.3
Kids should be protected from excessive colds & rains.	100.0	0.0	0.0
Kids need to be kept in a clean enclosure.	100.0	0.0	0.0
Dung should be regularly removed from goat pens.	100.0	0.0	0.0
Breeding does should be mated with their kids.	3.6	10.7	85.7
It would be good if someone is around at the time goats give birth.	92.9	3.6	3.6
A goat pen need not be water – proof.	3.6	3.6	92.9
Many farmers do not keep goats because they need more land than they have.	60.7	3.6	35.7
Goats are not easy to keep because they always require supplementary feeding.	14.3	0.0	85.7
Goats that are tethered need to be rotated & given plenty of water.	100.0	0.0	0.0

Source: Survey data, 2004.

Table 16 shows that most of the study farmers (over 50%) had acquired good knowledge and skills in goat rearing either from school, long - term livestock extension contacts or goat rearing experience. Accordingly, majority (over 50%) of the farmers had good understanding of the basic goat rearing principles and practices they were tested on. Very few (less than 10%) of the study farmers were uncertain of the facts presented by the statements.

Whereas extension advises that kidding should coincide with the rainy season when the kids would get adequate feed, most of the study farmers indicated that the kidding season did not affect the kids' survival. They argued that it all depended on the farmers' management level. This suggests that the study farmers had acquired much of the knowledge and skills they had in goat rearing mainly from long term experience. Most of the farmers that felt that kidding season had no effect on the kids' survival maintained that kids born

during the rainy season tended to perform better than those born during the dry season. They argued that during the rainy seasons does have plenty of food and so kids got more milk. However, farmers that felt kidding season had no effect on kids' survival maintained that kids born during the dry season tended to do better. While their explanation was that fewer diseases attacked such kids, it is the relatively high dry matter (DM) content of forage in the dry seasons that make does meet most of their DM requirements during such seasons. Such does generally have better body condition and are better placed to feed their kids.

Whereas only 35.7% of the study farmers maintained that goats did not need more land than most farmers had, the 67.5% who maintained that goats needed more land than most farmers had cited the extensive eating habit of goats. They were quick to add that goats roam a lot and, farmers with inadequate land to allow this would certainly not be able to raise goats. This argument is true, especially for goats raised under the traditional extensive production system as in Southeast Kadem Location, but should not be in itself enough justification for failure to adopt the technology, since most farmers in the study area left very little of their land parcels for grazing or browsing; yet they raised several goats. This is because much of the government trust land in the study area was open to farmers for grazing and browsing, with only a small portion requiring payment of grazing or browsing fee. Since farmers in the study area who had small land holdings, but had capital rented land from others and used it in raising goats, this suggests that it is the high poverty level in the area that probably played a much greater role in influencing the technology adoption.

4.8 Hypothesis Testing

Statistical Package for Social Sciences (SPSS) for windows, version 11.5 was used to test each of the hypotheses as per the specific study objectives. The rest of this chapter presents the test results ($p < 0.05$) of each of the null hypotheses of the study, followed by a discussion and an explanation for the findings.

4.8.1 Sub - location Differences in the Crossbred Goat Technology Adoption Levels

The study undertook to establish and compare the adoption levels of crossbred goat technology among farmers in the three sub – locations of the study area in line with the first objective. The hypothesis under test was that:

H_01: There is no statistically significant difference between farmers' adoption levels of the crossbred goat technology in the three sub – locations of Southeast Kadem Location.

Crossbred goat technology adoption level was considered in terms of the number of crossbred goats kept, as well as the extent to which the various and specific crossbred goat technology practices were practised by the study farmers in each of the three sub – locations of the study area. The hypothesis was tested using One – Way ANOVA test for any significant differences in the means for the three sub - locations of the study area. Least Squared Difference (LSD) test was done after ANOVA test showed significant differences between the three sub – locations of the study area, in order to be able to know which of them had a higher adoption level, and by how much. Table 17 presents the cross - tabulation analysis of the number of goats kept in the three sub – locations of the study area.

Table 17:
Local and Crossbred Goats Kept by Farmers in the Study Area (n = 120)

Sub Location	Farmers Keeping Local Goats Categorised by Number (n = 120)			Farmers Keeping Crossbred Goats Categorised by Number (n = 28)				
	No. of Local Goats Kept			No. of Crossbred Goats Kept				
	1- 5	6- 10	11+	1	2	3	4	6
Nyatike	17	9	4	6	2	0	1	1
Owich	16	13	1	4	4	2	0	0
Mikei	38	17	5	5	3	0	0	0
Total	**71**	**39**	**10**	**15**	**9**	**2**	**1**	**1**

Source: Survey data, 2004.

Key: 11+ = 11 and above.

N.B: The highest number of crossbred goats kept was 6, while that of local goats kept was 60, hence the difference in the cohorts in the table.

From Table 17 it is seen that most of the study households kept between 1 and 10 local goats. Mikei farmers had more local goats than farmers in the other two sub – locations, and Nyatike farmers generally had more crossbred goats than their counterparts in the other two sub – locations. The increasing gold mining activities in Mikei would imply that most farmers here had better financial standing than those in the other two sub – locations. Apparently, despite this they chose to purchase more local goats than crossbred goats. While a few farmers in Mikei indicated they had at some point in time adopted crossbred goat technology, majority seemed not to have adopted due to lack of adequate information regarding the same. More Nyatike farmers adopted crossbred goat technology because of availability of access to more information regarding the technology, due to the farmers' proximity to Macalder Station and the divisional extension offices. Moreover, being in a

natural grazing land set aside for this purpose by the government, their physical environment presented them with a relative advantage over farmers in the other two sub – locations.

To find out any significant differences in the sub - location means, ANOVA test was run, and the results are presented in Table 18.

Table 18:
One – Way ANOVA Results for Significant Differences in the Sub – location Means for Adoption of Crossbred Goat Technology and Technology Practices (n = 28)

Technology Adopted		Test Results				
		Sum of Squares	df	Mean Square	F	P value
Number of crossbred goats kept	Between groups	7.92	2	3.96	4.65*	0.011
	Within groups	99.55	117	0.85		
	Total	107.47	119			
Warm/ water - proof pen	Between groups	0.000	2	0.00	0.00	1.000
	Within groups	13.87	117	0.12		
	Total	13.87	119			
Regular supplementation	Between groups	0.53	2	0.27	1.10	0.335
	Within groups	28.27	117	0.24		
	Total	28.80	119			
Fodder conserved	Between groups	0.02	2	0.01	0.50	0.605
	Within groups	2.90	117	0.02		
	Total	2.92	119			
Reliable water source	Between groups	0.00	2	0.00		
	Within groups	0.00	117	0.00		
	Total	0.00	119			
Pye - grease used	Between groups	0.05	2	0.02	0.77	0.467
	Within groups	3.82	117	0.03		
	Total	3.87	119			
Regular acaricide dipping	Between groups	0.01	2	0.00	0.17	0.846
	Within groups	2.92	117	0.02		
	Total	2.92	119			
Regular acaricide spraying	Between groups	1.88	2	0.94	4.04*	0.020
	Within groups	27.12	117	0.23		
	Total	28.99	119			

Regular deworming	Between groups	0.45	2	0.22	0.96	0.386
	Within groups	27.42	117	0.23		
	Total	27.87	119			
Maximum attention at kidding	Between groups	0.28	2	0.14	1.10	0.335
	Within groups	15.02	117	0.13		
	Total	15.30	119			
Culling done	Between groups	0.15	2	0.08	1.58	0.210
	Within groups	5.55	117	0.05		
	Total	5.70	119			
Inbreeding not allowed	Between groups	0.30	2	0.15	1.17	0.314
	Within groups	15.00	117	0.13		
	Total	15.30	119			

* = Significant at $p < 0.05$; **Key:** df = Degrees of freedom.

The results showed that among the adopters, there was a significant difference in the sub – location means with respect to the number of crossbred goats kept and acaricide spraying. Least squared difference (LSD) test was done in order to compare the three sub – location means in order to show the direction and magnitude of this difference. The results are presented in Table 19.

Table 19:
Results of Least Squared Differences Test for Comparison of the Sub – location Means (n = 28)

Technology	Sub - locations of Comparison	Mean Difference (I - J)	Std. Error	*P* value
Number of crossbred goats	Nyatike (I) vs. Owich (J)	0.17	0.24	0.485
	Owich (I) vs. Mikei (J)	0.58*	0.21	0.006
	Mikei (I) vs. Nyatike (J)	-0.58*	0.21	0.006
Warm & water - proof pen	Nyatike (I) vs. Owich (J)	0.00	0.09	1.000
	Owich (I) vs. Mikei (J)	0.00	0.08	1.000
	Mikei (I) vs. Nyatike (J)	0.00	0.08	1.000
Regular supplementation	Nyatike (I) vs. Owich (J)	0.00	0.13	1.000
	Owich (I) vs. Mikei (J)	-0.13	0.11	0.228
	Mikei (I) vs. Nyatike (J)	0.13	0.11	0.228
Fodder conserved	Nyatike (I) vs. Owich (J)	-0.03	0.04	0.414
	Owich (I) vs. Mikei (J)	0.00	0.04	1.000
	Mikei (I) vs. Nyatike (J)	0.00	0.04	1.000
Pye – grease used	Nyatike (I) vs. Owich (J)	0.03	0.05	0.476
	Owich (I) vs. Mikei (J)	0.05	0.04	0.218
	Mikei (I) vs. Nyatike (J)	-0.05	0.04	0.218
Regular acaricide dipping	Nyatike (I) vs. Owich (J)	0.00	0.04	1.000
	Owich (I) vs. Mikei (J)	-0.02	0.04	0.638
	Mikei (I) vs. Nyatike (J)	0.02	0.04	0.638
Regular acaricide spraying	Nyatike (I) vs. Owich (J)	0.00	0.12	1.000
	Owich (I) vs. Mikei (J)	0.25*	0.11	0.022
	Mikei (I) vs. Nyatike (J)	-0.25*	0.11	0.022
Regular deworming	Nyatike (I) vs. Owich (J)	0.10	0.12	0.425
	Owich (I) vs. Mikei (J)	-0.05	0.11	0.645
	Mikei (I) vs. Nyatike (J)	0.05	0.11	0.645
Maximum attention to kidding Does	Nyatike (I) vs. Owich (J)	-0.10	0.09	0.282
	Owich (I) vs. Mikei (J)	-0.12	0.08	0.148
	Mikei (I) vs. Nyatike (J)	0.12	0.08	0.148
Culling of old & unproductive goats	Nyatike (I) vs. Owich (J)	-0.10	0.06	0.078
	Owich (I) vs. Mikei (J)	-0.05	0.05	0.307
	Mikei (I) vs. Nyatike (J)	0.05	0.05	0.307
Inbreeding not allowed	Nyatike (I) vs. Owich (J)	0.00	0.09	1.000
	Owich (I) vs. Mikei (J)	-0.10	0.08	0.214
	Mikei (I) vs. Nyatike (J)	0.10	0.08	0.214

*= The mean difference is significant at $p < 0.05$. **Key:** Std. = Standard.

