THE INFLUENCE OF EXTERNAL ACTORS IN CROP FARMING:
Strategies Adopted by Small-scale Farmers in Laikipia

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other university.

Signed_____

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This Thesis has been submitted for examination with my approval as university supervisor.

Signed_____

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(Supervisor)

December 1998

DEDICATION

This work is dedicated to my parents, David Muroki and Serah Wangari and my grandfather Samuel Gatonye Robert.

Your unfailing and constant inspiration has seen me through all my academic life.

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ABBREVIATIONS

ApproTEC	Appropriate Technology for Enterprise Creation /a local NGO working in technological package development and transfer
APL	Arid and Semi-Arid Lands Development Programme, Laikipia
ARU	Applied Research Unit
ASALs	Arid and Semi Arid lands
CBS	Central Bureau of Statistics
DECs	Drought Escaping Crops
DFRD	District Focus for Rural Development
f_e	Expected frequencies
FLES	Front line extension staff
f_o	Observed frequencies
ITCZ	Inter-Tropical Convergence Zone
IUCN	International Union for Conservation of Nature and Natural Resources
KARI	Kenya Agricultural Research Institute
KEFRI	Kenya Forest Research Institute
KGs /kgs	Kilogrammes
LCFs	Local community facilitators
LH	Lower highlands (in agro-ecological zones)
LRDP	Laikipia Rural Development Programme
LRP	Laikipia Research Programme
M/K	Mutirithia /Kariunga /a smallholder settlement area in Laikipia
MoALDM	Ministry of Agriculture Livestock Development and Marketing
MoPND	Ministry of Planning and National Development

NGOs	Non governmental organisations
RDF	Rural Development Fund
T&V	Training and visits approach
UH	Upper highlands (in agro-ecological zones)
UM	Upper midland (in agro-ecological zones)
UNEP	United Nations Environment Programme
x^2	Chi-Square

ABSTRACT

Over the past three decades there has been tremendous land use change in Laikipia district occasioned by increasing migration of small-scale farmers from the districts surrounding Laikipia. This trend has resulted to a strain on the limited and fragile natural resources in the district and hence has been a threat to sustainable use of the resources.

Small-scale farmers are migrating to Laikipia and have limited knowledge regarding the potential and productivity of the area. In addition, the plots on which they settle are subdivided without taking into consideration the ecological potential of the land. The current study therefore is aimed at examining the influence of external actors in crop farming strategies adopted by the small-scale farmers in the midst of escalating environmental degradation and persistent crop failure. This was prompted by the fact that most studies tend to focus on indigenous farmers in high and medium potential areas and not paying attention to the migrant farmers in a new ecological set-up who have to perpetuate farming activities but in a completely different set-up.

The objectives of the study were: to examine the influence of external actors in crop farming strategies adopted by small scale farmers in Laikipia; to compare the external influence in two areas and finally to examine whether the introduced packages are sustainable. This study is based on the assumptions that increased population will prompt land subdivision hence the need for intensified extension services access. Secondly, the exposure of the farmers to crops and farming strategies suited for the area and which provide the migrant farmers with an assured means of livelihood and secure incomes will encourage farmers' acceptance of new innovation.

Primary and secondary methods of data collection were used during the study. Quantitative and qualitative data analysis techniques were used. The chi-square was used to establish the relationship between the socio-economic factors and adoption of new crop packages and also to test the hypotheses of the study. Analysis demonstrated that socio-economic and socio-cultural factors influence adoption of technology. For instance, the age of the farmers, level of education, land size and history of settlement were found to influence adoption of technology. The study found that the farmers were mainly concerned with survival and when they accepted new innovation they were mainly concerned with profit maximisation and risk aversion. The study also found that the farmer-extension agent linkages are weak and hence if sustainable development is to be achieved, the linkage has to be strengthened. The small-scale farmers are faced by problems ranging from insecurity, constant crop failure, lack of information regarding suitable crops for the area, and poor infrastructure.

The external actors are also faced with constraints that hinder their efficient operations. These include lack of motivation as a result of poor pay packages, lack of active supervision of the frontline extension staff, absence of demonstration materials, inadequate transport services and under-staffing in specific areas especially the extremely remote sections. These constraints are adversely making individual extension officers less motivated and pose bottlenecks in operations and efficiency. On the other hand, it was evident that the divergence in the socio-economic characteristics of the farmers in the two study areas explained the variation in the adoption rates.

The study proposed strategies addressing the problems especially enhancing the linkage between the farmers and extensionists. This would ensure that farmers get access to regular information on the suitable area-specific crop farming strategies. Sustainable use of the resource will mainly depend on the availability of necessary information through regular

extensionist - farmer contacts. This contact is maintained through training, visits, demonstrations and field days. The success of the external actors in influencing the farmers can only be realised if the introduced innovations have any impact on the target farmers. Other recommendations include pooling of land among farmers and the need to conserve the environment in an attempt to achieve maximum benefits.

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CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Natural resource management is becoming an increasingly important issue in the world today as a consequent of the shrinking resources occasioned by the soaring population growth and rapid development. This has often resulted in over-exploitation and poor management of natural resources on which many lives depends. A major environmental and development challenge today is how to maintain the equilibrium between population, ecosystems and development (NEAP, 1998). The situation is particularly serious in the marginal areas where poor strategies in resource management results to serious modification or depletion of the natural resources. The current concern in the utilisation and management of natural resources in Kenya is prompted by the increasing trend of populations to migrate from agriculturally high and medium potential areas to low potential ones which are mainly unsuited for agriculture and especially crop production.

Kenya's Arid and Semi Arid lands (ASALs) comprise about 80 per cent of the total land surface area and currently support about 25 per cent of the human population and slightly over half of the livestock population (GoK, 1993). With this fact in mind it is pertinent to address ways and means of harnessing this vast resource in the wake of shrinking land sizes and decreasing agricultural productivity in the areas of high and medium agricultural potential. A wide range of variation exists in agricultural land use practice in Kenya's, marginal areas. For example from predominantly subsistence to predominantly commercial, from livestock rearing to crop production, from the use of simple farm implements to tractors drawn ploughs, from natural dependence on natural vegetation for maintaining fertility to the application of organic and inorganic fertilisers. All these activities have varying ecological impacts on resources as

users strive to derive ecological, economic and socio-cultural satisfaction out of their resource utilisation. Up to 1980's, pastoralism and large scale ranching were the predominant land-user types in ASALs of Kenya.

The predominantly semi-arid Laikipia District was largely characterised by extensive large scale ranching in addition to pastoralism prior to independence in Kenya. However, after independence large-scale ranches were subdivided paving way for small holders to practice arable agriculture. The small holders are mainly migrants from neighbouring high potential districts which are Nyeri, Murang'a, Kiambu, Nyandarua and Meru. Settlement schemes in the district fall under two categories: settlement schemes that were set up on land purchased by the government from settlers willing to sell with the aim of subdividing and settling the landless. The second category of small-scale farms results from land transfers to self-help groups organised as companies or co-operatives for the purpose of buying our former European farms. In Laikipia land buying companies own 24.3 per cent of the district (Kohler, 1987). The subdivisions were carried out without due regard to the carrying capacities of the land resulting in plot sizes that are not economically viable (Huber and Opondo, 1995).

The small-scale farmers lack knowledge regarding farming practices suitable for the area. Consequently, there is a great deal of trial and error in a bid to achieve ecological adaptation and a tendency to cling to their farming practices from high potential areas. This trend leads to unsustainable use of the land causing immense environmental degradation and frequent crop failures. This trend leads to a situation where food security is not achieved. In this regard, World Bank (1994) observed that the rate of food production cannot keep pace with population growth and the supplies of staple foods are shrinking in most African countries.

In order to ensure optimum output per unit, and enhance sustainable use of natural resources, external intervention is deemed necessary. Following independence, most developing countries chose to follow 'statist' models of development whereby the public sector controlled all key aspects of the economy. In agriculture, this included government monopolising the supply of physical inputs, credit provision, research, extension and marketing systems either directly or through established agricultural parastatals (World Bank, 1994). As a result, extension workers often 'transferred' inappropriate technologies and inputs failed to arrive in time to fit in with the agricultural calendar (Sims and Leonard, 1990). Today Non governmental institutions have come up to collaborate with the government in agricultural research and extension to overcome the problems brought about by monopoly of the government in the sector. This is a measure to ensure that the farmers reap maximum productivity out of their farming activities and yet enhance sustainability. The current study focuses on small holder farming in the crop production sub-sector and the extent to which it has been influenced by external actors notably extension. The study was carried out in Laikipia district of Rift Valley Province. The study aims at identifying appropriate means of intervention to ensure sustainable use of natural resources. It was carried out in the context of Actors Strategies and Perceptions (ASP), whereby the focus is on actors and the strategies hey adopt in the use of resources based on their perceptions.

1.2 Problem Statement

For many decades the principal land use system in the semi-arid regions of Kenya was extensive livestock production interspersed with wildlife habitation. However, since independence, the scenario has relatively changed prompted by change in ownership and consequent influx of migrants into the area in search of land for cultivation due to increasing human population pressure in their areas of origin. With the exception of the very arid or desert regions, therefore, the inhabitants of these areas are becoming increasingly involved in

crop production (Asambu, 1993). Small-scale farming therefore occupies a significant proportion of the area and is still expanding with the increasing rate of land subdivision. Development in ASALs is constrained by a number of factors which are:- limited primary resource base, use of inappropriate technologies, rapidly increasing human population and poor infrastructure. Laikipia the study area, is characterised by limited natural resource base for rain-fed agriculture and rapid land use transition due to subdivision of former large scale ranches and subsequent immigration of peasant households from high potential areas of Kenya (Wiesmann, 1997). In addition to these problems, small-scale farming is faced by specific problems that relate to:

1. Climate: The climatic conditions are harsh due to erratic rainfall patterns. Migrant farmers find themselves in a completely different environment that barely accommodates rain fed agriculture.

2. Land: In Laikipia, land subdivision is on the increase brought about by population increase. Farmers from high and medium agricultural potential neighbouring districts migrate to Laikipia due to population pressure in their areas. The land subdivisions are not taking into consideration the ecological characteristics of the land and its agricultural capability. The result has been the creation of small plots that are unsustainable leading to social and economic marginalization of the new inhabitants.

3. Incompatible resource use strategies: The migrant farmers tend to perpetuate crop farming as an activity in areas that are not suited for such crop production with dire effects not only to productivity but also to the fragile ecosystem. In addition, little information is available for the new settlers on how to run crop and livestock production systems on their smallholdings. Furthermore, few technologies exist so far for ASAL development hence

limited knowledge of actual development options for the small holder settlers. Their perceptions have been deeply rooted in the perceptions of the management systems of the home districts. Consequently, there has been importation of technology from home areas with poor results as evidenced by low and erratic crop yields.

In this fragile ecosystem, it becomes important to focus on future survival of the communities by assessing areas where more social benefits can be sourced. Keen support of the crop production sub-sector in terms of information is possibly an important tool towards this goal. From the above factors therefore, the place of agricultural extension intervention becomes crucial in assisting the small-scale farmers in the district to improve their crop farming strategies and consequently their living standards. This is seen in the light of increasing productivity and enhancing resource use sustainability as well. Yet in spite of agricultural extension services, problems relating to agricultural production still persist. The key issue that continues to occupy planners concerned with ASAL development is the need to develop technological packages suited for ASAL though the development of such techniques is continually hampered by many constraints of social, economic, and ecological nature.

The current study analyses the input, role and influence of external intervention in small scale farming crop production sub sector with a view to identifying appropriate interventions. It also attempts to understand the perceptions of the external actors towards the farmers and vise versa. In the end it endeavours to identify areas of weakness in extension service delivery and also assess the potentials and opportunities for the sustainability of the service in the long run whereby the farmers are expected to shoulder a relatively bigger responsibility in the support of the service. This approach is based on the understanding that it is the farmer who benefits from extension services support.

1.3 Objectives of the Study

The broad objective of the study is to examine the influence of external or institutional actors (notably extension officers) on land use strategies among small scale farmers in Lamuria and Mutirithia/Kariunga (M/K) in Lamuria and Central divisions respectively of Laikipia District.

The specific objectives are:

1. To examine the extent to which extension services have influenced the crop production sub-sector among the small-scale farmers.
2. To examine the immigrant farmers' perception of the role and extent of extension services by comparing two different areas of Laikipia, namely M/K and Lamuria.
3. To examine the extent to which the promoted crop farming strategies are sustainable.
4. To make necessary recommendations to the various actors involved in sustaining crop production strategies at the small holder level.

1.4 Hypotheses of the Study

The study hypothesizes that:

H_o As population increases in Laikipia, there will be no need for institutionalized extension services.

H_1 As population increases more small-scale farmers will migrate to Laikipia and since they lack knowledge on the ecological potential of the area, the need for institutional extension services becomes important to enhance sustainable use of resources.

H_o Exposure to crop farming strategies suited for the area does not lead to acceptance and application of new crop packages promoted and delivered by the external actor

H_1 Exposure of the local actors to external input are effective in measuring the acceptance and application of new packages promoted and delivered by the external actor.

1.5 Study's Rationale and Basis

1.5.1 Justification

A significant proportion of farmers in Laikipia depends on subsistence farming. In subsistence farming, continuous production of food for survival is a must even when it is unprofitable and uneconomical because if the farmer stops producing, he and his family would starve (Beets, 1990). There is therefore need for extension services to enlighten the farmer on crop production strategies suitable for the area to enhance economic, environmental and socio-cultural sustainability. This would be done by understanding the perceptions of the actors involved as their perceptions play a major role in determining the strategies proposed for resource utilisation and the strategies adopted. It is noted that often local resource users (i.e. the small-scale farmers) and external agencies (e.g. extension officers) perception of resource use do not always coincide.