The results indicate that there were significantly more crossbred goats in Nyatike than Mikei and more in Owich than in Mikei. Moreover, Owich farmers did significantly more spraying of their goats with acaricides than those in Mikei did, much as Nyatike farmers did more than their counterparts in Mikei. The differences in numbers of crossbred goats kept and spraying done in Nyatike and Owich were found not to be statistically significant. Once again, these findings confirm the observation that Nyatike farmers had a relative advantage than their counterparts in the two other sub – locations, in terms of access to agricultural information and the physical environment for goat rearing. As for Owich farmers, these

results further attest to the fact that due to a much richer agricultural potential the farmers had a much better financial base than probably their counterparts in Mikei and Nyatike, hence better placed to adopt the technology practices. The fact that Owich farmers share Macalder trading centre with Nyatike farmers, while Mikei farmers relied more for services on Masara trading centre, itself far from Macalder that houses the Sheep and Goat Station and the divisional livestock extension offices, could explain the lack of significant differences between adoption levels among Nyatike and Owich farmers.

Based on the study findings, the null hypothesis of no significant difference in the technology adoption among farmers in the sub-locations of Southeast Kadem Location was rejected. This concurred with the findings of Misiko (1976) that adoption of hybrid maize production technologies could be influenced by several factors, one of which is the farmer's characteristics including his/ her wealth.

4.8.2 Farmers' Personal Characteristics and Technology Adoption

The study undertook to evaluate the relationship between smallholder goat farmers' personal characteristics of gender and age on the technology adoption in the study area. This was in line with the second objective of the study, for which the hypothesis under test was that:

$H_0$2: Farmers' personal characteristics have no statistically significant relationship with the adoption of crossbred goat technology.

Chi – square test of independence was used to test the hypothesis that farmer's gender has no statistically significant relationship with the adoption of crossbred goat technology. Cross – tabulation and Chi – square test results of crossbred goat technology adoption by gender among the smallholder goat farmers in the study area are presented in Table 20.

Table 20:
Adoption of Crossbred Goat Technology by Gender of the Household Head (n = 28)

Gender of Household Head	Number of Crossbred Goats Kept						Chi - square Results		
	1	2	3	4	6	Total	χ^2	df	*P* value
Male	7	5	2	0	1	**15**	4.06	4	0.399
Female	8	4	0	1	0	**13**			
Total	**15**	**9**	**2**	**1**	**1**	**28**			

Source: Survey data, 2004; significance tested at $p < 0.05$.

Table 20 shows that there was no statistically significant relationship between the household head's gender and the number of crossbred goats kept by the household. Table 21 presents the cross - tabulation and Chi – square test results for the adoption of crossbred goat technology practices by gender of the household heads.

Table 21:
Adoption of Crossbred Goat Technology Practices by Gender of the Household Head (n = 28)

Crossbred Goat Technology Practices	No. of HH Head Adopting/ Not Adopting Technology by Gender				Chi-square Results		
	Male		Female		χ^2	df	*P* value
	Yes	No	Yes	No			
Goats in warm & water – proof pens	12	3	9	4	0.43	1	0.512
Regular supplementation	7	8	4	9	0.74	1	0.390
Fodder conserved	1	14	0	13	0.90	1	0.343
Reliable water- source	15	0	13	0	.(a)		
Pye – grease used	0	15	0	13	.(a)		
Regular dipping in acaricides	0	15	1	12	1.20	1	0.274
Regular spraying in acaricides	11	4	7	6	1.15	1	0.283
Regular deworming	6	9	6	7	0.11	1	0.743
Kidding Does given maximum attention	15	0	12	1	1.20	1	0.274
Culling of old & unproductive goats	14	1	13	0	0.90	1	0.343
Inbreeding not allowed	13	2	11	2	0.02	1	0.877

Source: Survey data, 2004; Significance tested at $p < 0.05$.
Key: (a) = Chi - value cannot be computed, because at least one of the variables is a constant;
df = Degrees of freedom;
HH = Household;
No. = Number.

As shown by Table 21, adoption of crossbred goat technology practices had no statistically significant relationship with the household head's gender. Thus, household head's gender had no statistically significant relationship with the adoption of both crossbred goat technology and the technology practices. This is probably because farmers in the study area have had a long period of exposure to the technology, which has been in the area since 1981. Moreover, the female household heads could have out of experience discovered that they had to compete with male household heads for access to information regarding agricultural technologies. This was seen in more female household heads going for information in the divisional livestock extension offices compared to male household heads. As for male headed households where the male is married, the study findings seem to suggest that both males and females in the households jointly made decisions regarding crossbred goat technology adoption. In such cases, male headship of a household is more of a socio –

cultural ideology, but in practice both the females and males in the household shared responsibilities and roles regarding the daily running of the households.

The study, therefore, did not provide enough evidence to reject the null hypothesis of no statistically significant relationship between gender of the household head and adoption of crossbred goat technology. These findings seemed to concur with findings of Wanyoike *et al.*, (2002) that adoption of *Calliandra* fodder tree in Embu District, Kenya was highest in farms that were jointly managed by males and females, compared to those managed by either males or females singly. The findings, however, differed with those of Ndiema (2002) that males made most of the decisions regarding the adoption of wheat production technologies.

The hypothesis that age of the household head no statistically significant relationship with adoption of crossbred goat technology was tested using Pearson Product Moment Correlation test. Results are as presented in Table 22.

Table 22:
Pearson Correlation Results of Relationship of Household Head's Age with Adoption of Technology/ Technology Practices (n = 28)

Technology/ Technology Practice Adopted	Test Results	
	Pearson rho	*P* value
Number of crossbred goats kept	0.32	0.091
Goats in a warm and water – proof pen	-0.21	0.279
Regular supplementation	-0.31	0.112
Fodder conserved	-0.05	0.806
Regular dipping in acaricides	-0.41*	0.029
Regular spraying with acaricides	0.15	0.458
Regular deworming	-0.34	0.075
Does given maximum attention at kidding	0.01	0.950
Culling of old & unproductive goats	0.01	0.950
Inbreeding not allowed	-0.46*	0.015

* = Correlation is significant at $p< 0.05$ (2 tailed)

The results presented in Table 22 show that age of the household head had a statistically significant and negative relationship with the adoption of the practice of dipping goats in acaricide solutions (rho = -0.41; $p = 0.029$), and inbreeding control (rho = -0.46; $p = 0.015$). The interpretation is that, older farmers tended to dip their goats less frequently and took little care to prevent inbreeding among the goat flocks, than their younger counterparts. This can be explained from the point of view that older farmers lack the energy required for this laborious exercise, hence preferred to either let their more energetic children do it or they sprayed instead. As for inbreeding control, this is probably negatively correlated with age,

simply because old farmers lack the knowledge that this should be done, unless it is an act they had earlier engaged in and are continuing in out of experience.

Based on these findings, the null hypothesis of household heads' age having no statistically significant relationship with adoption of crossbred goat technology was rejected. The findings agreed with findings of Ndiema (2002) that adoption of use of fertiliser, improved seeds and chemicals was picked up more by the younger wheat farmers (aged 15 - 45 years) in her study, being more energetic and enthusiastic to adopt the technologies than their older counterparts. The findings, however, differed with findings of Wasula (2000) that there was no relationship between age and the adoption of agroforestry technologies. Wasula (2000) remarked that farmers' age had no statistically significant influence on the adoption of selected agroforestry technologies due to prior exposure the farmers had to agroforestry practices, which made them form a positive attitude towards the technologies.

4.8.3 Farmers' Socio - economic Characteristics and Technology Adoption

The study undertook to investigate the relationship between the smallholder goat farmers' highest formal educational level and farm sizes on the technology adoption, in line with the third objective, testing the hypothesis that:

$H_0$3: Farmers' socio – economic characteristics have no statistically significant relationship with the adoption of crossbred goat technology.

Chi – square test was run to test the null hypothesis that household head's highest education level has no statistically significant relationship with crossbred goat technology adoption. The cross – tabulation and Chi – square test results for the relationship of household head's highest educational level with the number of crossbred goats kept are presented in Table 23.

Table 23:
Relationship of Household Head's Highest Education with Number of Crossbred Goats Kept (n = 28)

Highest Education Level	No. of Crossbred Goats Kept						Chi - square Results		
	1	2	3	4	6	Total	χ^2	df	*P* value
None	1	0	0	0	0	1	6.42	8	0.601
Primary	12	7	2	1	0	22			
Secondary	2	2	0	0	1	5			
Total	**15**	**9**	**2**	**1**	**1**	**28**			

Source: Survey data, 2004; Significance tested at $p < 0.05$.

Table 23 shows that most of the crossbred goats were kept by the household heads with primary education, and that the highest number of crossbred goats kept by a single farmer was kept by the household head with secondary education. These differences were, however, statistically insignificant.

Cross – tabulation and Chi – square test results for the level of adoption of crossbred goat technology related practices are presented in Table 24. From the table, it is seen that there was a general tendency for the adoption of most of the crossbred goat technology practices to increase with increases in the education level of the household heads, but this was not statistically significant. For example, more educated household heads underscored the need for proper goat housing, regular spraying, culling and attention to kidding does, but Chi – square test results did not show any statistically significant relationship in their adoption with farmers' education level.

Thus, differences in the adoption of both crossbred goat technology and the technology practices were shown by the study to have no statistically significant relationship with the household head's highest education level. This, again, could be because the study farmers had had prior exposure to the technology, which as been in the study area since 1981. Thus, the study did not provide sufficient evidence to reject the null hypothesis that household head's highest education level has no statistically significant relationship with crossbred goat technology adoption.

Table 24:
Adoption of Crossbred Goat Technology Practices by Household Head's Highest Educational Level (n = 28)

Technology Practice Adopted	No. of Households Adopting/ Not Adopting by Household Head's Highest Educational Level						Chi - square Results		
	None		Primary		Secondary		χ^2	df	P value
	Yes	No	Yes	No	Yes	No			
Goats in a warm and water - proof pen	1	0	15	7	5	0	2.54	2	0.280
Regular supplementation	0	1	10	12	1	4	1.78	2	0.411
Fodder conserved	0	1	0	22	1	4	4.77	2	0.092
Reliable water source	1	0	22	0	5	0	.(a)		
Pye – grease used	0	1	0	22	0	5	.(a)		
Regular dipping in acaricides	0	1	1	21	0	5	0.28	2	0.868
Regular spraying with acaricides	0	1	15	7	3	2	1.98	2	0.371
Regular deworming	0	1	9	13	3	2	1.38	2	0.501
Does given maximum attention at kidding	1	0	21	1	5	0	0.28	2	0.868
Culling of old & unproductive goats	1	0	21	1	5	0	0.28	2	0.868
Inbreeding not allowed	1	0	19	3	4	1	0.31	2	0.857

Source: Survey data, 2004; Significance tested at $p < 0.05$.

Key: df = Degrees of freedom;
No. = Number.

The findings agreed with findings of Wasula (2000) that prior exposure to agroforestry practices meant no difference in the adoption of agroforestry technologies, but differed with findings of Ntege - Nanyeenya *et al.*, (1997) that formally educated farmers were more likely to adopt the Longe 1 maize technology by a factor of 4.3 than their illiterate counterparts. The findings differed with those of Weir and Knight (2002) that better educated farmers are early innovators and better able to copy those who innovate first. The findings also differed with findings of Ndiema (2002) that household head's education level significantly influenced fertiliser – and improved seed – use in wheat production, and of Wanyoike *et al.*, (2002) that better educated farmers significantly adopted *Calliandra* as an improved fodder tree more than their lowly educated counterparts. The findings in this study seem to differ with conventional knowledge on the influence of education on technology adoption. Whereas prior exposure to the technology by the farmers in the area is a possible explanation, more studies are needed before documenting whether education plays any significant role in influencing technology adoption.

Pearson Product Moment Correlation test was used to test the hypothesis that household farm size has no statistically significant relationship with adoption of crossbred goat technology. The study showed that the farmers in the study area were generally small scale, with the average farm size being 7.37 acres (Table 4). Table 5 shows that the average area of land under pasture was low compared to that under crops. Pearson correlation results for significant relationship are shown in Table 25.

Table 25:
Relationship of Adoption of Crossbred Goat Technology/ Technology Practices with Farm Size (n = 28)

Technology/ Technology Practice Adopted	Test Results	
	Pearson rho	*P* value
Number of crossbred goats kept	0.04	0.824
Goats in a warm and water – proof pen	-0.13	0.524
Regular supplementation	0.00	0.992
Fodder conserved	0.17	0.397
Regular dipping in acaricides	-0.57*	0.002
Regular spraying with acaricides	-0.12	0.553
Regular deworming	-0.27	0.159
Kidding Does given maximum attention	-0.17	0.397
Culling of old & unproductive goats	0.08	0.690
Inbreeding not allowed	0.18	0.354

* = Correlation significant at $p < 0.05$.

Table 25 shows that farm size had no statistically significant relationship with the adoption of crossbred goat technology and most of the associated practices, but had a significantly negative correlation with regular acaricide dipping (rho = -0.57; $p = 0.002$). The results further reaffirm the earlier observation that even farmers with very small land holdings could adopt the technology, using the vast government trust land available in the study area or land rented from others. For most of the associated technology practices, farm size probably had no statistically significant relationship with their adoption largely because the farmers had been exposed to them over time, Macalder Station having been in the study area since 1981. The statistically significant negative relationship farm size has with dipping in acaricides implies that the larger the farm sizes, the less the study farmers dipped their goats, and vice - versa. Considering the fact that most of the dips were non – functional at the time of the study, the possible explanation for this could only be that in large farms, there was a comparatively low level of contamination of the pastures and browses with ticks, hence, the tick menace was not as great as in the smaller farms where their numbers rapidly build up.

Based on the study findings, the null hypothesis that farm size has no statistically significant relationship with crossbred goat technology adoption holds true, except for acaricide dipping. For most of the adoption studies done so far, farm size has been found to have either no statistically significant influence or a significantly positive influence on technology - adoption. Okuro *et al.*, (2002) found farm size not to have any statistically significant influence on the adoption of maize production technologies in Embu District, Kenya. Irungu *et al.*, (1998) found land size to jointly significantly and positively influence both the probability and adoption level of Napier grass (*Pennisetum purpureum*) in smallholder dairying in the highlands of Kenya. Thus, the findings of this study regarding the influence of farm size disagreed with most of the research findings, but could form the basis of investigation for reproduction in other studies.

4.8.4 Farmers' Goat Rearing Knowledge and Skills and Technology Adoption

The study undertook to determine the level of the smallholder farmers' knowledge and skills in goat rearing, and to establish its influence on the adoption of crossbred goat technology, in line with the fourth objective. The hypothesis under test was that:

$H_0$4: The level of farmers' knowledge and skills in goat rearing has no statistically significant influence on the adoption of crossbred goat technology.

The hypothesis was tested using Pearson Correlation test. Cross – tabulation analysis for both the adopters and non adopters are presented in Table 26.

Tables 16 and 26 show that the farmers in the study area were generally very knowledgeable in goat rearing principles and practices, although Table 26 shows that the adopters were slightly more knowledgeable than the non adopters. For example, all the adopters agreed with the statements that, reliable water – source is essential in goat rearing; kids need protection from cold and rain, and need to be kept in clean enclosures. They also agreed with the statements that dung ought to be regularly removed from goat pens, and that tethered goats ought to be rotated and given plenty of water.

Table 26:
Cross – tabulations for the Level of Knowledge & Skills for Adopters and Non Adopters (n = 120)

Statement on Goat Rearing	Percent of Adopters (n = 28)			Percent of Non- Adopters (n = 92)		
	Agree	Uncertain	Disagree	Agree	Uncertain	Disagree
Ticks & worms pose the greatest health problem to goats.	89.29	3.57	7.14	93.48	5.43	1.09
Goats should be dewormed anytime a dewormer is available.	42.86	7.14	50.00	56.52	11.96	31.52
Hand – picking is the most effective tick control method.	14.29	0.00	85.71	13.04	5.43	81.52
A reliable source of clean water is essential in goat rearing.	100.00	0.00	0.00	98.91	0.00	1.09
Supplementary feeding is not economical in goat rearing.	10.71	3.57	85.71	11.96	2.17	85.87
The season of the year when goats give birth does not affect the survival of the kids.	53.57	7.14	39.29	58.70	9.78	31.52
Kids should be protected from excessive colds & rains.	100.00	0.00	0.00	100.00	0.00	0.00
Kids need to be kept in a clean enclosure.	100.00	0.00	0.00	100.00	0.00	0.00
Breeding Does should be mated with their kids.	3.57	10.71	85.71	14.13	8.70	77.17
It would be good if someone is around when goats kid.	92.86	3.57	3.57	78.26	8.70	13.04
Dung should be regularly removed from goat pens.	100.00	0.00	0.00	100.00	0.00	0.00
A goat pen need not be water – proof.	3.57	3.57	92.86	10.87	2.17	86.96
Many farmers do not keep goats because they need more land than they have.	60.71	3.57	35.71	69.57	3.26	27.17
Goats are not easy to keep because they always require supplementary feeding.	14.29	0.00	85.71	33.70	2.17	64.13
Goats that are tethered need to be rotated & given plenty of water.	100.00	0.00	0.00	100.00	0.00	0.00

Source: Survey data, 2004.

To show if farmers' level of knowledge and skills in goat rearing had any statistically significant influence on the adoption of crossbred goat technology, Pearson Product Moment Correlation test was done and results presented in Table 27.

Table 27:
Results of Bivariate Pearson Correlation Analysis of the Influence of Farmers' Level of Knowledge and Skills in Goat Rearing on Crossbred Goat Technology Adoption (n = 28)

Statement on Goat Rearing	Technology/ Technology Practices Adopted									
	No. Cbg.	Wm.	Sup.	Fd.	Dp.	Sp.	Dw.	M. Att.	Cl.	No Ib.
T & W										
Rho	0.13	0.27	-0.28	0.06	0.06	-0.11	0.02	-0.06	0.65	0.05
P	0.500	0.168	0.154	0.747	0.747	0.581	0.923	0.747	0.000	0.784
Dw										
Rho	0.35	-0.04	-0.02	-0.19	-0.19	0.02	-0.09	-0.21	0.19	-0.46*
P	0.070	0.828	0.934	0.343	0.343	0.911	0.664	0.273	0.343	0.015
Hp.										
Rho	0.18	-0.24	-0.12	-0.08	-0.08	-0.12	-0.35	0.08	0.08	-0.12
P	0.354	0.227	0.545	0.691	0.691	0.537	0.065	0.691	0.691	0.526
Sup.										
Rho	0.21	-0.16	-0.32	-0.08	-0.08	0.06	0.11	0.08	0.08	-0.48
P	0.276	0.408	0.100	0.701	0.701	0.766	0.564	0.710	0.710	0.009
Kd. Sn.										
Rho	-0.07	-0.26	-0.43*	0.17	-0.23	-0.04	-0.13	-0.17	0.23	-0.37
P	0.736	0.182	0.023	0.378	0.237	0.821	0.510	0.378	0.237	0.055
Ib.										
Rho	0.12	-0.66	-0.31	-0.07	-0.07	-0.19	-0.18	0.07	0.07	-0.50
P	0.545	0.000	0.111	0.710	0.710	0.323	0.369	0.710	0.710	0.007
Sn. Kd.										
Rho	-0.18	-0.15	0.03	0.05	0.05	0.17	-0.13	0.42*	-0.05	-0.11
P	0.373	0.442	0.872	0.799	0.799	0.389	0.523	0.026	0.799	0.588
No Wp - p.										
Rho	-0.21	-0.45*	0.15	-0.05	-0.05	0.20	0.30	0.05	-0.89	0.11
P	0.274	0.015	0.456	0.799	0.799	0.319	0.117	0.799	0.000	0.588
> Ld.										
Rho	-0.23	-0.02	-0.44*	0.15	-0.25	0.04	0.23	0.25	-0.15	-0.11
P	0.247	0.913	0.018	0.440	0.193	0.843	0.243	0.193	0.440	0.588
Als. Sup.										
Rho	0.09	-0.24	0.09	-0.08	-0.08	-0.12	-0.15	-0.47*	0.08	-0.42*
P	0.645	0.227	0.650	0.691	0.691	0.537	0.454	0.011	0.691	0.027

* = Correlation is significant at $p < 0.05$;

Key: Technology/ Technology Practices

No. Cbg.	=	Number of Crossbred goats kept;
Wm.	=	Goats kept in warm & water – proof pen;
Sup.	=	Goats regularly supplemented;
Fd.	=	Fodder conserved for use during the dry season;
Dp.	=	Goats regularly dipped in acaricides;
Sp.	=	Goats regularly sprayed with acaricides;
Dw.	=	Goats regularly dewormed;
M. Att.	=	Kidding Does given maximum attention;
Cl.	=	Old/ unproductive goats culled;
No Ib.	=	Inbreeding (mating of Does with own kids) not allowed.

Key: Statements on Knowledge & Skills in Goat Rearing

T & W	=	Ticks and worms pose the greatest health menace in goat production;
Dw	=	Deworming ought to be done anytime a dewormer is available;
Hp.	=	Hand – picking is the best tick control method;

Sup.	=	Supplementation is uneconomical in goat rearing;
Kd. Sn.	=	Kidding season has no effect on kids' survival;
Ib	=	Inbreeding be done (Breeding Does be mated with their own kids);
Sn. Kd.	=	Someone ought to be around when Does kid;
No Wp - p	=	There is no need for a water - proof pen;
> Ld	=	Goat rearing needs more land than most farmers have;
Als. Sup.	=	Goats are not easy to keep as they always require supplementation;

The correlation results presented in Table 27 show that farmers' level of knowledge and skills in goat rearing had no statistically significant influence on the adoption of crossbred goat technology, but had a statistically significant influence on the adoption of some of the technology practices, whose adoption were either influenced negatively or positively.