The perceptions of the small scale farmers in high potential areas has been given a lot of attention through studies regarding the impact of extension services but no special attention has been accorded to migrants who find themselves in a new environment and have to perpetuate their way of life. Studies usually focus on the indigenous people while special circumstances in which the migrants find themselves after migrating are left out. Besides low production in ASAL has often been blamed on the inability of the farmers to adapt to technologies appropriate to a variable climate and to less fertile areas (Vitta, 1988). In Laikipia non-adoption of appropriate techniques has also been blamed on persistent use of farming techniques developed for wetter areas and not for the arid areas (Liniger, 1991).

The study is carried out in an area where small-scale farmers are settlers from neighbouring high potential districts who have migrated to the areas in search of land for cultivation mainly. They therefore have the same history in Laikipia whereby they built homesteads and started

cultivation at more or less the same period under similar circumstances. There is need therefore to dig deeper into the farmers' situation in order to understand the unique circumstances that face them. This is because perceptions of the farmers regarding crop production in the new environment and the new technology have not been fully evaluated in the past. Evaluation of the influence of external agents on crop production strategies by the new farmers is still a green area as appertains to their perceptions towards the local actors and the sustainability of the technology introduced. The findings of the study are aimed at assisting policy makers to accord special attention to the migrants.

1.5.2 Relevance and Place within the Field of Urban and Regional Planning

This study, being largely on the examination of the role of external intervention in crop farming among small-scale farmers, has a significant bearing in the Urban and Regional Planning fraternity, practice and profession. However, the relationship and association may appear unclear to some readers. This section therefore endeavours to place the study in its right perspective and whose attempt is based on a number of topical and scientific concerns;

- ***Land-use Planning:*** This study is based on the land-use planning challenges in the marginal areas. Evidently, changes in the land-use systems have become widely evident in Kenya's marginal areas with excess population moving in from high agricultural potential areas in search of land simply for settlement and agricultural production. More than three-quarters of this population are finding themselves in new areas where their land-use practices of their areas of origin do not fit unless adjustment has to be effected. However, these new settlers seem to take so long before realising that the new areas are new in all aspects. In this context, there are a number of factors that continue to pose serious challenges to the development of these new areas. These include the uneconomical land sizes, cultural traits, inclinations and practices, economic demands and survival needs.

Within the framework of these challenges, the study pursues a critical look at the relationship between the best use of the smallholder land vis-à-vis its location within a fragile ecosystem. It endeavours to provide appropriate and sustainable systems in support of land-use categories that are in harmony with the general national practices related to land-use planning and productivity.

- ***Food Security:*** As an important component in regional planning, smallholder agriculture and extension plays an instrumental role in food security facilitation. The achievement of food security status is widely seen as a development vehicle for both rural and urban areas. It is also seen and appreciated as a significant media of growth. The attempt of this study to monitor the role of external support in the smallholder crop production sector is appreciated in the light of regional-level food-demand satisfaction. At the discipline level, the study engenders in the end to provide food security to the two level planning regions as well as reducing over-dependency of urban based economy. Overall, the study contributes significantly in the support of the government's food security strategy as well as developing rural based nets to hold back the rural-urban migration. This is appreciated in the light of developing better and appropriate packages delivery within the marginal environments.

- ***Environmental Planning Strategy:*** The role of regional planning and its importance in marginal areas need not be over-emphasized. The rate at which the environment has continued to be degraded within the fragile ecosystems in Kenya has been alarming. This has been an issue of concern especially where there has been migration into fragile area. The essence of this study in appraising the environmental status through "new" area practices such as agro-forestry and woodlots introduction is seen as a major contribution in

environmental control. These attempts are well placed within the regional planning arena and bears significant relevance to the whole urban and regional planning discipline.

- ***The ASP Approach and Support:*** The study falls within the framework of 'Actors Strategies and Perceptions For Sustainable Resource Use and Management' Project (ASP). This project is a scientific collaborative framework of the Department of Urban and Regional Planning (DURP), University of Nairobi and Institute of Geography, University of Berne – Switzerland and executed locally through the Laikipia Research Programme. ASP research operations mainly concentrate on a sub-national level where local needs and perceptions illustrate a significant interplay of resource use and users leading to (potential) conflicts with national and regional policies. It focuses on the articulation of local users, strategy formulation and the influence of deciding actors in resource use and management.

  The undertaking of this study was partially sponsored by this initiative with the understanding that the study would assume a problem-oriented approach incorporating local resource users in order to fit within the ideals and objective of the initiative. In essence ASP searches for concepts and conflict resolution in resource use and management; it searches for participatory management and planning at the lowest appropriate level and finally it searches for better polarization of self-organising capacities and social knowledge. These are principles that form a working and operational direction of this study.

1.6 The Scope of the Study

The study examines the responses of farmers in Mutirithia and Kariunga Locations of Central division and Wiyumiririe, Sirima and Lamuria Locations all of Lamuria division of Laikipia district. The two areas were chosen on the basis of their concentration of extension services.

Mutirithia /Kariunga has a high concentration of agricultural extension services provided by Applied Research unit (ARU) of Arid and Semi Arid Lands Development Programme Laikipia (APL) since 1995. ARU has propagated drought-escaping packages in many parts of Laikipia but the packages have a longer experimentation in M/K and hence have relatively stabilised. There was a similar input of extension services in Lamuria by ARU hence the need to compare the two areas to identify whether there are unique features that enhance or hinder the effectiveness of extension services.

The study will focus on two main categories of actors. The first category comprises small-scale farmers who largely depend on farming for their livelihood. The majority of the farmers have migrated from high potential and medium potential areas in adjoining districts due to population pressure in those areas. Within this category of actors, there are three types of actors who have different roles: contract farmers, contact farmers and ordinary farmers. The contract farmers are those farmers who have been engaged by external agents to propagate seeds for a particular package. On the other hand, contact farmers are those elite, early and successful adopters of innovations who in most cases have their farms acting as informal demonstration plots to extensionists. Ordinary farmers are mainly the larger population target-group forming the key focus of external agents assisted by the local contact farmers. These farmers are largely and comparatively slow in embracing a new technology although this is not always the case.

The second category comprises the institutional /external intervenors into the farming practice among the small-scale farmers. They have a significant impact on farming strategies' adoption. These will be referred to as external actors. In the study area they include; ARU, APL, and MoALDM. Within the MoALDM there is the Soil and Water Conservation Department and Crop Production Department.

The study will limit itself to the influence of external intervention on crop production among the small-scale farmers paying attention to perceptions that the stakeholders in the resource management have towards each other and the extent to which their resource utilisation strategies can be sustained. This is aimed at looking at the current strategies that the external intervenors are using, how the target farmers are responding and how these can be enhanced to promote sustainable production of crops.

1.7 Methodology

1.7.1 Data Sources

(a) *Secondary Sources*

Before a field survey was conducted, secondary data was sourced from published research findings, government publications, journals and unpublished works related to the study problem and the study area. The secondary data helped the researcher to get an insight into the problem under investigation and to fully grasp the background of the research problem.

(b) *Primary Sources and Collection*

This study gathered both primary and secondary data. Primary data was collected by conducting a field survey by use of questionnaires, observation, informal interviews, focused group discussions, key informants' interviews and photography. Primary data exposed the researcher to the respondents' personal views regarding the subject under investigation.

Primary Data Collection: In the field survey several techniques were used to elicit the relevant data and information towards achieving the objectives of the study.

Questionnaire: A standardised questionnaire was administered to elicit information and opinions of the farmers about their farming activities. This had both open-ended and closed

questions. The information collected related to personal details, household characteristics, historical background, crop production, extension services and packages, output and marketing and environmental issues.

Direct Observation: This method offered the opportunity to check what was reported against what was observed on the ground. This is because respondents may report about the standard practice in the neighbourhood rather than what applies to them in particular field settings. This was being conducted simultaneously with the other instruments of data collection. Aspects of observation include; the types of crops grown, the allocation of land uses within the farm, estimation of land under cultivation, and the age of the respondent.

Key Informant Interviews: This method involved conducting interviews with key persons in the extension services. These persons included agricultural extension officers of various ranks in the two study areas, staff in ARU and APL officers in Laikipia. In addition, staff from the Soil and Water Conservation Branch of the MoALDM were interviewed on their support in crop production among the smallholder farmers. Key informants among the community were also interviewed and included the area sub-chiefs and farmers representatives. The aspects of focus from the interviews involved: extension activities, operations of the agents, joint activities with small holder farmers and packages disseminated in the areas of study.

Focus Group Discussion: A group discussion with sampled farmers was conducted to supplement the information from the questionnaire. This was done by requesting every third farmer interviewed to avail themselves for the group discussion. This was to avoid a situation whereby only farmers with distinct qualities would be selected. The researcher asked the farmers to choose the appropriate meeting place and it was agreed that the area chief's place was the most ideal. Arrangements therefore were made with the chief regarding the venue and

he conceded. The discussion was conducted by introducing a given topic and then the farmers would discuss it freely. To avoid domination of the discussion by particular farmers, the researcher would point at different farmers randomly and ask them to discuss certain issues.

Photography: This method was used to supplement all methods of primary data collection. Some of the photographs taken include farming activities, agro-forestry, mixed farming, new crop packages among others.

1.7.2 Selection of Survey Sites

Out of the six divisions of Laikipia district, two were selected. These are Central Division and Lamuria division. In the Central division, Mutirithia / Kariunga (M/K) was selected while in Lamuria division Wiyumiririe /Sirima were included in the survey. M/K was selected on the basis of the area's concentration of extension services facilitated by ARU since 1995. An area adjacent to it was selected for comparison purposes with the assumption that its concentration of extension services is not as high. This area is Lamuria division. Another reason for selecting M/K was due to the political instability that occurred in the area slightly before the field survey and hence the need to concentrate on the eastern part of the district which was relatively stable.

1.7.3 Sample Size and Sampling Technique

The main focus is on small scale farming household mainly engaged in the crop production sub-sector. In M/K 22 per cent of the 185 households in the area were selected. This translates to 40 households. For comparison purposes, a similar number of households was selected for Lamuria making a total of 80 households for interviewing. Simple random sampling of the households was done in order to avoid selecting only the households that had adopted extension services.

1.7.4 Data Collection Span

The primary data which involved field survey was collected between the months of February and March 1998, taking a period of about two months. During this period, structured questionnaires were administered and a focus group discussion in addition to interviews with key informants regarding the problem of under investigation were held.

1.7.5 Data Analysis and Interpretation

For purposes of analysing and presenting the data, both qualitative and quantitative methods were used. The quantitative method that was used was the Chi-Square (x^2) test to examine the extent to which various categories of variables related to each other. The dependent variable is explained by each of the independent variables. In the Chi-Square, the null hypothesis is that the variables are independent. Under the assumption that the null hypothesis is true, the cell frequencies we would expect to find if only random chance is operating are computed. These frequencies are called expected frequencies (f_e) and they are compared, cell by cell with the frequencies actually obtained in the table (observed frequencies, f_o).

$$X^2 \text{ (obtained)} = \text{sum of } \frac{(f_o - f_e)^2}{f_e}$$

Where f_o = observed frequencies

f_e = expected frequencies

If the null hypothesis is true and the variables are independent, then there should be little difference between the expected and the observed frequencies. If the null hypothesis is false, however, there should be large differences between the two. The greater the difference between the expected and the observed frequencies, the less likely that the variables are in fact independent and the more likely that they will be able to reject the null hypothesis.

As is the case with all tests of hypothesis, the test with Chi square consists of computing a test static, x^2 (obtained) from the sample data and placing that value on the sampling distribution of all possible sample outcomes. Specifically the obtained results will be compared with the value of the critical level that will be determined by consulting a chi square table for a particular alpha level degrees of freedom. If the calculated Chi square is greater than the tabular Chi square, the difference is said to be statistically significant (H_1) and vise versa (H_0).

- H_0 = There is no statistically significant difference between the variables.
- H_1 = There is a statistically significant difference between the variable.

The qualitative techniques used were mainly percentages and averages,. For illustrations, tabulations, bar graphs and pie charts were used.

1.8 Definition of Operational Terminology

Local Actor: This refers to individuals or groups in the community who are involved in crop production at small-scale level. There are two categories of the local actors namely: contract and contact farmers. Contract farmers are progressive farmers who have been engaged by external agents to propagate seeds for a particular package and /or host demonstration plots. Contact farmers are those early adopters of innovations and are used as examples for the other farmers by the external agents.

External Actor: This refers to institutional supported agents who intervene into the crop farming activities of the small-holder crop producers. This category includes extension officers sponsored by organisations like ARU, APL and MoALDM.

Adoption: This refers to acceptance to use and apply a new innovation introduced by external agents. This acceptance is then determined by the will of the farmers to embrace new

technology, their economic power to secure the technology and social acceptance of the innovations.

Influence: This refers to the ability of an individual in a more advantaged position to affect the behaviour of a person in a lesser position.

Sustainability: Refers to the ability of a given innovation to meet the present needs of the farmers for food, fuel, shelter without damaging the resource base thus making it impossible to meet the needs of future generations. For an innovation to be considered sustainable, it must be compatible with economic, socio-cultural and environmental needs of the people. The study takes into consideration three dimensions of sustainability namely:

(i) Economic sustainability: This refers to the ability of a given technology package to meet the material needs of the people utilising it.

(ii) Socio-cultural sustainability: This refers to the compatibility of a given technology package with the socio-cultural aspects of a given community.

(iii) Ecological sustainability: This refers to the ability of a given package not to disrupt ecological balance and possibility of recovery to a steady state of a given ecosystem.

Perception: This refers to the attitude of the mind that an actor has towards a given phenomenon. It was measured qualitatively by asking respondents to state their understanding, views and opinions regarding a given phenomenon.

CHAPTER TWO

THE ROLE OF AGRICULTURE AND ACTORS IN EXTENSION SERVICE DELIVERY

2.1 Overview

2.1.1 The Importance of Agriculture in the Kenyan Economy

Agriculture is the major source of income and employment for the majority of Kenyans. The Kenya government is determined to raise income levels and consequently living standards for the people in the rural areas where the majority of the people live. This goal is articulated in agricultural policies as outlined in Kenya's development plans. The aim is to contribute towards the achievement of the country's objectives of increasing employment opportunities, income generation, foreign exchange earnings, rural-urban balance, food security and overall economic growth.

It follows therefore that production of basic food crops particularly in ASALs must be promoted through full engagement of agricultural extension services in order to guide farmers on ways and means of reaping maximum output from their production.

2.1.2 The Role of Extension Service in Agricultural Development

The Government has an Extension Service Division under the Ministry of Agriculture, Livestock Development and Marketing (MoALDM) whose responsibility is to educate and advice farmers on the role of better farming practices. The dissemination of recommended agricultural technological innovations to farmers is chiefly carried out by extension service officers, either from the government or collaborating agencies. From the point of view of the government and other collaborating agencies, the use or adoption of technologies is expected to boost the living standards of the farmers through generation of income and thereby contribute to the rural development effort in general (Asambu, 1993).

2.2 Agricultural Extension Service

2.2.1 External Actors in Agricultural Extension Work

In the agricultural sector there are institutions that offer external intervention into the farming strategies adopted by small-scale farmers. Such actors have different approaches in the crop production system and have different packages. There is need therefore for the external agents to collaborate in their activities to avoid duplication of activities and conflicts. Agricultural extension is largely controlled by MoALDM through the extension and agricultural services division and the department of livestock production and veterinary services. Other agencies whether quasi government or NGOs offer their services in collaboration with the line ministries.

The underlying philosophy in crop and livestock extension is reflected in the training and visits (T&V) approach. In essence the T&V approach focuses on the transfer of knowledge and farming skills through close contact with farmers on the basis of regular visiting cycle (GoK, 1993).

2.2.2 Different Approaches to Extension Services

The approaches to extension services are " take it or leave it" approach and the contract farmer approach (Lele, 1975). She further explains that in the take or leave approach, farmers are introduced to innovations and information that they are free to accept or reject. On the other hand the contract farmer approach involves a situation whereby farmers who volunteer to receive innovations are granted a license, those who do not follow project guidelines may have their licenses revoked. Contract farmers in the Kenyan situation receive free agricultural inputs and are trained through on-farm trials; demonstrations on how to use such inputs appropriately to achieve expected benefits with the aim of propagating it to other farmers. With the take it or leave it approach, innovations must be highly profitable to gain wide acceptance. Farmers

would have to be convinced of the benefits they could reap out of a given innovation and the benefits accruing have to be over and above what they get without the use of the innovations (Lele, 1975).

2.2.3 Incentives and Performance of Extension Services

Staff motivation is a very important aspect while evaluating the performance of extension services. Poorly motivated staff would hardly perform their duties well and this would impinge on the level of delivery of services. The absolute number of extension workers in a programme area is less important than their individual performance (Lele, 1975). Programs cannot be very successful without energetic, motivated staff. The two incentives conventionally considered crucial to staff performance are salaries and promotion. Unpleasant working conditions and erratic administrative supervision also contribute to the sense of frustration among extension workers (Chambers, 1993).

2.2.4 Problems of Agricultural Extension in ASALs

Kenya has devoted impressive resources to extension. By 1973 there was one extension agent per 310 farmers on average, which was high by comparison with other African countries (Heyer and Waweru, 1976). However agriculture and veterinary services research in Kenya was oriented towards the needs of the large farm sector, particularly in high potential areas. Thus for coffee a crop already grown by white farmers, there was a good research base. The low potential areas were not accorded as much attention. It was with the establishment of the Katumani Research station in 1957 that attention was given for the first time to agriculture in semi arid areas. This research led to the development of Katumani composite varieties of maize. In Kenya's ASALs, agricultural extension in the crop sub-sector takes the form of transfer of crop varieties that are drought escaping. Other services that in the long run help in enhancing farming productivity include water-harvesting techniques including water dams,

water pans, and water tanks. Tree planting is also included in the package since these in the long run ensure that crops do well in spite of the harsh climate by transforming the climate.

Dissemination of extension services is faced by many constraints that hinder the effective execution of services. Extension agents are few and far between ill paid, ill trained, ill equipped with a technical package and consequently very poor in quality (Lele, 1975). This is an indication that dissemination of agricultural extension packages is faced by many constraints. The dissemination is skewed in that agricultural extension services tend to be concentrated in areas of high potential at the expense of the low agricultural potential areas with various developmental constraints within physical, social to economic arena. The evaluation of the effectiveness of extension services is by no means easy (Lele, 1975). It raises many methodological problems, some of which arise from the interactions of the extension service with other services such as credit and marketing while others arise from the very considerable variability between farms in resource endowment and in climatic factors. Such variability may often be far more important in explaining yield differences than is the effectiveness of any particular intervention including extension. Another factor is the social organisation, which has profound influence on communications and therefore, has implications for how extension programmes should be organised and administered.

This therefore means that in an effort to examine the effectiveness of extension services many factors are surveyed and the interrelation between them analysed. Increasing extension packages without considering other mitigating factors is indeed a futile exercise. In line with this Lele further argues that merely intensifying the extension service may often be futile unless conscious effort is made to:

- Impart a technological package that is sufficiently profitable at the farm level to provide an incentive for the farmer to adopt innovations.
- Train the extension staff to solve the specific but diverse farm level constraints faced by the cultivator.
- Develop an incentive system to encourage the extension service to perform its task efficiently meaning not only rapid growth in production but also broad participation in the adoption of innovations.
- Relieve extension staff of the heavy burden of delivering inputs, writing credit applications, chasing credit defaulters etc.
- List the active support and participation of the farmers themselves.

The issues arising from the above is that there is need for all services to be self-sustaining through capacity building. Farmers receiving handouts from external intervenors end up being left more helpless than they were before such interventions. In this regard, investment in extension services should not be assessed only in terms of extension worker /farmer ratios but also in terms of capacity building on the part of the local actors. There is a consensus among the social scientists that non-adoption of new technology may be a result of technology itself which favours high resource farms because of high field cost so that even the so called ' scale neutral' techniques require other components of technological package to provide a significant impact (Moyes, 1979). Furthermore, land size, land tenure, credit availability, education level have been mentioned as important factors affecting technology change (Vitta, 1988). These factors however should not be generalised since each of them influence adoption in a unique way depending on the ecological conditions in question.

2.3 Review of Related Research Findings on Agricultural Extension Services

The number of research studies on adoption and diffusion of technological innovations grew very rapidly in the 1960s and 1970s. These studies were initially concentrated in the industrialised countries until the 1960s when in their quest for advancement and wholesale transfer of technology being assumed to be the heart of development; attention turned to the third world countries. Although according to Rogers (1983) the number of studies conducted in developing countries then increased from about 54 in 1960 to 331 in 1968 and 912 around 1981, this number was expected to continue rising since the search for better means to economic prosperity was still the central focus of many developing nations (Asambu, 1993).

Studies done in many developed countries showed relationships between adoption of technology with factors such as age, level of education, farm size, family labour, frequency of visits by agricultural extension officers, attendance to field demonstrations and access to market facilities. For instance Cutie (1975), who studied the diffusion of hybrid corn technology in El Salvador found that availability of credit facilities and access to production units were important incentives for adoption of innovations. Further, Cutie found out that agro-climatic region and education were the only factors influencing the adoption of hybrid corn.

Similar studies have been conducted in Africa. In Ethiopia for instance, Kadebe (1988) conducted one of the recent studies in technology adoption. He evaluated the factors that influence the use of recommended farm practices in Nazareth area. From the results, the study found out that the adoption of maize technology was positively and significantly related to the availability of family labour, and that this was the major factor determining the adoption behaviour of farmers. Access to credit facilities was found to be positively and significantly related to adoption. Total farm capital was found to be negatively and significantly related to

adoption. Negative but statistically significant relationship was found between the percentage of land allocated to maize and adoption of maize technology package. Other factors such as the agricultural agent visits, attendance to field demonstrations, farmers' education and farm size showed positive but weak association with adoption of this maize technology package.

Studies done in Kenya on the topic of adoption of technological innovations show that Heyer and Ascroft (1970) was one of the earliest studies. They studied the adoption of modern practices on small farms and found no relationship between farmers' age and the rate of adoption. However they found out that higher rates of adoption were positively associated with years spent at school and use of hired labour. A number of other studies on technology adoption were conducted thereafter.

Moock (1971) found from his study that formal education, extension visits and attendance at field demonstration were the variables positively related to adoption of innovations by farmers from Vihiga Division of Western Kenya. Gerhat (1975) similarly reported formal education, extension visits, attendance at maize field demonstrations to be positively related to adoption. Other factors that had the same magnitude of influence were knowledge of credit, availability of production inputs, farm income and attendance at farmers training centres.

Misiku (1976) conducted a study on the incentives and disincentives influencing farmers in adoption of agricultural innovations in Bungoma District of Western Province. He used a combination of techniques including cross tabulations, chi-square test of statistical independence, analysis of variance, Pearson's correlation and multiple linear regression. He found that contact with extension officers, social participation, family size, income and endowment of economic resources to be significantly related to adoption. Access to agricultural credit and frequency of contact with extension officers positively influenced

adoption. Factors that were identified as significant incentives in his study included increased yields, higher income, early crop maturity, use by neighbours and availability of technical guidance. The disincentives were lack of knowledge, lack of technical guidance, lack of credit, poor seed, expensive seed, lack of timely supply of production inputs and technology being very complex.

In their study on extension education and farmers performance in improved crop farming in Kakamega District, Chitere and Van Doorne (1985) analysed the variables that relate adoption of farm innovations by means of cross-tabulations. They found that formal education, economic status and farmers level of technical knowledge had an influence on the rate of adoption. Knowledge was therefore identified as the main factor responsible for adoption of agricultural technological innovations.

More recently, Kimenye (1997) in Embu and Mbeere districts did a study on improving the dissemination of agricultural technologies and utilisation by women farmers. The focus was more on factors that influence transfer of extension service information to the farmer particularly women farmers by looking at the linkages that exist among the actors involved in the crop production sub sector. It was found that researcher-farmer, researcher-extension, and researcher-extension-farmer was found in the area while research-input suppliers-farmer linkage was non-existent. Among the methods through which the extension -research linkage is enhanced is through: individual farm visits under contact farmer approach, contact group approach, field days and demonstrations, residential farmer training and courses, chiefs' *barazas* and special projects.

This review shows clearly that there are variations among the results of the studies. This is as a result of the fact that circumstances facing each region are different from the other. This is

probably because individuals are unpredictable and their priorities change over time on the basis of the prevalent physical, socio-economic, environmental and institutional factors. Therefore the results of one region cannot be used to draw conclusions about another region, but a similar framework of analysis can be used.

In this section, the role of agriculture and extension services were reviewed as well as the factors that influence adoption of innovation. However, there are certain factors that tend to be common in most studies as they are significantly related to adoption. Income, contact with extension, education and age most commonly influenced adoption. In this study, age, income, farm size, contact with extension and education level are the variables that are used to examine the extent of influence of the extension officers on crop farming among small scale farmers in Laikipia.

2.4 Actors Strategies and Perceptions in Resource Management

2.4.1 Natural Resource Management

The examination of natural resources and the perception of different actors are crucial in understanding the resource use dynamics. In understanding the influence that the external actors have towards the local actors on crop production it is vital to consider the resource base and how variations in perception by different actors influence the way in which the resources are exploited. Sustainability of such resource use is also examined to find out the extent to which it is accorded importance in resource use. This leads to the theoretical framework where there is an examination of the way in which resources are utilised to either lead to sustainable development or unsustainable land use hence environmental degradation and poor production.

Under this section natural resource management will be reviewed bearing in mind that conservation of natural resources is the main focus by extension agents given that productivity

of any disseminated crop varieties is determined by the extent to which the natural environment is conserved. As far as agriculture is concerned the main focus is on soil conservation measures since the extension information would be pointless without soil conservation measures. Issues of sustainability and ASALs farming are considered. These include: perception and resource use; sustainability and natural resource use and farming systems in ASALs of Kenya.

2.4.2 Perceptions and Resource Use

There is no satisfactory definition of a resource, and no one definition has remained generally acceptable through time. A resource is not necessarily a tangible object, but is a culturally defined and abstract concept. Essentially, anything can be regarded as a resource if it offers means of attaining certain socially valued goals (Cloke, 1985). The perception that people in a given place under certain circumstances have towards a given phenomenon determines whether or not the phenomenon under question is a resource or not. Appraisal of opportunities depends on perception of their presence, recognition of their capacity to satisfy human wants and development of means of utilising them to achieve socially desired goals (Cloke, 1985).

A given phenomenon which could be tangible or intangible may be regarded so in another situation. This will basically depend on whether the given item can satisfy the needs of those in question resources are created to satisfy human wants. This act of "creation" depends on many factors, such as the identification of technological abilities. In the rural area, land use resource "creation" will depend on a number of factors. These include existing land uses, evaluation of land capability for different forms of land use, the physical proportions of the land in question, and social and economic views on the sustainability of that land for different uses. Others are the level and type of land management, and development control, the levels of experience and technical capabilities in successfully changing land use to that required

(Zimmermann, 1957). "The availability for human use, not merely physical presence, is the chief criterion of resources." In semi-arid areas where sand soil is predominant, the inhabitants of such an area may not view sand as a resource just because of its mere presence. This is because availability of a resource in turn depends on human wants and abilities.