Table 27 further shows that farmers' level of knowledge on deworming had a significantly negative influence on adoption of inbreeding control (rho = -0.46; p = 0.015). The table further shows that farmers' level of knowledge of the influence kidding season had on kids' survival also had a significantly negative influence on adoption of supplementation as a technology practice (rho = - 0.43; p = 0.023). The level of knowledge of need for proper goat housing significantly influenced the type of housing structures for the goats (rho = -0.45; p = 0.015), much as the level of knowledge of land requirement for goat rearing significantly influenced supplementation of the goats (rho = - 0.44; p = 0.018). The table shows that the level of knowledge of the fact that goat rearing was difficult because goats always required supplementation had a significantly negative influence on both the attention given to kidding does (rho = - 0.47; p = 0.011) and inbreeding control (rho = - 0.42; p = 0.027). The table, further shows that the level of farmers' knowledge of the need for someone to be around when does kid had a significantly positive influence on the attention given to kidding does (rho = 0.42; p = 0.026).

That farmers' level of knowledge on deworming had a significantly negative influence on inbreeding control implies that the more the farmers felt deworming should not be done anytime a dewormer is available, the more they controlled inbreeding among their goat flocks. This can be explained by the fact that out of experience, the adopters had come to appreciate the value of the technology, and knew that for maximum productivity of the crossbred goat to be realised, both proper and more routine worm and inbreeding control were paramount.

That farmers' level of knowledge on the influence of kidding season on kids' survival had a significantly negative influence on supplementation implies that the more the farmers came to appreciate the fact that the season of the year when does kid significantly affected

their kids' survival, the more they synchronised tupping with the desired season and supplemented the goats during periods of shortage, knowing that this is more economical to do than to have the kids born at a time when chances of their survival were low. Proper knowledge of the influence of kidding season on kids' survival requires more of formal education than experience. The same applies to farmers' appreciation of the need for supplementation, hence the more enlightened farmers knew the greatest profit from the crossbred goat was the kid, which needed to be given full opportunity to grow and develop into an adult, even if that meant supplementary feeding of the does and synchronising kidding season with favourable environmental conditions.

That farmers' level of knowledge of the need for proper goat housing significantly influenced the type of goat house the farmers had shows that those farmers who knew that a goat pen needed to be water proof also went ahead to provide the same to their goats. Similarly, the experience the farmers had that it did not matter the size of land one had, but the quality of the feeds the goats got from a unit of land, made them to adopt supplementary feeding in order to cater for the goats' nutrient demands. Such farmers, therefore, would not agree to the statement that goat rearing needed more land than most farmers had, hence the negativity of the influence on adoption of supplementation.

That farmers' level of knowledge of the fact that goat rearing was not difficult because goats always required supplementation had significant influence on inbreeding control shows that farmers who appreciated the value of the kid also knew that supplementation was only necessary at times of deficiency, but inbreeding could greatly lower the potential of the kid, while lack of proper supervision of the kidding doe could mean a complete loss of the kid, hence the future generation, leading to a drop in production. For this reason, the farmers who knew that there was need to supervise the kidding doe also went ahead to pay maximum attention to kidding does.

Based on the findings, the null hypothesis that farmers' level of knowledge and skills in goat rearing has no statistically significant influence on the adoption of crossbred goat technology was rejected. It appeared the more knowledgeable the farmer was, the more likely the farmer was able to adopt the crossbred goat technology and the associated technology practices.

4.8.5 Technology Cost and its Adoption

The study undertook to investigate the relationship between the perceived cost of the crossbred goat technology and its adoption among the smallholder goat farmers of the study area. This was in line with the fifth objective of the study, which was tested by the null hypothesis that:

$H_0$5: The cost of crossbred goat technology has no statistically significant relationship with its adoption among the smallholder goat farmers of Southeast Kadem Location.

The hypothesis was tested using Pearson Chi - square test for significant relationship. The results are presented in Tables 28 and 29.

The study farmers were asked to indicate what they perceived to be the current prices of both crossbred male and female goats at Macalder Station at the time of the study. This information was further corroborated with data from Macalder Station on the actual prices charged. The figures given as the farmers' perceived prices of the technology developed at Macalder Station were then put in price ranges and Chi –square test for significant relationships run. Table 28 presents the relationship of the perceived costs of mature crossbred female and male goats with crossbred goat technology adoption.

Table 28:
Cross – tabulation and Chi – square Results of Relationship of Perceived Price of Crossbred Goat Technology with Technology Adoption (n = 28)

No. of Crossbred Goats Kept	No. of Farmers as per Categories of Current Price of Mature Female Crossbred Goat (Ksh.)				Chi - square Results			No. of Farmers as per Categories of Current Price of Mature Male Crossbred Goat (Ksh.)				Chi - square Results		
	600-900	1000-1300	1500-2500	3000+	χ^2	df	*P* value	700-1000	1200-1600	1800-2500	2800-4000	χ^2	df	*P* value
1	2	6	6	1	25.86	36	0.894	1	5	5	4	28.08	44	0.970
2	2	2	4	0				2	2	4	1			
3	0	1	2	0				0	0	1	1			
4	0	0	1	0				0	1	0	0			
6	0	0	0	1				0	0	1	0			
Total	**4**	**9**	**13**	**2**				**3**	**8**	**11**	**6**			

Significance was tested at $p < 0.05$.

The actual prices charged by Macalder Station for both crossbred male and female goat were found to be far much lower than the study farmers' perceived prices, even though both the Station and the study farmers concurred on the fact that the male crossbred goat was priced higher than the female one. The Station prices ranged from Ksh. 800 to Ksh. 1,000 for a breeding crossbred female goat and Ksh. 1,200 to Ksh. 1,800 for a breeding crossbred buck. Table 28 shows that generally the study farmers perceived the cost of the female crossbred goat to be in the range of Ksh. 1,500 to 2,500, and that of mature male crossbred goat to be in the range of Ksh. 1,800 to 2,500. Nevertheless, these differences had statistically insignificant relationship with the technology adoption, judging from the Chi – square results.

Table 29 presents the relationship of the perceived cost of mature crossbred female and male goats with the adoption of crossbred goat technology practices. The table shows that the perceived prices of both crossbred male and female goats had no statistically significant relationship with the adoption of the technology practices.

Thus, as seen in Tables 28 and 29 the study shows that the perceived current price of crossbred goat technology had no statistically significant relationship with its adoption, as well as the adoption of the technology practices. This finding is encouraging, and implies that the farmers attach a much higher relative advantage to the technology over and above the local goat; hence their adoption of the technology is not deterred by the perceived costs, which are higher than the actual prices charged by Macalder Station. Thus, technology price was not one of those factors that deterred farmers from adopting the technology.

The study, therefore, did not provide sufficient evidence to reject the null hypothesis of the cost of crossbred goat technology having no significant relationship with its adoption among the study farmers. These findings agree with those of Batz *et al.* (1999) that farmers

adopted the zero – grazing dairy technology if its characteristics promised a higher utility relative to the traditional technology. Since the crossbred goat was introduced in the study area in 1981, it may be that the farmers have over the time come to appreciate its tangible benefits over and above those of the local goat; hence the perceived price of the technology may not really influence its adoption.

Table 29:
Cross – tabulation and Chi – square Results of Relationship of Perceived Price of Crossbred Goat Technology with Adoption of Technology Practices (n = 28)

Practice	No. of Farmers Adopting/ Not Adopting as per Categories of Current Price of Mature Female Crossbred Goat (Ksh.)				Chi - square Results			No. of Farmers Adopting/ Not Adopting as per Categories of Current Price of Mature Male Crossbred Goat (Ksh.)				Chi - square Results		
	600-900	1000-1300	1500-2500	3000+	X^2	df	*P* value	700-1000	1200-1600	1800-2500	2800-4000	χ^2	df	*P* value
Wm.					13.11	9	0.158					13.48	11	0.264
Yes	4	6	12	1				2	6	10	3			
No	2	2	3	1				1	2	1	3			
Sup.					5.60	9	0.779					7.20	11	0.783
Yes	1	4	5	1				1	4	4	2			
No	2	4	10	1				2	4	7	4			
Fd.					2.59	9	0.978					3.11	11	0.989
Yes	0	0	1	0				0	0	1	0			
No	3	8	14	2				3	8	10	6			
Wr.					.(a)							.(a)		
Yes	3	8	15	2				3	8	11	6			
No	0	0	0	0				0	0	0	0			
Pg.					.(a)							.(a)		
Yes	0	0	0	0				0	0	0	0			
No	3	8	15	2				3	8	11	6			
Dp.					6.22	9	0.717					4.77	11	0.942
Yes	0	1	0	0				0	1	0	0			
No	3	7	15	2				3	7	11	6			
Sp.				2	9.63	9	0.381					10.95	11	0.447
Yes	3	2	11					3	3	8	4			
No	0	6	4	0				0	5	3	2			
Dw.					8.13	9	0.521					9.78	11	0.550
Yes	1	4	5	2				1	3	5	3			
No	2	4	10	0				2	5	6	3			
M. Att.	3	8	14	2	2.59	9	0.978					3.11	11	0.989
Yes								3	8	10	6			
No	0	0	1	0				0	0	1	0			
Cl.					13.48	9	0.142					13.48	11	0.263
Yes	3	8	14	2				3	8	11	5			
No	0	0	0	0				0	0	0	1			
No Ib.					7.99	9	0.535					6.49	11	0.838
Yes	3	7	12	2				3	7	10	4			
No	0	1	3	0				0	1	1	2			

Key:

Wm.	=	Goats in warm and water – proof pen;
Sup.	=	Goats regularly supplemented;
Fd.	=	Fodder conserved for use during the dry seasons;
Wr.	=	Goats have a reliable water source;
Pg.	=	Pye – grease used against ticks;
Dp.	=	Goats regularly dipped in acaricides;
Sp.	=	Goats regularly sprayed with acaricides;
Dw	=	Goats regularly dewormed;
M. Att.	=	Kidding Does given maximum attention;
Cl.	=	Culling of old and unproductive goats;
No Ib.	=	Inbreeding not allowed;
No.	=	Number.

4.8.6 Compatibility of the Crossbred Goat with Existing Farm Practices and Socio – cultural Values

To determine the extent to which the crossbred goat technology is compatible with existing farm practices and values and its relationship with the adoption of crossbred goat technology among farmers in the study area in line with the sixth objective of the study, the following hypothesis was tested:

$H_0$6: Compatibility of the crossbred goat technology with existing farm practices and values has no statistically significant relationship with its adoption among the smallholder goat farmers in Southeast Kadem Location.

To test this hypothesis, Pearson Product Moment Correlation test for significant relationship was run. Table 30 gives the relationship of the existing farm conditions and land use patterns and practices at the time of study with the adoption of the crossbred goat technology and technology practices. Table 31 presents the Cross – tabulations of the uses the adopters put their crossbred goat to, bearing in mind the socio – cultural practices and values in the study area at the time of study, while Table 32 gives the relationship of the existing farm practices and Socio – cultural practices and values with the adoption of Crossbred goat technology and the associated technology practices.