In line with the foregoing discussion, Zimmerman (1957) pointed out that, *resources are not, but they become*, they are not static but expand and contract in response to human wants and human actions. This is where the aspect of perception comes in because a given object will be regarded as a resource based on the perception that the person looking at it has. For instance in farming, there tends to be a wide gap between what outsiders perceive and believe and what the small holder believes (Beets, *ibid*).

It is the perception that people in a given situation have regarding the resources at their disposal that dictates the strategies they adopt in utilising the resources. The perception is influenced by factors like age, income level, education level, farm-size, structure and size of the household. Thus, strategies may differ among actors utilising the same resource, due to the variations in factors influencing perception.

Many problems of country side planning stem from the ways in which people view the countryside whether these people are planners, residents, visitors etc (Cloke, 1985). Because each actor tends to have his perception regarding resources availability, conflicts in resource management tend to be inevitable. The decision-makers tend to overlook the perceptions of the local actors and hence conflict.

Farming in rural areas may be perceived from many points of view depending on the person looking at it. A farmer may be viewed by an urban dweller as a provider of food and other raw

materials, while an environmentalist may view a farmer as a destroyer of the nation's heritage, promoting rape of the natural landscape. To the farmer, agriculture is both a business and a way of life. As a result of these variations in perceiving the same phenomena, conflicts in resource use are endless. An agricultural extension officer strongly believes that inputs in farming such as fertilisers increase productivity while a farmer may argue that generations have survived on the same farm yet no inputs as fertilisers were used. These are among the issues that emerge in rural planning. Gordon Cherry (1975) has defined rural planning as "a question of recognising emergent areas of conflict in values and taking action to reconcile or otherwise meet that conflict. The conflicts arise out of differences in adoption of strategies. Since land use is a product of human decisions the strategies are adopted on the basis of decision making. Decisions about the use of land involve a multiplicity of factors: the objectives of the land user, the process or means by which he reaches a decision and the background factors that consciously or unconsciously influence his decision. These include both intrinsic personal and psychological factors, and also external influences stemming from the nature of the land unit and its wider setting (Mather, 1986).

Resource use is unavoidable hence decisions have to be made based on certain perceptions. However limits to resource use ought to be defined and therefore the basic concern ought to be avoiding approaching the limits of resource availability. This is because resources especially natural ones are limited and can be damaged irreparably if not used cautiously.

The situation is worse in fragile ecosystems because simple mistakes on resource utilisation strategies have for reaching environmental impact. This brings in the concept of sustainability in resource management. In understanding the concept of sustainability in resource use and management, the attitudes, capacities and needs of resources users ought to be taken into consideration. Attitudes may be derived from religious, social, customary and economic

considerations. They tend to be highly specific in place and time There are however few general attitudes which are widespread, like aversion to taking risks with the main subsistence crop, fear and suspicion of outsiders especially officials and dependence on public opinion of the collectivity itself. Beyond these generalised fears there may be far more specific roles and taboos about particular crops, planting dates, mutual help and grazing rights. Thus, in understanding sustainability in resource use the perceptions of actors and the factors influencing perception must be understood.

2.4.3 Sustainability and Natural Resources Use

Rural areas offer a broad spectrum of natural resources to the actors inhabiting those areas. Cloke (1985) observes that natural resources derive ultimately from the natural environment and so there is a limit to the total quantity of those resources that will be available. Whilst many natural resources can be recycled, the overall resource base is finite.

All resources are culturally defined and therefore, different aspects of the natural environment might be regarded as "resources" in the future if the framework of this cultural definition changes. Natural resources are uneven in their distribution and have ubiquitous distribution between and within countries. The quantities, qualities and characteristics of the natural resource base vary in space and in time. Land is the basic natural resource. Over the span of human history, man has drawn most of his sustenance and much of his fuel, clothing and shelter from the land. Land has been man's habitat and living space, land has been a matter of life and death, of survival and starvation (Mather, 1986).

In using land as an ecosystem, man seeks to manipulate the ecological processes of the resources at his disposal that he perceives as valuable or useful for food, clothing or timber. Man therefore adopts strategies to manipulate the resources and in so doing removes and

suppresses the elements that are not perceived as valuable. In many instances man tends to over stretch those resources that he perceives as valuable to him, and this leads to unsustainability in use. As a result, sustainable levels of use of natural resources and patterns of use compatible with long term social and environmental objectives ought to be adopted. Natural resources need careful allocation to ensure equitable distribution, which is sustainable.

Sustainable system (or process) must be based on resources that will not be exhausted over a reasonable period (Spedding, 1996). In rural areas agriculture is the main preoccupation either for subsistence or commercial purposes. Farming therefore has to be carried out sustainably to maintain productivity, whether of a field or farm or nation in the face of stress or shock (Conway and Barbier, 1990).

Conway and Barbier (1990), further argued that the international development policies are now incorporating the concept of sustainability. Thus, the World Bank (1988) listed three criteria for agricultural development. It must be sustainable, by ensuring conservation and proper use of renewable resources, it must promote economic efficiency and its benefits must be distributed equitably.

In this context, sustainable use of natural resources in ASALs ought to be accorded special attention. Until 1970's, attention on farming had been on high and medium potential areas. However, due to increased pressure on the resources in those zones, trends of migration towards the fragile regions of low potential have been on the rise in the last two decades. These low potential zones comprise the arid and semi-arid land (ASALs). As a result of the inevitable increase in population in the ASALs and consequent pressure on the fragile land and scarce resources like water, sustainable strategies ought to be devised to ensure that irreparable

damage is not inflicted on the land. This is based on the belief that the environments whether arid or high potential provides the resources that sustain man.

Therefore, sustainable development should be considered while farming so as to preserve resources. Through inappropriate land use systems man is capable of irreparably ruining his habitat. Beets (1990) points out that recognition has began that all land use development must be carried out within the constraints set by the physical and natural environment if we are to avoid further damage.

2.5 Farming Systems in ASALs in Kenya

ASALs in Kenya comprise about 80 per cent of Kenya's total land surface area, support well over 25 per cent of the human population and slightly over half of the livestock population. A majority of the inhabitants are pastoralists although agro-pastoral and farming communities do exist. A prominent feature of the ecosystem is the low and variable rainfall, which rarely exceeds 800 mm, with most areas receiving 200 to 350 mm annually. The water resources are limited and poorly distributed. There are few permanent rivers, several boreholes and wells have been developed to tap the ground water resource.

Inappropriate policies and models prescribed by experts have not had the desired success and in many ways have been responsible for the environmental crisis in the arid lands. (Keya, 1991). It has been estimated that approximately 30 to 40 per cent of Kenya's ASALs regions are quickly degrading and that another 2 per cent has been completely lost to this process (NEHSS, 1984). In order to arrest this trend it is important as Walker (1981) put it, that new technology is "right" and that one knows for sure how new varieties and practices interact with local agro-climatic and socio-economic environments. It should be realised that farmers often perceive

such interactions and their perceptions often play the leading role in decision-making under uncertainty.

In Kenya's marginal areas, a wide range of variation exists in agricultural land use practices. For example from predominantly subsistence to predominantly commercial, from livestock rearing to crop production, from use of simple farming implements to tractors drawn ploughs, from natural dependence on natural regeneration for maintaining fertility to the application of organic and inorganic fertilisers (Sing, 1986).

As population in these marginal area soars, subdivision continues on a significant scale. Hazelwood (1971) stressed this point further by stating that "illegal subdivision of once economically viable holdings in the mixed farm areas is on the increase despite governments declared policy to discourage the practice. In Laikipia, land sub-division is on the increase brought about by population increase. Farmers from high and medium potential neighbouring districts migrate to Laikipia due to population pressure in their areas.

The land sub-division brought about land use changes with new farming systems emerging. Because little information is available for the new settlers on how to run crop and livestock production on their holdings, the new farming systems are mainly developed through trial and error. Environmental degradation and social and economic marginalization of the inhabitants are taking place (Huber and Opondo, 1995). Intervention into the situation is therefore needed.

One of the main features of subsistence farming is that the farmer has to produce in order to live. Consequently he often resists changing production methods since, when the changes turn out to be unproductive, his livelihood and survival are threatened. Beets (1991) observes that "low resource", "resource poor" or "under valued resource" agriculture is identified with

unfavourable or difficult areas. These are mainly associated with fragile soils. The demands of the increasing population on such land explains what Beets calls a decline in productivity and omnipresent environmental deterioration, where productivity falls below the needs of the smallholder.

Sustainable development of farming systems has been defined as development which meets the present needs of the farmers family for food, fuel-wood and shelter without damaging the resource base, thereby compromising the ability of future generations to produce their needs on the same land, using the same resource base. There are two major problems identified by Beets in sustainable agriculture: the needs of the tropical small holder are urgent, he has to produce today because he has to eat today, and it is much easier to produce today's subsistence needs at the expense of the environment than in a sustainable way, in many cases not only "easier" but the sustainable option hardly even exists.

A critical look at the environmental situation in East Africa in the early 1990's gives causes for grave concern. Assessments by the World Bank, United Nations Environment Programme (UNEP), International Union of Conservation of Nature and Natural Resources (IUCN) and other institutions point out that food production per capita has been declining for a long time and that recurrent drought aggravates rural vulnerability. Rapid population growth in conjunction with technical stagnation in food production and absence of massive off-farm employment opportunities led to a situation where the ecological basis of food production is undermined. The worse scenario for year 2000 is widespread food deficits and starvation, rural migrations and armed clashes between regional and ethnic groupings spurred by competition for ever more denuded land resources.

In the semi-arid areas the woodlands are cut and burnt for fuel after which livestock are introduced and maize planted. All these present attempts by poor rural households to earn a living, mainly at subsistence level, from extraction and exploitation of the natural resources to which access is available. The link between environmental degradation and food security in ASALs is evident as food production relies on direct exploitation of the environment by primary producers. Young families are pushed into ecologically marginal area. Their technologies are extractive as they are not well adapted to the marginal ecology and this results to environmental degradation. External intervention is therefore crucial in order to ensure sustainable land use strategies.

2.6 Theoretical and Conceptual Framework

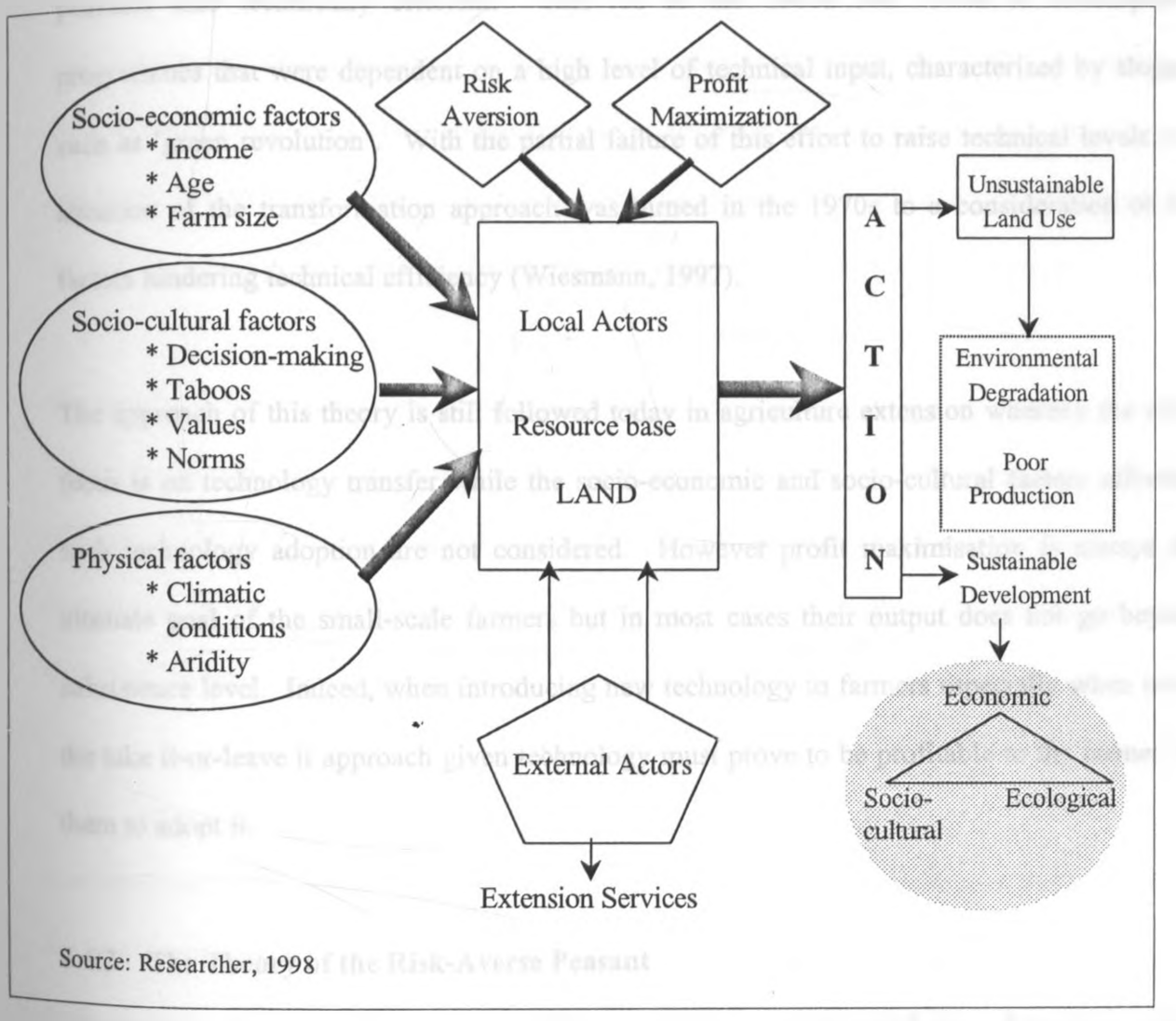
Having identified the actors in the crop production sub-sector, and the factors that influence the manner in which they relate to each other, this section looks at theories that raise the question of small scale farmer rationale of action in the context of external intervention. These describe the guidelines or principles involved in the process of harmonising and optimising within strategies of action. As a result of different circumstances that face the small-scale farmers in their choice for different farming technologies they make decisions by evaluating their circumstances and hence similar factors are found to influence the actors differently. The economic variants of the theories will be considered as they illustrate the respective principles of household resource allocation in the simplest terms.