The socio – cultural practices considered in this study included giving a goat as a gift, exchanging a goat for property, using a goat to pay dowry; using a goat to pay fines, settle disputes, pay for services rendered, settling debt; and taking a goat to the bereaved or to a friend to keep for sometime. Other are, slaughtering a goat for skin, slaughtering a goat for the family, a friend or visitor for use as food; slaughtering a goat in social gatherings, and passing on a goat to children for inheritance. In an area where most of the farmers are fairly poor, but such socio – cultural practices thrive and are highly upheld and recognised even by the authorities, it would be important to establish whether the technology is compatible with them and to establish the relationship of these values and practices, if any, with the adoption of technology and the associated technology practices. This could offer a better understanding of the technology adoption in the light of the prevailing socio – cultural environment, given the socio – economic environment is now fairly well established.

Table 30:
Relationship of the Existing Farm Conditions and Practices with Adoption of Technology/ Technology Practices (n = 28)

Technology/ Technology Practice	Existing Farm Conditions and Land Use Patterns and Practices						
	Farm Size	Ownership Mode	Av. Acreage: Crops	Av. Acreage: Pastures	Av. Acreage: Rented from Others	Av. Acreage: Rented to Others	Goat Rearing Method
No. Cbg.							
Rho	0.04	0.28	-0.04	0.13	0.18	0.33	0.04
P	0.824	0.151	0.836	0.507	0.368	0.084	0.845
Wm.							
Rho	-0.13	-0.28	-0.11	-0.19	-0.12	-0.06	-0.50
P	0.524	0.152	0.591	0.325	0.561	0.772	0.007
Sup.							
Rho	0.00	0.09	0.03	-0.10	-0.20	-0.11	0.02
P	0.993	0.660	0.871	0.599	0.300	0.580	0.915
Fd.							
Rho	0.17	-0.28	0.12	0.10	-0.13	0.10	-0.28
P	0.397	0.152	0.542	0.616	0.498	0.628	0.152
Dp.							
Rho	-0.57	0.07	-0.32	-0.63	0.13	-0.17	0.03
P	0.002	0.731	0.091	0.000	0.498	0.380	0.866
Sp.							
Rho	-0.12	-0.20	-0.18	-0.08	-0.21	-0.16	0.11
P	0.553	0.317	0.365	0.677	0.290	0.407	0.570
Dw.							
Rho	-0.27	-0.21	-0.13	-0.36	1.00	-0.37	0.27
P	0.159	0.276	0.518	0.062	0.612	0.050	0.169
M. att.							
Rho	-0.17	-0.07	-0.22	-0.10	0.13	-0.10	-0.03
P	0.397	0.731	0.262	0.616	0.498	0.628	0.866
Cl.							
Rho	0.08	,0.10	0.08	0.05	0.00	-0.10	-0.34
P	0.690	0.595	0.694	0.812	1.000	0.628	0.072
No Ib.							
Rho	0.18	-0.33	0.27	0.10	-0.28	-0.20	-0.07
P	0.354	0.089	0.164	0.614	0.144	0.300	0.720

* = Correlation is significant at $p < 0.05$;

Key: Technology/ Technology Practices

No. Cbg.	=	Number of Crossbred goats kept;
Wm.	=	Goats kept in warm & water – proof pen;
Sup.	=	Goats regularly supplemented;
Fd.	=	Fodder conserved for use during the dry season;
Wr.	=	Goats have a reliable water – source;
Pg.	=	Pye – grease used to prevent ticks;
Dp.	=	Goats regularly dipped in acaricides;
Sp.	=	Goats regularly sprayed with acaricides;
Dw.	=	Goats regularly dewormed;
M. Att.	=	Kidding Does given maximum attention;
Cl.	=	Old/ unproductive goats culled;
No Ib.	=	Inbreeding (mating of Does with own kids) not allowed.

Key: Existing Farm Conditions and Practices

Av. Acreage: Crops = Average land acreage under crops (2002 – 2004);
Av. Acreage: Pastures = Average land acreage under pastures and browses (2002 – 2004);
Av. Acreage: Rented from others = Average land acreage rented from others (2002 – 2004);
Av. Acreage: Rented to others = Average land acreage rented to others (2002 – 2004).

Table 30 shows that the existing farm conditions and land use patterns and practices had no statistically significant influence on the adoption of crossbred goat technology and the associated technology practices. Thus, farm sizes, land ownership mode, land acreages under crops and pastures and browses, and land acreages rented from others and to others, did not seem to significantly influence the farmers' decisions to adopt the technology in the study area. Thus, the crossbred goat technology is compatible with these farm conditions and practices, a finding which seems to further strengthen the fact that even farmers with small land holdings could still adopt the technology, given the presence of government trust land in the area, the fairly cheap cost of renting land for use in the area, as most of the study farmers were themselves settlers in rented land.

Table 31:
Cross – tabulation Results for Uses of the Crossbred Goats among the Adopters (n = 28)

Uses to Crossbred Goat	Frequency and Percent of Adopters Putting Crossbred Goat to the Uses					
	Readily		Not Readily		Not at all	
	Freq.	%	Freq.	%	Freq.	%
As gift	2	1.7	14	11.7	12	10.0
For property	13	10.8	13	10.8	2	1.7
For dowry payment	16	13.3	10	8.3	2	1.7
For settling fines and disputes	3	2.5	17	14.2	8	6.7
For services	5	4.2	13	10.8	10	8.3
To bereaved	4	3.3	16	13.3	8	6.7
To be kept by a friend	3	2.5	12	10.0	13	10.8
To offset dept	15	12.5	9	7.5	4	3.3
For family food	2	1.7	2	1.7	24	20.0
For food for friend or visitor	2	1.7	14	11.7	12	10.0
Slaughtered in social gatherings	8	6.7	14	11.7	6	5.0
Slaughtered for skin	0	0.0	4	3.3	24	20.0
For children's Inheritance	17	14.2	8	6.7	3	2.5

Key: Freq. = Frequency (Numbers).

Table 31 shows that none of the adopters would readily slaughter their crossbred goats for skin, only2 (1.7%) would readily give their crossbred goats as gift; even as only 3

(2.5%) would readily send the crossbred goats to be kept by a friend. The table further strengthens the early finding that the adopters attached more higher value to the crossbred goat compared to the local one, but the fact that the crossbred goat was also involved in such socio – cultural uses and practices shows the compatibility of the goats to these practices, a fact that means that even poor farmers could adopt the technology if the mode of acquiring it was not strictly on monetary terms. For example, the fact that the farmers could use the crossbred goat to settle debt, but with restraint suggests that given an opportunity to acquire the technology, but pay with local goats over time most farmers who may not have the money to pay for the technology would have the opportunity to acquire it.

As shown in Table 32, using crossbred goat to settle debt is negatively and significantly related with regular supplementation (rho = -0.44; p = 0.020). It also shows that using crossbred goat for fines and disputes is positively and significantly related with regular dipping in acaricides (rho = 0.38; p = 0.048), sending crossbred goat to be kept by a friend for sometime is positively and significantly related with regular dipping in acaricides (rho = 0.39; p = 0.039), while slaughtering crossbred goat for skin is negatively and significantly related with giving kidding Does maximum attention (rho = -0.47; p = 0.011).

Table 32:
Relationship of the Existing Farm Practices and Socio – cultural Practices and Values with the Adoption of Technology/ Technology Practices (n = 28)

Technology/Technology - practice	Existing Socio - cultural Practices and Values												
	Cbg. - gt.	Cbg. - pt.	Cbg. - dy.	Cbg. - f/d.	Cbg. - sv.	Cbg. - bd.	Cbg. - fd.	Cbg. - dt.	Cbg. - f-f.	Cbg. - f-f/v.	Cbg. - sg	Cbg. - sn.	Cbg. - in.
No. Cbg.													
rho	0.12	0.06	0.08	-0.09	0.10	0.25	0.26	0.36	0.20	0.24	0.07	0.00	-0.07
p	0.546	0.745	0.700	0.639	0.609	0.201	0.177	0.058	0.308	0.229	0.731	1.000	0.723
Wm.													
rho	-0.17	0.10	-0.07	0.24	0.32	-0.13	-0.06	-0.03	-0.37	-0.20	0.06	0.24	-0.06
p	0.546	0.612	0.739	0.218	0.097	0.513	0.754	0.886	0.053	0.301	0.767	0.227	0.760
Sup.													
rho	-0.06	-0.04	0.06	-0.13	-0.21	-0.16	-0.12	-0.44*	-0.18	0.11	-0.19	-0.12	0.16
p	0.775	0.848	0.768	0.523	0.284	0.406	0.551	0.020	0.365	0.573	0.344	0.545	0.413
Fd.													
rho	-0.22	-0.12	-0.15	0.06	0.05	-0.26	-0.19	-0.37	-0.07	-0.20	-0.29	-0.08	-0.14
p	0.267	0.535	0.435	0.772	0.807	0.185	0.344	0.052	0.709	0.301	0.130	0.691	0.473
Dp.													
rho	0.10	-0.12	0.15	0.38*	0.32	0.34	0.39*	-0.37	-0.07	0.11	0.25	-0.08	-0.14
p	0.602	0.535	0.435	0.048	0.097	0.073	0.039	0.052	0.709	0.568	0.192	0.691	0.473
Sp.													
rho	-0.03	0.23	-0.12	-0.10	-0.19	-0.17	-0.18	-0.01	-0.25	0.17	-0.03	0.09	-0.11
p	0.893	0.233	0.547	0.622	0.339	0.397	0.371	0.970	0.203	0.375	0.878	0.644	0.580
Dw.													
rho	0.10	0.27	0.34	0.50	0.12	0.08	-0.08	-0.17	-0.07	0.03	0.12	0.26	-0.11
p	0.602	0.169	0.072	0.007	0.556	0.683	0.696	0.385	0.709	0.864	0.552	0.173	0.592
M. att.													
rho	-0.10	-0.19	-0.15	-0.06	-0.05	-0.04	-0.10	-0.16	0.07	-0.11	0.02	-0.47*	-0.14
p	0.602	0.335	0.435	0.772	0.807	0.828	0.601	0.412	0.709	0.568	0.921	0.011	0.473
Cl.													
rho	-0.10	-0.19	0.15	-0.06	0.22	-0.04	0.19	-0.16	0.07	-0.11	0.02	0.08	-0.14
p	0.602	0.335	0.435	0.772	0.255	0.823	0.344	0.412	0.709	0.568	0.921	0.691	0.473
No Ib.													
rho	-0.22	0.09	0.16	0.05	-0.10	-0.25	-0.52	-0.06	-0.76	-0.24	-0.10	-0.12	0.00
p	0.264	0.633	0.408	0.806	0.603	0.198	0.004	0.760	0.000	0.221	0.600	0.526	1.000

* = Correlation is significant at $p < 0.05$;

Key: Technology/ Technology Practices

No. Cbg.	=	Number of Crossbred goats kept;
Wm.	=	Goats kept in warm & water – proof pen;
Sup.	=	Goats regularly supplemented;
Fd.	=	Fodder conserved for use during the dry season;
Dp.	=	Goats regularly dipped in acaricides;
Sp.	=	Goats regularly sprayed with acaricides;
Dw.	=	Goats regularly dewormed;
M. Att.	=	Kidding Does given maximum attention;
Cl.	=	Old/ unproductive goats culled;
No Ib.	=	Inbreeding (mating of Does with own kids) not allowed.

Key: Existing Socio- cultural Practices and Values

Cbg. - gt.	=	Crossbred goat as gift;
Cbg. - pt.	=	Crossbred goat for property;
Cbg. - dy.	=	Crossbred goat for dowry;
Cbg. - f/d.	=	Crossbred goat for fines and disputes;
Cbg. - sv.	=	Crossbred goat for services;
Cbg. - bd.	=	Crossbred goat to bereaved;
Cbg. - fd.	=	Crossbred goat to a friend for keeping;
Cbg. - dt.	=	Crossbred goat for dept;
Cbg. - f-f.	=	Crossbred goat for family food;
Cbg. - f-f/v.	=	Crossbred goat for food for friend/ visitor;
Cbg. - sg.	=	Crossbred goat slaughtered in social gatherings;
Cbg. - sn.	=	Crossbred goat for skin;
Cbg. - in.	=	Crossbred goat for inheritance.

That use of crossbred goat technology to settle debt is negatively related with supplementation indicates that due to the high value farmers in the study area attach to the technology, the adopters realise the need to supplement the goat for maximum productivity, hence least readily used it to settle debt. Likewise, since dipping is a rare practise in the study area, most dips being inactive, use of crossbred goats in settling fines and disputes was equally rare among the adopters for the same reason, high poverty levels in the study area notwithstanding. The same explanation holds for the significantly positive relationship sending a crossbred goat to a friend to keep for sometime had with adoption of dipping in acaricides. Similarly, due to their high value, the adopters strove to give kidding crossbred goats maximum attention, hence could not slaughter the same to merely get skins from them.

From the results, the crossbred goat technology is compatible with the existing farm conditions and practices, as well as the existing socio – cultural practices and values, even though farmers became more careful that the latter did not negatively impact the productivity of the technology. Thus, the null hypothesis of compatibility of the crossbred goat technology with existing farm practices and socio – cultural values having no significant relationship with its adoption was rejected. The explanation for this is that the crossbred goat technology has been in this physical, socio – economic and cultural environment since 1981; hence has since stabilised in this environment. The farmers have had prior exposure to the technology either through direct contact with the Station or indirect contact with the early adopters, and; as such, have adapted it to suit their farming and economic conditions as well as the prevailing socio – cultural environment.

4.8.7 Extension Contact and Technology Adoption

The level of contact the households had with extension in the year 2003 was evaluated against the adoption of crossbred goat technology and the technology practices in line with the seventh objective of the study. The hypothesis under test was that:

$H_0$7: Farmers' contact with livestock extension has no statistically significant influence on the adoption of crossbred goat technology.

Pearson's product moment correlation test was done to test this null hypothesis. The results are presented in Table 33.

Table 33:
Pearson Correlation Test Results for Influence of Extension Contact on the Adoption of Technology and Technology Practices (n = 28)

Correlation with Extension Method	Crossbred Goat Technology/ Technology Practices									
	No. Cbg.	Wm.	Sup.	Fd.	Dp.	Sp.	Dw.	M. Att.	Cl.	No Ib.
I-f/v										
rho	0.04	-0.11	-0.24	0.04	0.04	-0.14	-0.22	-0.04	-0.04	-0.08
P	0.828	0.574	0.220	0.852	0.852	0.466	0.256	0.852	0.852	0.691
G-f/v										
rho	-0.18	-0.15	-0.15	0.05	0.05	0.17	0.05	-0.05	-0.05	0.14
P	0.373	0.442	0.456	0.799	0.799	0.389	0.799	0.799	0.799	0.469
V-e/o										
rho	-0.09	-0.05	-0.01	0.08	0.08	-0.21	-0.21	-0.08	-0.08	-0.18
P	0.665	0.796	0.974	0.666	0.666	0.291	0.276	0.666	0.666	0.357
F/d										
rho	-0.12	-0.13	-0.28	0.04	0.04	0.23	0.12	-0.04	-0.04	-0.09
P	0.548	0.504	0.144	0.824	0.824	0.246	0.541	0.824	0.824	0.637
S/d										
rho	0.11	-0.33	-0.33	0.11	0.11	-0.38*	0.04	0.43*	-0.11	-0.23
P	0.585	0.091	0.086	0.582	0.582	0.047	0.837	0.021	0.582	0.238
Bz.										
rho	0.05	0.17	-0.24	0.12	0.12	-0.43*	0.01	0.23	-0.21	-0.07
P	0.796	0.385	0.223	0.543	0.543	0.022	0.962	0.231	0.287	0.735
Sw.										
rho	0.07	0.46*	-0.07	0.06	0.06	-0.23	0.20	-0.06	-0.06	-0.12
P	0.731	0.014	0.735	0.767	0.767	0.245	0.302	0.767	0.767	0.528
Sm.										
rho	-0.08	-0.14	-0.33	0.07	-0.58	0.30	-0.11	-0.07	-0.07	-0.06
P	0.682	0.477	0.088	0.723	0.001	0.123	0.564	0.723	0.723	0.754
Wp.										
rho	-0.06	-0.16	-0.34	0.05	-0.69	0.37	-0.04	-0.05	-0.05	-0.11
P	0.755	0.416	0.072	0.787	0.000	0.051	0.840	0.787	0.787	0.566

* = Correlation is significant at $p < 0.05$.

Key: Crossbred Goat Technology/ Technology- practices

No. Cbg.	=	Number of Crossbred goats kept;
Wm.	=	Goats kept in warm & water – proof pen;
Sup.	=	Goats regularly supplemented;
Fd.	=	Fodder conserved for use during the dry season;
Dp.	=	Goats regularly dipped in acaricides;
Sp.	=	Goats regularly sprayed with acaricides;
Dw.	=	Goats regularly dewormed;
M. Att.	=	Kidding Does given maximum attention;
Cl.	=	Old/ unproductive goats culled;
No Ib.	=	Inbreeding (mating of Does with own kids) not allowed.

Key: Extension Method

I-f/v	=	Individual farm visits by extension officers;
G-f/v	=	Group farm visits by extension officers;
V-e/o	=	Farmer visits to extension offices;
F/d	=	On – farm demonstrations;
S/d	=	On – station demonstrations;
Bz.	=	*Barazaa* attended;
Sw.	=	Shows attended;
Sm.	=	Seminars attended;
Wp.	=	Workshops attended.

Table 33 shows that livestock extension contact has no significant influence on the technology adoption, but that the adoption of spraying of goats with acaricides was negatively and significantly influenced by farmers' attendance of on - station demonstrations (rho = -0.38; p = 0.047) and *Barazaa* (rho = -0.43; p = 0.022). It further shows that giving kidding does maximum attention was positively and significantly influenced by farmers' attendance of on - station demonstrations (rho = 0.43; p = 0.021), and that proper housing of goats was positively and significantly influenced by farmers' attendance of the shows (rho = 0.46; p = 0.014).

That the more the farmers attended on – station demonstrations and *Barazaa*, the more they developed a negative attitude towards spraying of the goats with acaricides could be due to the fact that acaricide spraying is a less tedious, but requires much more technical skills than dipping. Given the low education and financial status of most of the adopters, they probably saw this as a practice out of their reach. Such farmers, it was observed stuck to the traditional practices of tick control such as spraying and smearing with paraffin, some plant repellents or cow dung, piercing the ticks with some sharp materials such as thorns and needles, and de – ticking and burning the ticks.

That the more the farmers attended on – station demonstrations, the more they became careful in paying maximum attention to kidding does implies that the Station accorded them a chance of practically seeing some of the difficulties that usually arise when does kid and how these could be handled by someone nearby at the time. In the absence of someone, as is the case with most farmers whose goats kid when out for grazing and without any assistance, the Station provided the farmers with an opportunity to understand why kids born with some of the complications demonstrated ended up dying. Demonstrations form a crucial part in the technology transfer process (Mwigi, Gamba, & Onyango, 2002). This further suggests that the Station should open its gates more to the public if the public is to make maximum use of it.

Although crossbred goats in Macalder Station are properly housed, the high poverty level of the study farmers made them not adopt this style of housing, which they saw as far out of their reach, given the low numbers of the goats they kept. Consequently, the housing structures demonstrated to the farmers presented them with an opportunity to appreciate structures which were fairly cheap to construct, yet serving the same purpose as those in the Station. This explains why the farmers who frequently attended agricultural shows had proper goat housing structures. Probably the Station needs take some positive step to encourage the poor farmers in the area to adopt the type goat housing structures in the Station.

Based on the study findings, the null hypothesis of farmers' contact with livestock extension having no significant influence on the adoption of crossbred goat technology was rejected. The low level of livestock extension contact may, thus, explain the low technology adoption so far observed; high poverty levels in the study area notwithstanding. These findings were consistent with those of Misiko (1976) that lack of guidance to the majority of the farmers could explain why most farmers are not following recommended agricultural practices. The findings were also consistent with those of Okuro *et al.* (2002) that extension contact significantly and positively influenced the adoption of improved maize variety in Embu District, Kenya. The findings also concurred with those of Wanyoike et al., (2002) that extension and participation in on - farm trials on *Calliandra* positively and significantly influenced *Calliandra* adoption among smallholder male – managed and jointly managed dairy farms in Embu District, Kenya. Tuitoek *et al.*, (2002) also found that farmers' attendance of *Barazaa* or demonstrations directly influenced the adoption of water harvesting technologies for domestic and livestock use in Lari Division, Nakuru District – Kenya. The findings, however, differed with those of Irungu *et al.*, (1998) regarding the adoption of Napier grass in smallholder dairy farms in the Kenyan highlands. Here, technical factors such as extension contact only influenced the area planted, but not the farmers' decision to adopt the technology.

CHAPTER FIVE
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This study examined the factors affecting adoption of crossbred goat technology in Southeast Kadem Location of Nyatike Division, Migori District-Kenya; with a view to finding possible explanations for the observed low technology- adoption. It considered the influence of the unique socio – economic and physical differences of the three sub – locations of the study area, farmers' personal characteristics, farmers' socio – economic characteristics, and farmers' level of knowledge and skills in goat rearing, on the technology adoption. It also looked at the influence of the technology cost and compatibility with existing farm practices and values, on technology adoption by smallholder goat farmers in the study area. Finally, the influence of the smallholder goat farmers' contact with livestock extension on the technology adoption was studied.

The study failed to control for, but recognised the fact that the existing government policy, smallholder goat households' health status, general security and security of land tenure, could also influence the adoption of crossbred goat technology and technology practices, either directly, or indirectly. In this Chapter, major findings of the study, based on the hypotheses are listed. Conclusions drawn from the findings are presented, followed by the recommendations for the policy makers, implementers, farmers and researchers.