2.6.1 The Theory of Profit Maximising Peasant

The debate over economic rationale of peasant action began with the so-called 'Schultzian Revolution'. In 1964, Schultz put forward the proposition that peasant households are 'efficient but poor' thereby distancing himself from the prevailing opinion of the time, which held that peasant households in developing countries did not operate in an economically

rational way. Schultz suggested that 'there are comparatively few significant inefficiencies in the allocation of factors of production in traditional agriculture'. This in turn led to an economic formulation known as the theory of 'profit maximising peasant' (Schultz, 1964; Ellis, 1993. Quoted in Wiesmann, 1997).

Figure 2.1: Conceptual model of smallholder crop farming strategies in ASAL setting



Source: Researcher, 1998

In simplified terms, this neo-classical theory states that the profit- maximising peasant is efficient in the sense that no change in either input or output would have an additional positive effect on his net income. Aside from methodological problems empirical attempts to verify the theory of profit maximising peasant have led to the need to differentiate between two economic efficiencies: allocative efficiency which refers to the efficient allocation on a specific

technological level; and technical efficiency, which is function of the highest available technical level. Empirical studies undertaken in the 1960s and 1970s generally came to the conclusion that peasant households are efficient, but only in the allocative sense and not in terms of technical efficiency. A technological transformation approach was a logical consequence of the theory. This approach tried to make the already allocative efficient peasants also technically efficient. This led in the 1960s and 1970s to development programmes that were dependent on a high level of technical input, characterised by slogans such as 'green revolution'. With the partial failure of this effort to raise technical levels, the attention of the transformation approach was turned in the 1970s to a consideration of the factors hindering technical efficiency (Wiesmann, 1997).

The approach of this theory is still followed today in agriculture extension whereby the main focus is on technology transfer while the socio-economic and socio-cultural factors affecting such technology adoption are not considered. However profit maximisation is always the ultimate goal of the small-scale farmers but in most cases their output does not go beyond subsistence level. Indeed, when introducing new technology to farmers especially when using the take it-or-leave it approach given technology must prove to be profitable to the farmer for them to adopt it.

2.6.2 The Theory of the Risk-Averse Peasant

Almost as a counter-reaction to the profit maximising peasant, the theory of the risk-averse peasant was subsequently formulated. The economic variant of the theory of the risk-averse peasant postulates that peasant households while not efficient in terms of profit maximisation, nevertheless make decisions and take actions that are rational in economic terms. Peasant households' face a broad range of risks stemming from uncertainties related to markets and market information, social and legal rules and regulations, and autocracy, bureaucracy and

political unrest. The theory argues that the allocation of scarce household resource is therefore based on the principle of 'safety first'. Resources are allocated in such a way that risks understood as subjective evaluations of probabilities are minimised on balance over a longer period of time.

As in the case of the profit maximising peasant the theory has important consequences for development policy. The primary concern associated with the theory is the reduction of objective and subjective risks. Application of the theory within the framework of the 'green revolution' consequently concentrated on the reduction of natural production risks, for example through irrigation projects and the development of resistant crop varieties (Wiesmann, 1997).

The theory of the risk -averting peasant basically concerns itself with the issue of uncertainty regarding introduction of new technology and hence the resultant non-acceptance of such technology if there are perceived risks. In the context of this study, the farmer is torn between maximising profits and taking the risks involved. The evaluation of the situation depends on the given farmer's socio-economic and socio-cultural background.

2.6.3 Actors' Roles and Interaction

In understanding the concept of resource use strategies and sustainability in resource utilisation the study will focus on the "magic triangle" of sustainable development. This comprises economic sustainability, socio-cultural sustainability and ecological sustainability (Wiesmann, 1994). These three dimensions of sustainability ought to be considered in totality rather than in isolation if sustainable development is to be achieved.

Resources are of use to human beings in terms of their functions namely: productive functions, cultural functions, and physical functions. These relate to the three dimensions of sustainable

development. In cases where any of the three dimensions is considered in isolation then development cannot be said to be sustainable because emphasis on any one dimension would mean neglect of the other.

Economic sustainability is measured primarily as a function of the basic material security of all members of a particular society. Apart from basic security, such factors as economic growth, the potential for economic development and diversity of economic activities are considered constituent elements of economic sustainability. Resources that have a productive value include soil fertility, the genetic potential of cultivated plants and the domestic animals and the raw materials used in industry.

Socio-cultural sustainability is often understood to refer to individual spiritual, cultural and political potential for development and is also concerned with maintaining variety of socio-cultural values. Development is supposed to be carried out in a manner that will increase people's control over their lives. Such development is also supposed to be compatible with the culture and values of the people affected by it and should maintain and strengthen community identity.

Ecological sustainability is often associated with ecological stability and conservation of natural resources. It means that development is undertaken in a manner that is compatible with the maintenance and enhancement of essential ecological processes, biological diversity and the natural resource base. The ecological functions of natural resources are linked to components of nature, which are considered by a given society to contribute to the physical well-being of humankind.

Wiesmann (1994) argues that if development at the local, regional, national or global level is to be considered sustainable, it would have to fulfil the minimum condition of not causing any long term depreciation in the values used to assess economic, socio-cultural and ecological sustainability.

The conceptual model presented above helps in understanding the interaction between the local actors and the external actors and the resultant land use strategies adopted by the local actors out of that interaction. The kind of perception that the local actors have towards the external actors determines how sustainable the development would be. If the local actors do not accept the influence of the external actors the continued use of unsuitable land use strategies would degrade the environment.

There are two perspectives on natural resource use, which determine sustainability of the natural resources. There are external actors on the one hand and local actors on the other hand. It is the nature of interactions that the two categories of actors have towards each other that determine in the long run the nature of the sustainability package. Local actors may for example perceive the external actors negatively and refuse to adopt new farming technology. In that case their production remains low hence the resource utilisation tends to be economically unsustainable.

There are therefore inherent conflicts in an effort to achieve sustainable development because positive values in one dimension may mean negative impact on the other dimensions. This makes sustainable development a gradual process. The implication is that a process of consensus building at different times or stages in the development process is needed, during which different interest groups argue their points of view vis a vis desirable forms of economic, social and ecological development and agree on minimum conditions for ensuring

equity, means of enlarging social capital while at the same time guaranteeing ecological sustainability.

2.6.4 Local Actors Component

This is the situation in which the small-scale farmer finds himself in after migrating into Laikipia. The land is the resource at his disposal and agriculture tends to be the major economic activity. The farmer will more often than not cling to the farming strategies that he used in his area of origin in spite of the physical conditions facing him. The farmer's socio-cultural and socio-economic background influences his adoption of external technology. The farming knowledge that the immigrant farmer tends to have upon settling is knowledge that is suited for the wet region and is not ecologically adaptable to the arid region. Therefore without external influence or adoption of new suitable technology, continued use of strategies that are not suitable for the area result in dire environmental consequences and persistent crop failure.

It is important to note that there are contexts in which the local actors could also act as external actors. This happens in situations where such local actors are able to exert some influence on the neighbouring local actors. They could influence the local actors if they have knowledge regarding the suitable crop farming strategies. In this context then, the influence is not just from forces external to the local actors but also from within. However, given the constraints on the ground regarding the availability of extension officers, they cannot be expected to have a significant impact on the entire farming population without the entry of other actors.

The local actors aim at satisfying individual needs while the external actors are expected to guard the public good in the interest of the whole community. Those external actors who are

also local actors are caught up in a difficult situation balancing between serving individual interests and guarding the public good.

2.6.5 Socio-economic and Socio-cultural Factors

This is a complex component comprising sets of variables that are crucial to sustainability as they determine the adoption of new technology. The socio-economic factors comprise age, income, farm size, land size, level of education contact with extension officers and settlement history. The socio-cultural factors comprise norms and values as they relate to the decision making structure in the society. The physical factors comprise the prevailing climatic factors and they influence the adoption of new technology because the farmers find themselves in harsh climatic conditions and hence opt for any new technology that may improve on the farming.

During the encounter with the external actor the local actor already forms an opinion regarding the external actor and new technology package. The external actor's opinion regarding the local actor plays a crucial role in determining the extent of interaction between the two. A set of socio-cultural, economic and environmental factors and experiences of each actor determine the perceptions of the two sets of actors. The forces of risk aversion and profit maximization in the end determine whether a given innovation is adopted or not. This is because as far as the farmer is concerned, survival is the basic concern.

2.6.6 External Actors

This is where the external agent comes into contact with the local actors to influence their land use strategies. The extension agents interact with the small-scale farmers by creating awareness on the crop varieties that are suitable for the area. The small-scale farmers may adopt or resist new technology depending on the extent to which the external actors influence

the local actors' socio-cultural and socio-economic backgrounds. Their aim is to avert risks involved in crop production by introducing varieties that are suitable for the area.

2.7 Evaluation

At this point the small-scale farmer uses his judgement to decide whether to adopt a given strategy or not. If the farmer adopts new strategies that are suited for the area, sustainable development is achieved. If he does not and continues to use unsuited technology, the environment is degraded further. The extensionists should therefore strive to intensify their activities so as to ensure that the sustainability is achieved through the farming strategies adopted. The farmer response in rejecting or adopting new technology is influenced by the extent to which his survival is not threatened by the technology or innovation introduced.

2.8 Conclusion

Having examined the factors that make the small-scale farmers make certain decisions, it is clear that the small-scale farmers do not make haphazard decisions regarding land-use. Certain forces guide the farmer in taking his/her action with the priority being meeting basic needs. When faced with the option of adopting new innovations the farmer does so in the light of risk aversion and profit maximisation. This is the entry point for the external actor. If he is able to convince the farmer of profit maximising and no risk, the innovations are easily adopted. The government policy regarding land use in ASALs is basically geared towards environmental conservation and increased productivity so as to enhance the standards of living of the migrants and eventually contribute to national growth. This is the ultimate goal in the theoretical framework where it is envisaged that proper intervention leads to environmental conservation and increased productivity. Thus the influence of external actors on local actors enhances productivity and proposals addressing the problems in the study area should fall within this framework. The following section links the theory with the government policy.

2.9 Government Policy on ASAL Development and Agriculture

2.9.1 Potentials of the ASALs

The range and arable land in the ASALs of Kenya make up over 80 per cent of the country's land surface and carry over 25 per cent of the total human population and slightly more than half of the livestock population. The majority of the ASAL population is pastoralists although the semi pastoral and farming communities are becoming more important. The development of ASAL received low priority during the colonial period and during the first one and a half decades after independence. However since the late 1970s the development of ASALs has received increasing attention in recognition of the important contribution ASAL areas can make to national development. They have considerable potential albeit at a higher cost than the rest of the country. At the same time most of the rural poor people live in these areas, hence the need to improve their living conditions through increased productivity and creation of employment opportunities. Additionally, the increasing problem of soil erosion and environmental degradation, the threat of desertification and the negative consequences of such phenomena need to be addressed (Keya, 1994). The following are the specific constraints to ASAL development;

- Environmental constraints resulting from low, erratic, and unevenly distributed rainfall which in most cases is below 500mm on average, poor soil fertility, pests and diseases in both plants and animals.
- Resource scarcity as evidenced by low agricultural land potential using present technology and limited water availability.
- Previous research work has mainly concentrated on wetter areas in Kenya and migrants from these areas often bring with them unsuitable technology to exploit arid lands.
- Poorly developed public infrastructure, which prevents delivery of output and inputs and marketing of produce.

- The human resource is also the least developed in the country since the educational services are on the lower side. Thus most people are less prepared to cope with change and innovation (GoK, 1993).

These and other problems led to frequent food shortages, unemployment and underemployment. This prompted the sixth parliament to come up with "Second Generation Strategies for ASALs Development". The main objectives include;

- Making available the means of exploiting the important production potentials of ASALs resources, thereby contributing significantly to income, employment food security.
- Reclaiming where damaged and protecting valuable and fragile natural environments.
- Generating opportunities for improving the quality of life, of present and future populations on a sustainable basis.
- Determining ways and means of effecting symbiotic exchange with high potential areas.

To attain these, the broad ASAL policies and programs will direct attention on;

- Developing human resources and institutional capacities to enhance economic development.
- Strengthening community's participation on involvement in determining and executing development approaches.
- Use of low cost and appropriate technologies to increase the general productivity of the area.
- Diversifying traditional modes of production through mixed farming and introduction of non-pastoral and off-farm activities.

- Improvement of the delivery of social services and infrastructure and intensification of research on sustainable development of human, economic, and ecological resources (GoK, 1994).