5.2 Summary of Major Findings

The study established a significant sub – location difference in the number of crossbred goats kept ($F = 4.65$; $p = 0.011$) and consistency of spraying the goats with acaricide solutions ($F = 4.04$; $p = 0.020$). There were significantly more crossbred goats in Nyatike than Mikei ($I - J = -0.58$; $p = 0.006$) and more in Owich than Mikei ($I - J = 0.58$; $p = 0.006$). Significantly more farmers in Owich did spraying of their goats with acaricides than their counterparts in Mikei ($I - J = 0.25$; $p = 0.022$). Similarly, significantly more farmers in Nyatike sprayed the goats with acaricides than those in Mikei ($I - J = -0.25$; $p = 0.022$).

Gender of the household had no statistically significant relationship with the adoption of crossbred goat technology ($\chi^2 = 4.06$; $p = 0.399$) and the associated technology practices.

The household head's age also had no statistically significant relationship with the technology adoption (rho = 0.32; p = 0.091), but was found to be significantly related with the adoption of regular dipping of the goats in acaricides (rho = -0.41; p = 0.029) and inbreeding control (rho = -0.46; p = 0.015). Further, the study established that the household head's level of formal education had no statistically significant relationship with the number of crossbred goats kept (χ^2 = 6.42; p = 0.601), and the adoption of the crossbred goat technology practices. Farm size, on the other hand, had no statistically significant relationship with the number of crossbred goats kept (rho = 0.04; p = 0.824), but had a statistically significant relationship with the frequency of dipping the goats in acaricide solution (rho = -0.57; p = 0.002).

The household head's level of knowledge and skills in goat rearing was found not to significantly influence the number of crossbred goats kept, but the farmers' knowledge of the type of housing essential for goat rearing significantly influenced the keeping of goats in warm and water - proof pens at night (rho = -0. 45; p = 0.015). Likewise, knowledge of land size required for goat rearing significantly influenced the degree of supplementation of the goats (rho = -0.44; p = 0.018). Knowledge on the supplementation requirements for goats was found to significantly influence control of inbreeding in the goat flocks (rho = -0.42; p = 0.027) and the attention given to kidding does (rho = -0.47; p = 0.011). Knowledge on the need to pay attention to kidding does significantly influenced the attention given to kidding does (rho = 0.42; p = 0.026). Similarly, knowledge on the effect of the kidding season on the kids' survival significantly influenced the consistency of supplementing the goats (rho = -0.43; p = 0.023), and knowledge on the deworming regime significantly influenced the control of inbreeding in goats (rho = - 0.46; p = 0.015).

The study established that the cost of purchasing both mature female and mature male crossbred goat, had no significant relationship with the number of crossbred goats kept (χ^2 = 25.86; p = 0.894 for mature female crossbred goat and χ^2 = 28.08; p = 0.970 for mature male crossbred goat). It also had no significant relationship with the adoption of the associated technology practices. Further, the study established that the prevailing farm conditions and practices had no significant relationship with the number of crossbred goats kept, and the adoption of the associated technology practices. Use of crossbred goats to settle dept was found to have a significant relationship with regular supplementation of the goats (rho = -0.44; 0.020). Similarly, regular dipping of the goats in acaricides had a significant relationship with passing of crossbred goat to a friend for keeping (rho = -0.39; p = 0.039)

and using crossbred goat for fines and disputes (rho = -0.38; p =0.048). Slaughtering crossbred goat for skin was found to have a significant relationship with paying maximum attention to kidding Does (rho = -0.47; p = 0.011).

The study established that on - station demonstrations significantly influenced the consistency of spraying of the goats with acaricides (rho = -0.38; p = 0.047) and paying maximum attention to kidding Does (rho = 0.43; p = 0.021). Attendance to *Barazaa* was found to significantly influence the consistency of spraying of the goats with acaricides (rho = -0.43; p = 0.022), even as attendance to agricultural shows significantly influenced the practice of housing goats in a warm and water- proof house (rho = 0.46; p = 0.014).

The study came up with nine (9) main findings. These were:

i. That the crossbred goat technology adoption level on the basis of numbers of crossbred goats kept stood at 23.3%, with Nyatike and Owich having more adopters than Mikei sub – location.

ii. That the unique geophysical features of the sub - locations and socio – economic features of the farmers in the study area significantly influenced the number of crossbred goats kept and spraying frequency in each of the sub – locations of study. These features, thus, explain the differences in numbers of crossbred goats kept by farmers in each of the sub – locations of the study area.

iii. That the household heads' gender and highest educational level had no significant influence on the adoption of the crossbred goat technology and technology practices, hence could not explain the low level of crossbred goat technology adoption observed in the study area.

iv. That the household heads' age and farm size had no significant influence on crossbred goat technology adoption, but significantly influenced the dipping frequency, with the older farmers and those with large farm sizes tending to dip less frequently. Thus, farm size and age of household head could explain the low level of crossbred goat technology adoption observed in the study area.

v. That the age of the household head had significant influence on inbreeding control among the goat flocks, with the older farmers paying little attention to it than the younger ones. Thus, age could explain the low level of crossbred goat technology adoption observed in the study area.

vi. That farmers' level of knowledge and skills in goat rearing had no significant influence on the technology adoption, but significantly influenced inbreeding control among the goat flocks, the supplementation frequency, proper goat housing, and the attention given to kidding does, with the more educated, more knowledgeable and skilled farmers controlling inbreeding, supplementing the natural feedstuff, housing goats properly and paying maximum attention to kidding does. Thus, the low level of education of the study farmers, hence low level of knowledge and skills in goat rearing could explain the low level of crossbred goat technology adoption observed in the study area.

vii. That the cost of purchasing the crossbred goat technology had no significant influence on its adoption, as well as that of the associated technology practices, hence could not be a factor responsible for the low level of technology adoption.

viii. That crossbred goat technology's compatibility with existing farm practices and socio – cultural practices and values had no significant influence on the technology adoption, but significantly influenced the frequencies of supplementation and dipping, and the attention given to kidding does, hence could explain the low level of technology adoption observed.

ix. That farmers' contact with livestock extension had no significant influence on the crossbred goat technology adoption, but significantly influenced acricide spraying, proper goat housing, and the attention given to kidding does. The greater the extension contact, the more the farmers adopted the practices of acaricide spraying, proper goat housing, and paying maximum attention to kidding does. Thus, the low extension contact could explain the low level of technology adoption.

5.3 Conclusions

The factors considered in this study led to the establishment of the crossbred goat technology adoption level of 23.3%. The fact that there were more adopters in Nyatike and Owich and that more farmers in Nyatike and Owich frequently sprayed their crossbred goats with acaricides compared to those in Mikei, imply there were more favourable conditions for the adoption of the technology and the associated technology practices in these sub – locations of the study area than in Mikei. This may not be the geographical suitability, but the proximity of the two sub – locations to Macalder Station and the divisional livestock

extension office, hence more exposure to the technology and the associated technology practices.

The study concluded that the household head's gender and educational level, the technology cost and compatibility with existing farm practices and socio – cultural values and practices, are not related to the adoption of crossbred goat technology and the associated technology practices. Nevertheless, the household head's age, farm size, level of knowledge and skills in goat rearing, contact with livestock extension, are not related to the crossbred goat technology adoption, but are related to the adoption of some of the associated technology practices.

From the study findings, it appears that the adoption level of the crossbred goat technology in the study area is low due to the fact that most of the farmers have small land parcels forcing them to rely on government trust land for rearing goats. Since they do not have security of tenure over the same, they are reluctant to adopt a technology which they perceive as requiring more land than is available. Secondly, the farmers are young, not very knowledgeable and lack basic skills to adopt the technology and the associated technology practices, given their low levels of education. Thirdly, the farmers receive poor and inadequate contact with livestock extension. The implication of this is that there is need for a more deliberate effort to redesign Macalder Sheep and Goat Station's extension objectives to give them a more practical approach that is also sensitive to the local farmers' physical, economic, and socio – cultural environment and needs.

5.4 Recommendations

From the study findings, the following suggestions could help to improve the low adoption levels of the crossbred goat technology and the associated technology practices among the smallholder goat farmers in Southeast Kadem Location and others in a similar physical, economic, and socio – cultural environment. The suggestions have implications on policy, extension, and research. The recommendations include:

i. Redesigning Macalder Station's objectives in line with the existing farm practices and socio – cultural values and practices of the study area. In this regard, the Station could consider:

   a) Lending out the crossbred buck for use by farmers during the tupping (breeding) seasons and getting either the local goat or some of the resulting kids in return.

b) Loaning the spraying equipment to local farmers for use, probably in exchange for an agreed upon number of local goats.

c) Opening the Station's dip for use by the local community at a reasonable fee, which again could be paid in kind as most farmers may not afford cash payments.

d) Having the Station's staff participate more in such extension activities as demonstrations on silage and hay making, construction of cheap but warm and water – proof pens.

e) Encouraging the local farmers to visit the Station in case of need for extension services such as construction of goat housing, acaricide spraying and hay making. Payment for such services could, again, be done in kind.

f) Stocking materials for proper goat housing within the Station, and availing the same to the local farming community on a check – off system whereby, the local goats could be used to pay for the same. This way, the Station may not have to purchase local goats for upgrading, and will in addition get a friendlier environment to pass information regarding the technology developed at the Station. This will certainly help to bring the Station and the local community to a much more close working relationship with greater synergy.

ii. The Station staff and local livestock extension staff should consider holding more frequent on – station and on – farm demonstrations to improve the local community's level of knowledge and skills in goat rearing. The technology adopters could be used during such fora as resource persons, and some of the on – farm demonstrations could be held in their homesteads to give the local farming community a more practically oriented and friendlier atmosphere for learning new innovations. More of the on – farm demonstrations should be held in Mikei sub – location to improve the adoption level there.

iii. Further studies should consider investigating the following:

a) The influence of the factors that were never controlled for in this study (government policy, households' health status, general security and land tenure), and other production factors (labour, capital, credit, and market), on the adoption of crossbred goat technology and the associated technology practices.

b) Why farmers from afar are interested in crossbred goat technology developed at Macalder Sheep and Goat Station, by incorporating such farmers into the

sampling frame and finding out whether the factors established by this study as affecting the technology adoption similarly do affect their adoption of the technology and the associated technology practices.

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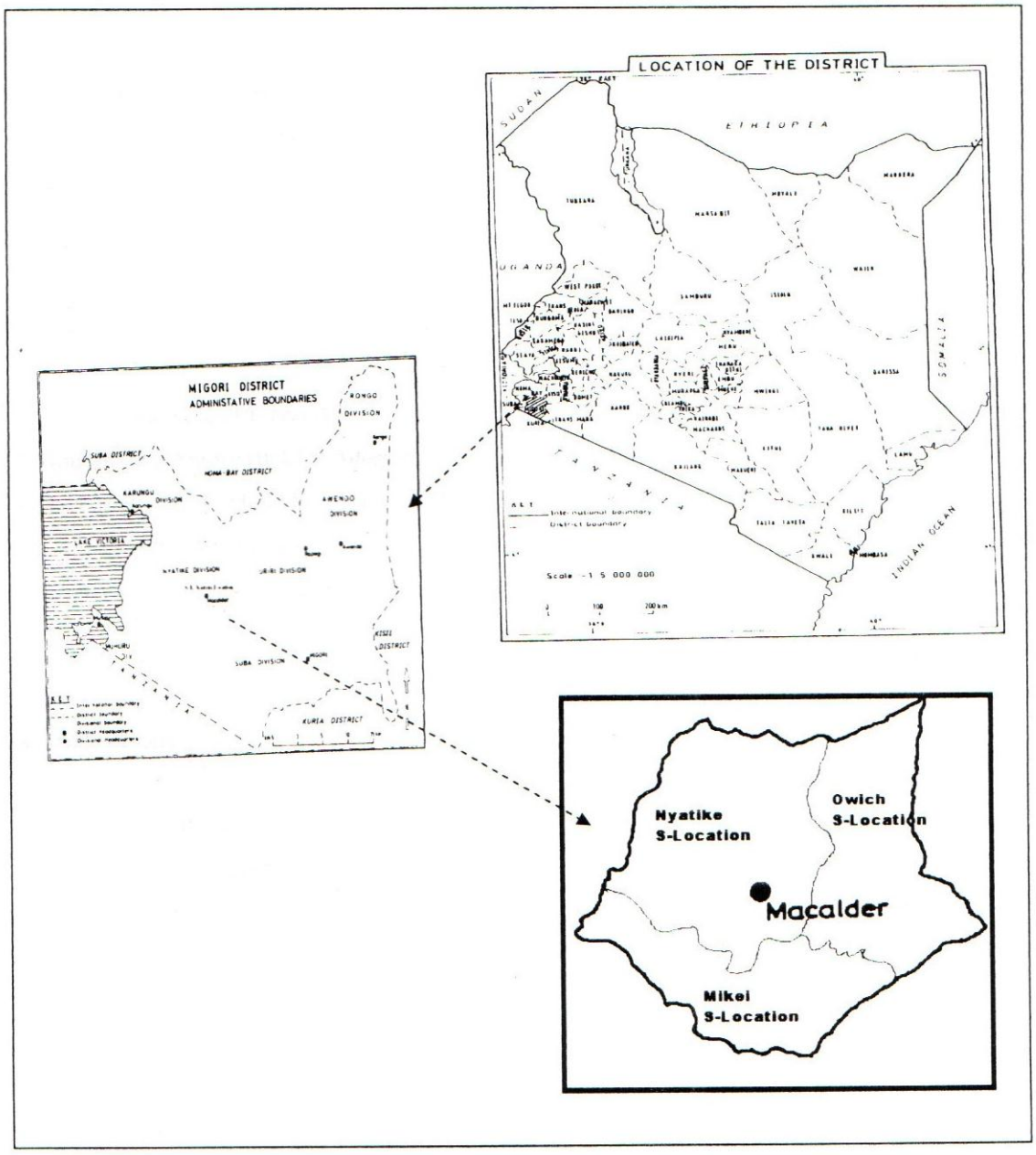
APPENDICES

APPENDIX A: LOCATION MAP OF THE STUDY AREA



APPENDIX B: QUESTIONNAIRE FOR HOUSEHOLD HEADS

Your household is among several goat – rearing households randomly selected from Southeast Kadem Location of Nyatike Division for this study. The study aims at finding out your opinion about why you decided to keep or not to keep crossbred goats. I would be glad to get your responses, and for this reason would not hesitate to clarify any questions that may not be clear to you. All the information obtained through this study will be treated with utmost confidentiality. Feel free to ask for clarification of anything that may not be clear to you.

Section A: Household Characteristics

1. Household No..... Interview Date.....

2. Sub - location (tick) 1. Nyatike [ ] 2. Owich [ ] 3. Mikei [ ]

3. Household category (tick) 1. Adopter [ ] 2. Non adopter [ ]

4. Gender of the household head (tick) 1. Male [ ] 2. Female [ ]

5. Age of the household head in years.....

6. Highest education level of the household head.....
0. None [ ] 1. Primary [ ] 2. Secondary [ ] 3. A - Level [ ] 4. Diploma [ ] 5. Degree and above [ ]

7. What is the estimated size of your land in acres?.....

8. Mode of land ownership (tick) 1. Purchased [ ] 2.Inherited/ Given [ ] 3.Purchased/ Inherited 4. Leased [ ]

Section B: Compatibility with Existing Farm Practices and Values

9. Land use in your farm:

Enterprise	Acreage in 2002	Acreage in 2003	Acreage in 2004	Average
Crop production				
Pastures/ Browse				
Rented farm from others				
Rented farm to others				
Total				

10. Which method do you use for rearing your goats? (Tick)
1. Free range [ ] 2. Grazing [ ] 3. Tethering [ ] 4. Grazing/ Tethering [ ]
5. Zero – grazing [ ]

11. How fast could you do each of the following for both local and crossbred goats?

Activity	Local Goat			Crossbred Goat		
	Readily (1)	**Not readily** (2)	**Not at all** (3)	**Readily** (1)	**Not readily** (2)	**Not at all** (3)
1. Giving as gift to friend/ visitor.						
2. Giving in exchange for property (e.g. Land, clothes, cows, etc.).						
3. Paying for services rendered (e.g. dowry, fine, ploughing, weeding, building etc.).						
4 Settling disputes (e.g. land, property damage, marriage feuds etc.).						
5. Taking to a bereaved friend/ relative.						
6. Sending to be kept for sometime by a friend.						
7. Selling to offset debt (including School fees).						
8. Slaughtering for family food.						
9. Slaughtering for a beloved friend/ visitor.						
10. Slaughtering in social gatherings (e.g. Wedding, initiation, funerals).						
11. Slaughtering for skin.						
12. Dividing among children for inheritance.						

Section C: Contact with Livestock Extension Personnel

12. In the past one year, how many times did you participate in each of the following exercises in relation to goat raring?

Contact with Extension	Number of times in the past one year					
	Not at all (0)	**Once** (1)	**Twice** (2)	**Thrice** (3)	**Four times** (4)	**More than four times** (5)
1. Individual farm visit by extension staff.						
2. Group visits by extension staff.						
3. Visits to livestock extension offices by farmer.						
4. Demos on- farm.						
5. Demos on- station.						
6. Barazaa.						
7. Shows.						
8. Field trips.						
9. Seminars.						
10. Workshops.						

Section D: Households' Knowledge & Skills in Goat Rearing

13. State whether you agree or disagree with each of the following statements about goat rearing.

Statement about Goat Rearing	Agree (1)	Uncertain (2)	Disagree (3)
1. Ticks & worms pose the greatest health problem to goats.			
2. Goats should be dewormed anytime a dewormer is available.			
3. Hand- picking is the most effective tick control method.			
4. A reliable source of clean water is essential in goat rearing.			
5. Supplementary feeding is not economical in goat rearing.			
6. The season of the year when goats give birth does not affect the survival of the kids.			
7. Kids should be protected from excessive colds & rains.			
8. Kids need to be kept in a clean enclosure.			
9. Breeding Does should be mated with their kids.			
10. It would be good if someone is around at the time goats give birth.			
11. Dung should be regularly removed from goat pens.			
12. A goat pen need not be water – proof.			
13. Many farmers do not keep goats because they need more land than they have.			
14. Goats are not easy to keep because they always require supplementary feeding.			
15. Goats that are tethered need to be rotated and given plenty of water.			

Section E: Crossbred Goat Technology Adoption

14. How many goats do you keep? .....

15. How many of your goats are: **(For Adopters only)**

    a. Local?.....

    b. Crossbred?.....

16. Which of the following technology- practices are adopted/ not adopted in your farm?

Technology Practice	Adopted (Yes) (1)	Not Adopted (No) (2)
1. Goats kept in warm/ waterproof enclosure at night.		
2. Supplementary feeding regularly given.		
3. Fodder conserved for use during the dry season.		
4. Goats have a reliable source of clean water.		
5. Pye – grease regularly applied on goats for tick control.		
6. Goats regularly dipped in an acaricide solution.		
7. Sprayed with acaricide solution.		
8. Goats regularly dewormed.		
9. Goats given maximum attention at birth.		
10. Old and unproductive goats sold for income or eaten.		
11. Kids born to does not allowed to breed with the same does.		

Section F: Cost of Crossbred Goat Technology

17. What is the current cost of buying one mature: a) female crossbred goat? Ksh.....

b) male crossbred goat? Ksh.....

c) female local goat? Ksh.....

d) male local goat? Ksh.....

Thank You for Your co- operation

APPENDIX C: RESEARCH AUTHORISATION

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY

Telegrams: "EDUCATION", Nairobi
Telephone: Nairobi 334411
When replying please quote

Ref. No. .....
and date

JOGOO HOUSE "B"
HARAMBEE AVENUE
P.O. Box 30040-00100
NAIROBI

..... 20.....

MOEST 13/001/34C 174.2

6th July, 2004

Charles Odhiambo Oketch
Egerton University
P.O. BOX 536
NJORO

Dear Sir

RE: RESEARCH AUTHORISATION

Please refer to your application for authority to conduct research on "Factors affecting Adoption of Cross Bred Goat Technology by farmers in the Macadder sheep and Goat Multiplication Station, Migori, I am pleased to inform you that you have been authorized to conduct research in Migori District for a period ending 30th June, 2005.

You are advised to report to the District Commissioner, the District Education Officer and the District Livestock Officer, Migori District before commencing your study.

You are further expected to deposit two copies of your research report to this Office upon completion of your research project.

Yours faithfully

B. O. ADEWA
FOR: PERMANENT SECRETARY

CC
The District Commissioner
Migori District

The District Education Officer
Migori District

The District Livestock Officer
Migori District

PAGE 2

THIS IS TO CERTIFY THAT:

Prof./Dr./Mr./Mrs./Miss CHARLES ODHIAMBO OKETCH

of (Address) EGERTON UNIVERSITY P.O. BOX 536, NJORO

has been permitted to conduct research in

Location.

MIGORI District,

NYANZA Province,

on the topic FACTORS AFFECTING ADOPTION OF CROSS BRED GOAT TECH. BY FARMERS IN THE MACALDER SHEEP AND GOAT MULTIPLICATION STATION, MIGORI

for a period ending 30th June 05

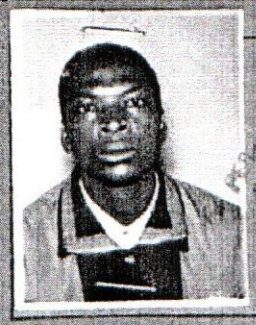
Applicant's Signature

PAGE 3

Research Permit No. MOEST 13/001/34C174

Date of issue 6th July, 2004

Fee received Shs. 500



B. O. ADENA

For: Permanent Secretary
Ministry of Education
Science and Technology