The use of low cost and appropriate technical packages is key to improved dryland farming. The participation and co-operation of the farmers in these areas will be crucial to the development of technical packages that can be replicated to wider areas of the ASAL. Cultivation of drought resistant but high yielding crops will be intensified paying more attention to sorghum, millet, pigeon peas, green grams and beans. Other crops will include cotton, oilseeds, and root crops such as cassava.

Since most farmers in ASALs are small scale in nature, the government through the MoALDM, NGOs and other stake holders including the private sector, will encourage the use of technologies appropriate in such areas, such as the use of drought animals in ploughing and animal drawn carts (GoK, 1997).

2.9.2 Agricultural Sector Information Management

Information will be increasingly important in a liberalized economy where the private sector will play a dominant role. Availability of timely and reliable agricultural information is crucial for decision making in both public and private sectors. The constraints to efficient and timely provision of agricultural information relate to the lack of co-ordination among the institutions in the sector, inadequate funding, differences in methodology, inadequate standardization and inadequate information management and dissemination. In addition a significant proportion of the data management equipment in public information institutions is outdated, and inaccessible to farmers due to bureaucracy and/or language barrier.

The MoALDM and the Central Bureau of Statistics (CBS) will help institutions to collect and analyze agricultural statistics through the provision of guidelines for data collection, standardization and reporting. In addition, the respective institutions will make regular budgetary provisions, supplemented by user charges as appropriate, for data collection, analysis and dissemination (GoK, 1997).

2.9.3 Institutional Arrangements for ASAL Planning and Management

Since the initiation of the ASAL programme in 1979 activities in these areas have been co-ordinated by the Rural Planning Department of the Ministry of Planning and National Development (MoPND). Funding for major projects and programs has remained with line ministries, the contribution to ASAL development through the RDF and through micro project schemes operated by the ministry have been significant. Over time the Rural Planning department has evolved as the focal point for the planning and co-ordination of the programs in ASAL. This evolution has been further extended within the context of the District Focus for Rural Development (DFRD) strategy. Donor funded agencies wishing to give assistance to the ASAL areas do so through the ASAL Programme (GoK, 1989).

In conclusion, the government's mission as postulated in its policies is the preservation of the environment in the fragile area and increased productivity hence improve living standards for the population. The recommendations of the study should therefore be geared towards that end. These policies are in line with the ultimate goal of the theoretical framework guiding the study, which is to achieve sustainable development and hence improve the living standards of the population. Conservation of natural resources should therefore be in line with the government policies hence the actors should work in collaboration so that their strategies may supplement one another rather that contradict one another.

CHAPTER THREE

THE SETTING OF THE STUDY; LAIKIPIA DISTRICT

3.1 Location

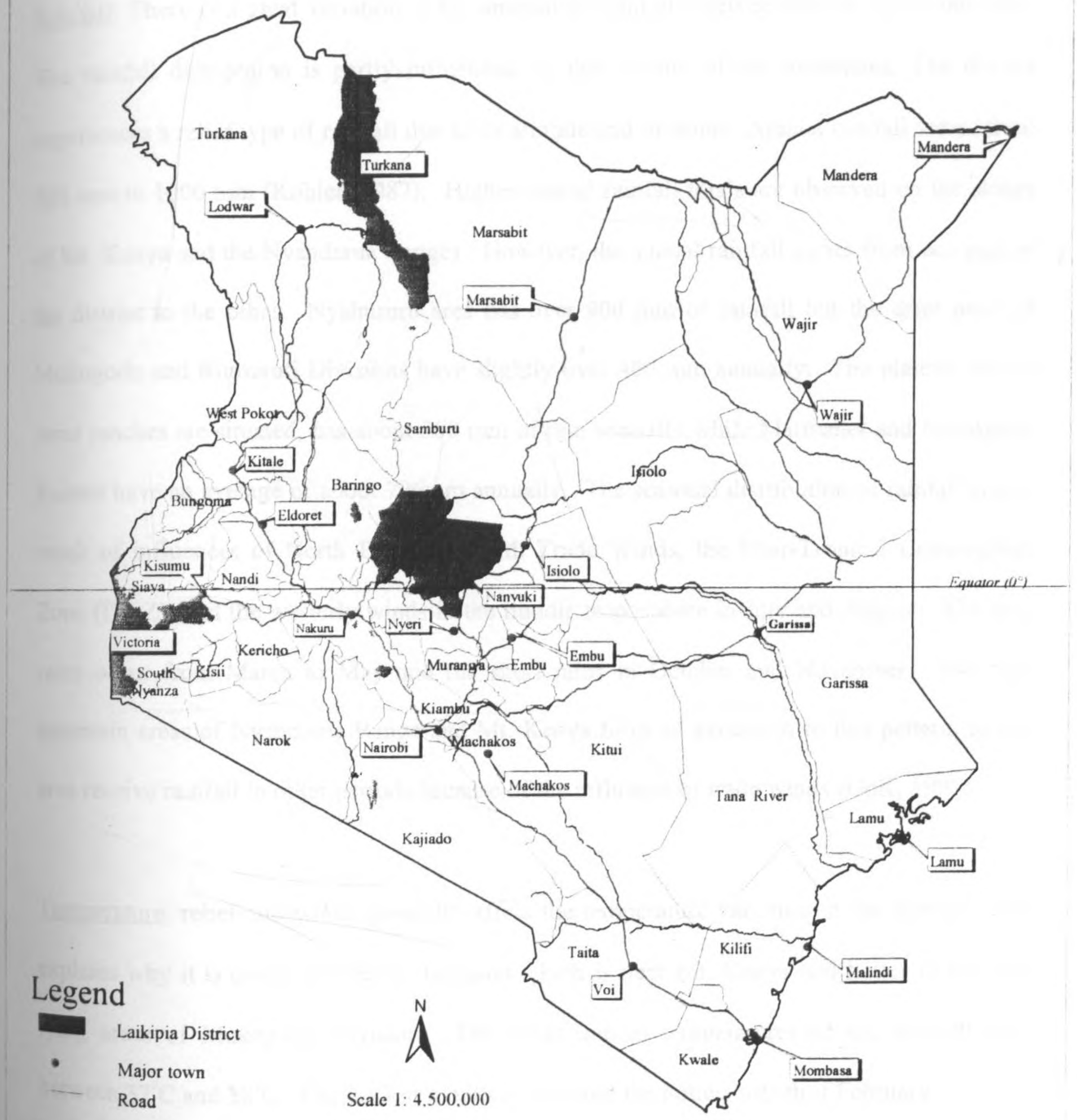
Laikipia district, one of the seventeen districts in the Rift Valley Province covers an area of 9,723 km^2. It lies east of the of the Aberdare ranges on the Rift Valley and is generally characterised by a level plateau. Its neighbouring districts are Samburu to the north, Isiolo to the northeast, Meru to the southeast, Nyeri to the south, Nyandarua and Nakuru to the southwest and Koibatek and Baringo to the west (GoK, 1997).

3.2 Topography and Climate

Laikipia district consists mainly of a plateau bounded by the Great Rift Valley to the West and the Aberdares and Mt. Kenya massifs to the south. In the northwest, the plateau descends towards the floor of the Rift Valley, while in the north and east it falls into areas that extend over many hundred kilometers towards the north. The altitude of Laikipia District varies between 1800 metres in the north and 2600 metres in the south. The maximum height of 2600 metres is found around Marmanet Forest. Other areas in the district of high altitude are Mukogodo and Loldaiga Hills to the east. Due to its leeward position, Laikipia is comparatively dry and is mainly used as pastureland, except on the mountain slopes and forest zones where crops are grown. The Laikipia plateau is drained by tributaries of the Ewaso Ng'iro River. These are Nanyuki, Rongai, Burguret, Segera, Naro Moru, Engare, Moyok, Ewaso Narok and Ngobit rivers. The flow of these rivers indicates that the district slopes gently from the highlands in the south to the lowlands in the north. There are two major swamps in the district, namely Marura and Ewaso Narok Swamps around Rumuruti Market Centre These swamps are important biodiversity pockets in drylands.

Map 1

Location Of Laikipia District Within Kenya

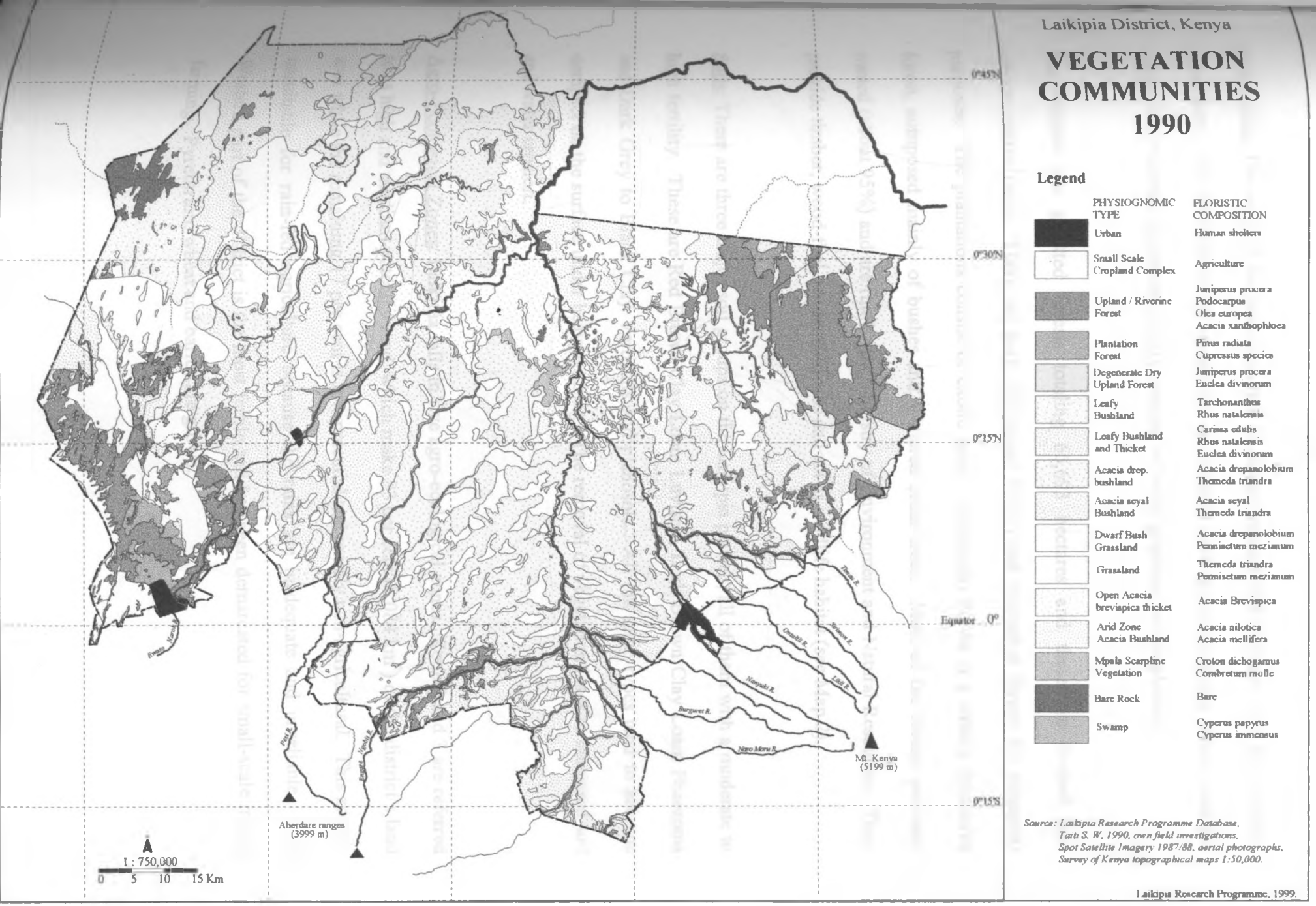


Source: Laikipia Research Programme Database 1998

However, due to population pressure, parts of the swamps have been converted into farming areas.

Rainfall: There is a great variation in the amount of rainfall received both in space and time. The rainfall distribution is partly influenced by the vicinity of the mountains. The district experiences a relief type of rainfall due to its altitude and location. Annual rainfall varies from 400 mm to 1000 mm (Kohler, 1987). Higher annual rainfall totals are observed on the slopes of Mt. Kenya and the Nyandarua Ranges. However, the annual rainfall varies from one part of the district to the other. Nyahururu area has over 900 mm of rainfall but the drier parts of Mukogodo and Rumuruti Divisions have slightly over 400 mm annually. The plateau, where most ranches are situated, has about 500 mm of rain annually while Marmanet and Mukogodo Forests have an average of about 706mm annually. The seasonal distribution of rainfall is as a result of influences of North East and South Trade Winds, the Inter-Tropical Convergence Zone (ITCZ), and the westerly winds in the middle troposphere in July and August. The long rains occur from March to May and the short rains in October and November. The high mountain areas of Nyandarua Range and Mt. Kenya form an exception to this pattern, as this area receive rainfall in other periods because of the influence of trade winds (GoK, 1997).

Temperature: relief and winds generally affect the temperature variation in the district. This explains why it is cooler in Central Division which is near Mt. Kenya and hotter in the low-lying areas of Mukogodo Division. The mean annual temperatures of the district range between 37°C and 38°C. The coolest month is June and the hottest month if February.

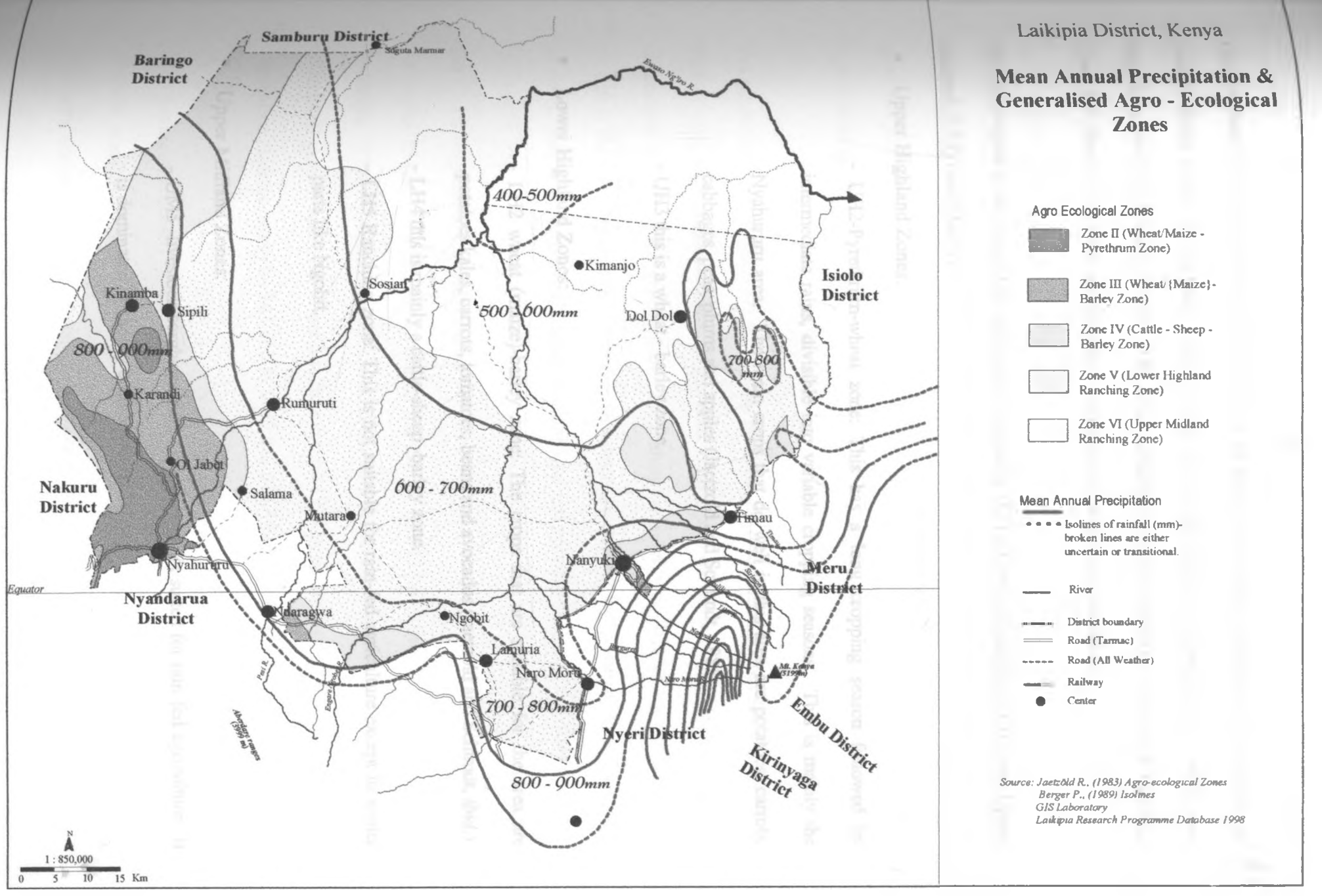

Laikipia District, Kenya
VEGETATION COMMUNITIES 1990
Legend
PHYSIOGNOMIC TYPE
FLORISTIC COMPOSITION
Urban
Human shelters
Small Scale Cropland Complex
Agriculture
Upland / Riverine Forest
Juniperus procera
Podocarpus
Olea europea
Acacia xanthophloea
Plantation Forest
Pinus radiata
Cupressus species
Degenerate Dry Upland Forest
Juniperus procera
Euclea divinorum
Leafy Bushland
Tarchonanthus
Rhus natalensis
Leafy Bushland and Thicket
Carissa edulis
Rhus natalensis
Euclea divinorum
Acacia drep. bushland
Acacia drepanolobium
Themeda triandra
Acacia seyal Bushland
Acacia seyal
Themeda triandra
Dwarf Bush Grassland
Acacia drepanolobium
Pennisetum mezianum
Grassland
Themeda triandra
Pennisetum mezianum
Open Acacia brevispica thicket
Acacia Brevispica
Arid Zone Acacia Bushland
Acacia nilotica
Acacia mellifera
Mpala Scarpline Vegetation
Croton dichogamus
Combretum molle
Bare Rock
Bare
Swamp
Cyperus papyrus
Cyperus immensus
0°45'N
0°30'N
0°15'N
Equator 0°
0°15'S
Mt. Kenya (5199 m)
Aberdare ranges (3999 m)
Ewaso Narok R.
Pesi R.
Ewaso Nyiro R.
Burguret R.
Naromoki R.
Nyiro Mtiru R.
Ontulili R.
Timau R.
Nanyuki R.
Likii R.
1 : 750,000
0 5 10 15 Km
Source: Laikipia Research Programme Database, Tatti S. W. 1990, own field investigations, Spot Satellite Imagery 1987/88, aerial photographs, Survey of Kenya topographical maps 1:50,000.
Laikipia Research Programme, 1999.

Vegetation: The original vegetation pattern is closely related to hydrology, soil and climatic conditions. The foothills of the mountains are covered with dense evergreen forests, and the vegetation becomes sparse and mainly consists of bushy grassland on the plateau.

The district has gazetted forests totaling 66,693 hectares and these are divided into administrative units. There are both indigenous forests and plantation forests for industrial purposes. The plantations consist of exotic trees. Mukogodo Forest is a wholly protective forest, composed mainly of bushes and scattered cedar trees. Most of the forests are state owned (about 95%) and are run by the Ministry of Environment and Natural Resources. They provide timber, wood-fuel, medicinal herbs and act as wildlife habitat (see Map 2).

Soils: There are three major soil groups on the Laikipia plateau, all of them with a moderate to high fertility. These are Red Brown Clay Loam Luvisoil, Dark Brown Clay Loam Phaezoms and Dark Grey to Black Clay Vertisoils and planosols. All the three types tend to become compact on the surface under heavy grazing. The removal of vegetation leads to increased soil and water erosion.

Agro-Ecological Zones: Laikipia falls in five agro-ecological zones. Zone 2 and 3 are referred to as high and medium potential land, which make 83 per cent (8,084 km^2) of the district's land area while the remaining 17 per cent is low potential and mainly non-agricultural. This zone is unsuitable for rain-fed agriculture because the rains are inadequate and unreliable. The Western part of the district is the most fertile and has been demarcated for small-scale mixed farming. Pyrethrum, wheat and barley are grown.


Laikipia District, Kenya
Mean Annual Precipitation & Generalised Agro - Ecological Zones
Samburu District
Baringo District
Isiolo District
Nakuru District
Nyandarua District
Meru District
Embu District
Kirinyaga District
Nyeri District
Equator
400-500mm
500 - 600mm
600 - 700mm
700 - 800mm
800 - 900mm
800 - 900mm
700-800 mm
Kimanjo
Sosian
Kinamba
Sipili
Karandi
Rumuruti
Dol Dol
Ol Jabet
Salama
Mutara
Timau
Nyahururu
Nanyuki
Ndaragwa
Ngobit
Lamuria
Naro Moru
Agro Ecological Zones
Zone II (Wheat/Maize - Pyrethrum Zone)
Zone III (Wheat/ (Maize) - Barley Zone)
Zone IV (Cattle - Sheep - Barley Zone)
Zone V (Lower Highland Ranching Zone)
Zone VI (Upper Midland Ranching Zone)
Mean Annual Precipitation
Isolines of rainfall (mm)- broken lines are either uncertain or transitional.
River
District boundary
Road (Tarmac)
Road (All Weather)
Railway
Center
Source: Jaetzold R., (1983) Agro-ecological Zones
Berger P., (1989) Isolines
GIS Laboratory
Laikipia Research Programme Database 1998
N
1 : 850,000
0 5 10 15 Km

The southern part of the district is composed of less agriculturally productive clay soils, as rainfall drops further to the east. The northern part of the district is generally dry with poor sand soils with the lowest rainfall. The most suitable economic activity is livestock farming. There are Maasai, Turkana and Samburu communities practicing nomadism.

The Agro-ecological zones fall into upper highlands (UH), Lower highlands (LH) and Upper midland (UM) (see Map 3).

- Upper Highland Zones:
  - UH2-Pyrethrum-wheat zone: This has a long cropping season followed by intermediate rains, divisible into variable cropping seasons. This is mainly the Nyahururu area. The main crops that do well in this area are potatoes, carrots, cabbages, peas, plums and apples (Jaetzold and Schimdt, 1985).
  - UH3 this is a wheat - barley zone.

- Lower Highland Zones:
  - LH2 wheat (maize)-barley zone: The crops that are suitable for the area are potatoes kales, carrots, tomatoes, beans and avocados (Jaetzold and Schimdt, *ibid.*).
  - LH4 this is mainly a cattle-sheep -barley zone.
  - LH5 Ranching zone: This is not suitable for rain-fed agriculture except in wetter parts like Ngobit.

- Upper Midland Zones:
  - UM5 -livestock-sorghum zone. This area is not suited for rain-fed agriculture. It is dominated by thorny bush Savannah.

3.3 Water Resources

The surface water resources in the semi-arid district are limited and highly dependent on the natural conditions of the catchment areas of Mt. Kenya and Aberdare Ranges forest belts. The ground water potential depends on the nature of the water bearing rock (aquifer) systems in place. The regional aquifer system covers most areas that are underlain by volcanic rocks. The regional aquifer systems are extensive and are connected whereas the local aquifer systems are limited in extent and mainly subsist as isolated reservoirs. It is estimated that the district has up to 120,220 million cubic meters of recharge water annually although most of it is lost as base-flow to springs and rivers.

The southwest of the district has the highest potential for forestry and mixed farming due to its high altitude, especially around Marmanet area. This is also the most densely settled area. The eastern part is suitable for grazing while the plateau between lying Rift Valley and Mt. Kenya massifs is the ranching region. The rivers also determine human settlement, as they are sources of water, both for livestock and human consumption and possible irrigation activities.

3.4 Demographic Characteristics

According to the 1989 population census the district had 218,957 people excluding Nanyuki Township. This represents an increase of about 60.8 percent over a period of ten years and an intercensal growth rate of 4.56 per annum over the 1979 population of 134,524. The district's population is projected to be 345,460 in 1999 and 378,447 in 2001.

The population density and distribution is greatly influenced by topographical features, climatic conditions, and patterns of land use and general concentration of other off-farm economic activities within different administrative divisions.

Table 3.1: District Population Projections

YEAR	PROJECTION
1989	218,957
1997	315,349
1999	345,460
2001	378,447

Source: District Development Plan, 1997

The population is unevenly distributed ranging from 19.2 persons per KM^2 in Mukogodo to 62.9 persons per KM^2 in Ng'arua as compared to the overall district density of 26.7 persons per KM^2 in 1990. Rumuruti and Ng'arua have the highest population due to the cultivatable land hence higher economic potential than the other divisions. These are followed by Central, which apart from being the second largest division with suitable for land for agriculture has the largest urban centre; Nanyuki town, which is the district, headquarters. Mukogodo Division has the least population in the district and is the driest in the district with minimal economic activities. The community solely depends on livestock.

Ng'arua and Mukogodo divisions have the largest forest reserves in the district. This part of the land under the forest reserves, which is also the most productive within the divisions, supports a small number of people. Ng'arua has the highest population density because it has the best quality of land in the district, with much higher rainfall. Immigration into the district is contributing to increasing population densities because of the many large farms which have been subdivided recently into smaller holdings (GoK, 1993).

Table 3.2: Population and Population Density by Division

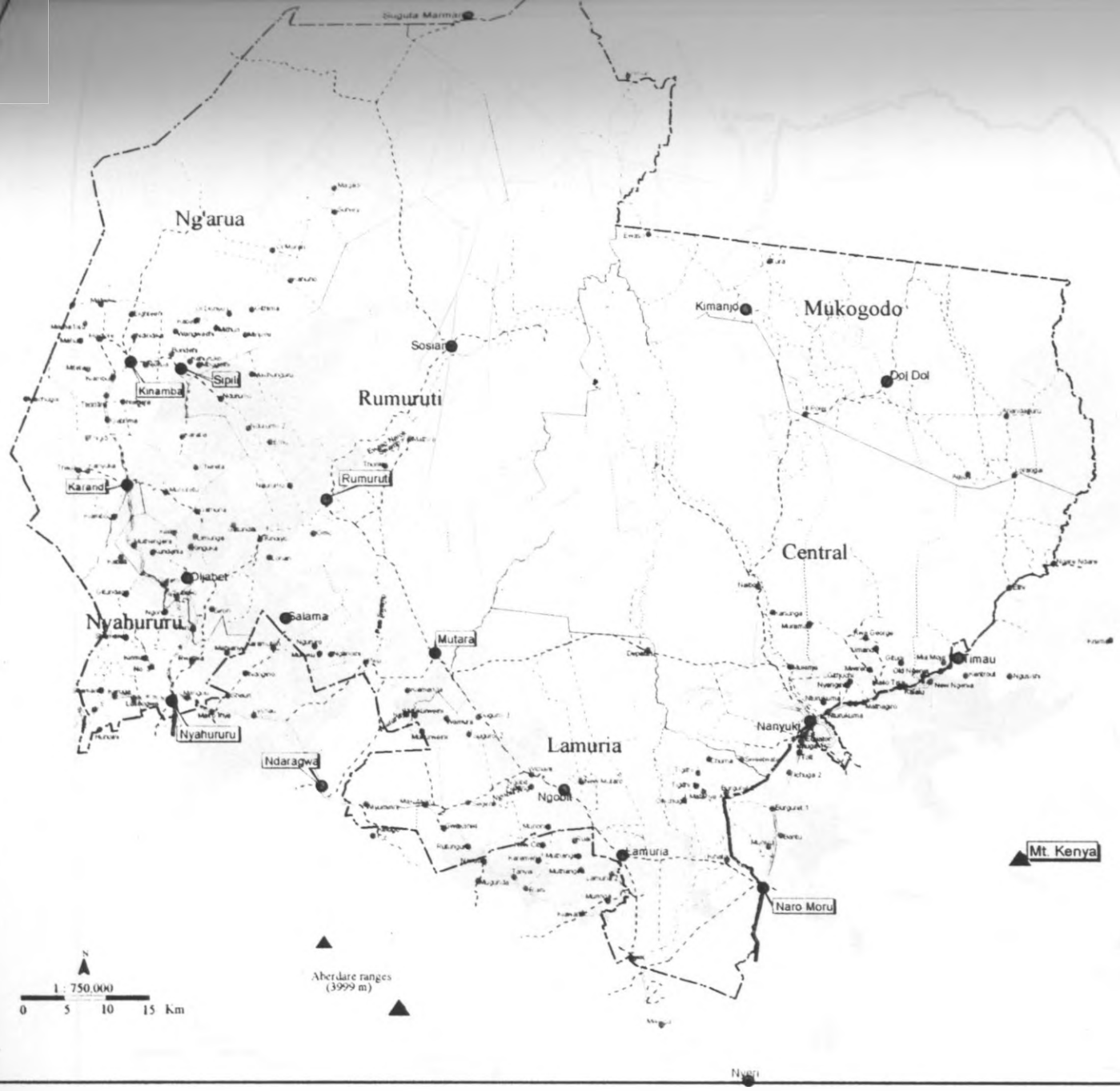
DIVISION	POPULATION (1997)	AREA (SQ.KM)	DENSITY (1997) PERSONS/KM^2
Rumuruti	92,089	2919	32
Ng'arua	94,922	1643	58
Central	76,701	2355	33
Lamuria	35,913	1116	32
Mukogodo	15,723	1129	14
Total	315,349	9162*	34

Source: District Development Plan, 1997 * Excluding Nyahururu Municipality

Map 6

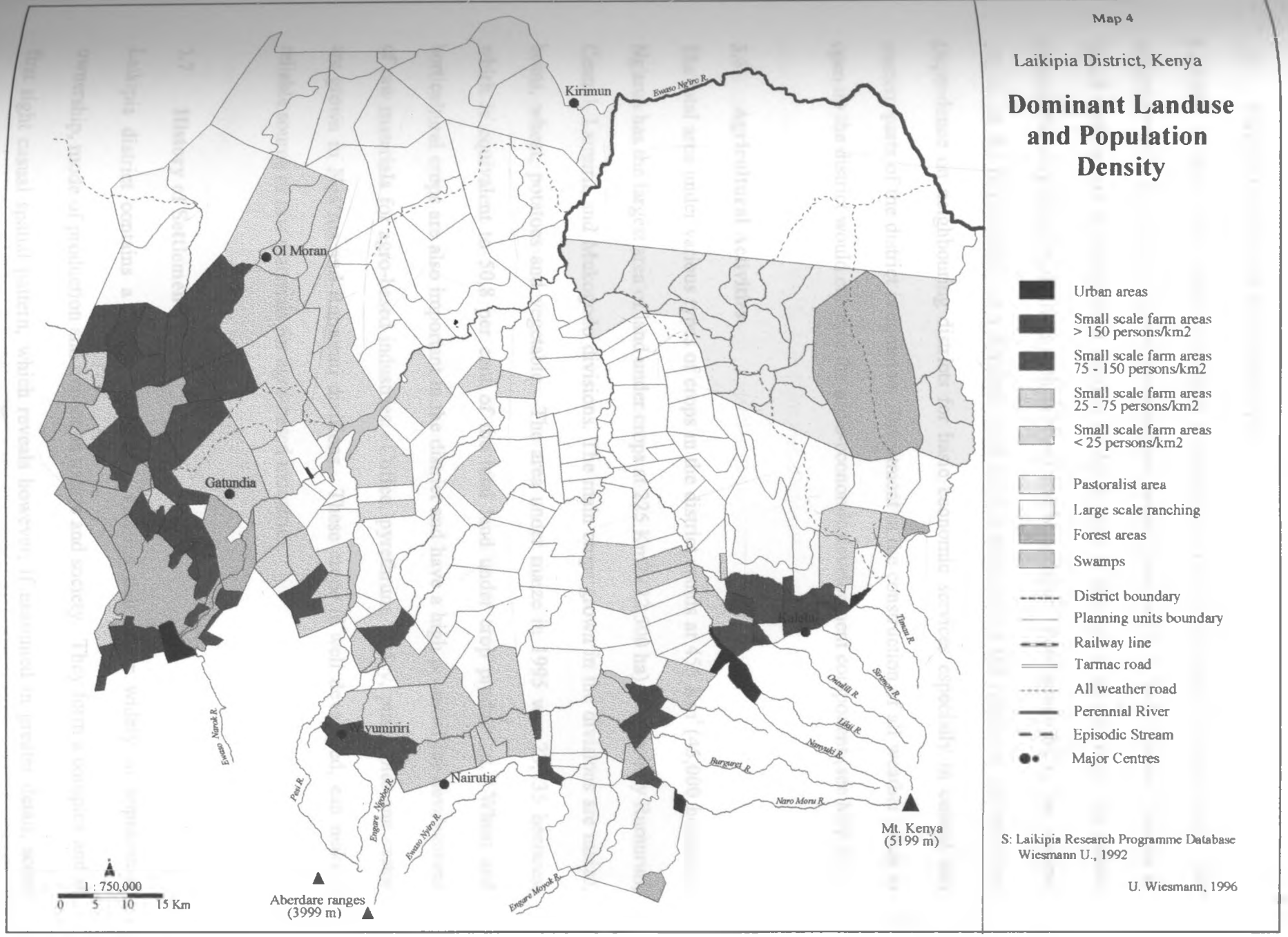
Road Network & Central Places

Laikipia District



- Major Centres & Divisional Headquaters
- Other Centres
- All Weather Loose Surface
- Dry Weather
- Railway
- Tarmac

Source: Laikipia Research Programme Database, 1998


Map 4
Laikipia District, Kenya
Dominant Landuse and Population Density
Kirimun
Ewaso Ng'iro R.
Ol Moran
Gatundia
Nyumiriri
Nairutia
Kalotu
Mt. Kenya (5199 m)
Aberdare ranges (3999 m)
Ewaso Narok R.
Pesi R.
Engare Ngobet R.
Ewaso Nyiro R.
Engare Moyok R.
Timau R.
Sirimon R.
Ontulili R.
Lilgi R.
Naenyuki R.
Burguret R.
Naro Moru R.
1 : 750,000
0 5 10 15 Km
Urban areas
Small scale farm areas > 150 persons/km2
Small scale farm areas 75 - 150 persons/km2
Small scale farm areas 25 - 75 persons/km2
Small scale farm areas < 25 persons/km2
Pastoralist area
Large scale ranching
Forest areas
Swamps
District boundary
Planning units boundary
Railway line
Tarmac road
All weather road
Perennial River
Episodic Stream
Major Centres
S: Laikipia Research Programme Database Wiesmann U., 1992
U. Wiesmann, 1996

3.5 Physical and Social Infrastructure

Laikipia is one of the least developed districts in terms of physical infrastructure. The communication network comprises roads that are largely impassable in wet weather. Access to major trading and administration centres of the district is through a tarmac road that passes through the neighbouring districts such as Nyeri and Nyandarua. Poor accessibility has adverse effects on the development of a dynamic rural market economy of the resources and services. Dependence on neighbouring districts for basic economic services especially in central and western parts of the district is common. Investment in the construction of all weather roads to open up the district would enhance the socio-economic development component (see Map 5).

3.6 Agricultural Activities

The total area under various types of crops in the district stands at 455 Km^2 (45,000 hectares). Ng'arua has the largest area of land under crops at 225 Km2 (22,500 ha) followed by Rumuruti, Central, Lamuria and Mukogodo divisions. The main crops grown in the divisions are maize, beans, wheat, potatoes and vegetable. The area under maize in 1995 was 23,135 hectares, which is equivalent to 50.8 per cent of the total land under crop production. Wheat and horticultural crops are also important in the district and have a high potential for development of raw materials for agro-based industries. Coffee, pyrethrum, barley, pineapples and castor are grown in Nga'rua and Rumuruti divisions. These crops if well developed, can make a reliable source of raw materials for agro-based industries.

3.7 History of Settlement

Laikipia district contains a range of land use systems that differ widely in appearance, ownership, mode of production and impact on nature and society. They form a complex and at first sight casual spatial pattern, which reveals however, if examined in greater detail, some fundamental changes that have taken in the utilisation of land in Kenya in the last decades.

During colonial times when Laikipia district formed part of the so- called scheduled areas, three main categories of land ownership could be found. The most important was large scale European owned ranching which covering approximately 80% of the area, pastoralism covered 7.3% of the land while forest reserve land which was government property occupied 8.8% of the area. In 1980s the pattern has undergone remarkable change as a result of transition.

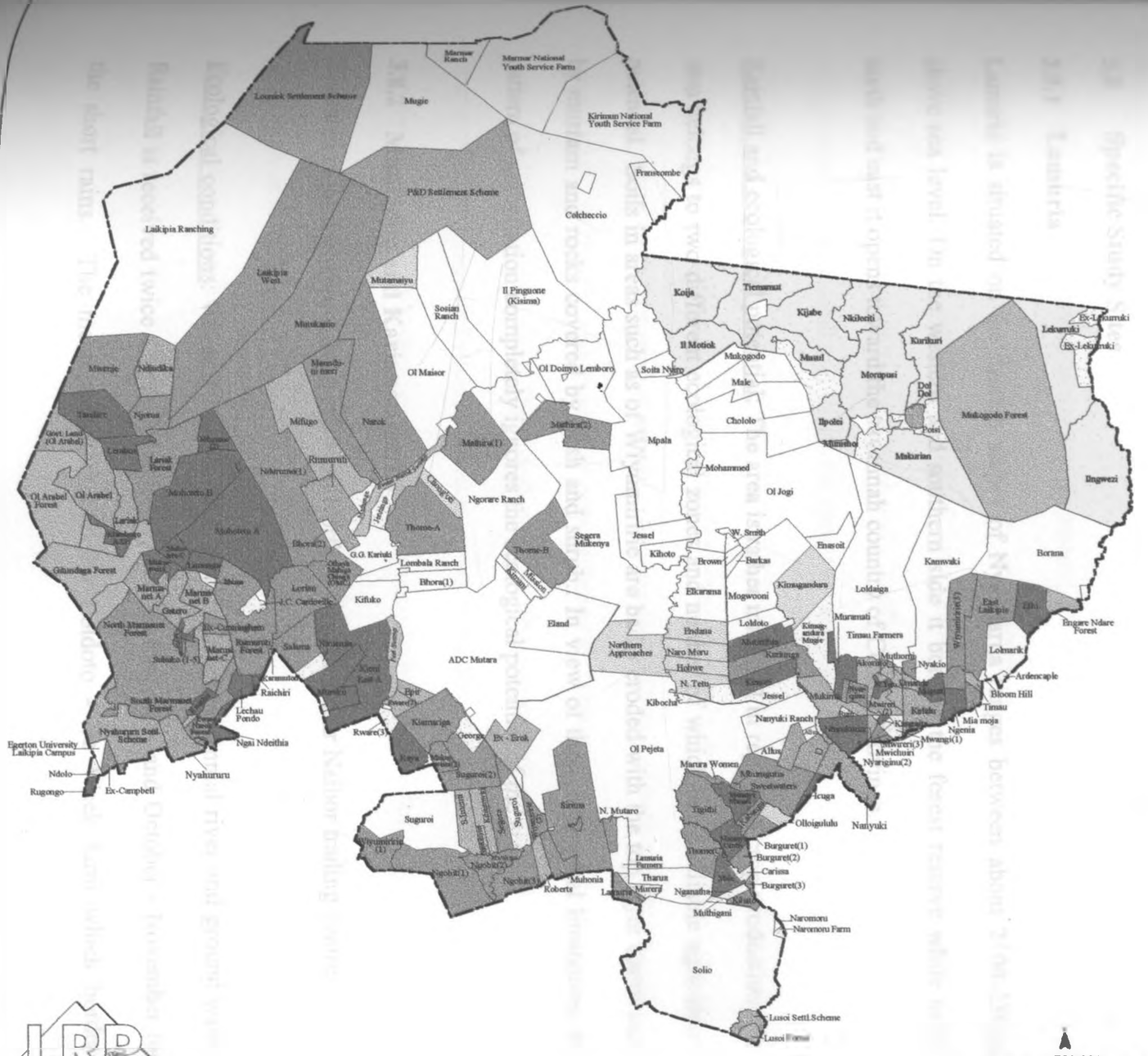
Small scale farming in Laikipia as in all other parts of the former white highlands has been made possible by the political changes that took place in connection with Kenya's independence in 1963, which opened up areas previously closed to non-European settlement. A significant proportion of the former European dominated farming area, comprising 32.4% of the district area has been converted to small-scale farming (Kohler, 1987).

The first category of small scale settlement schemes were set up on land purchased by the government from the settlers with the aim of subdividing it and settling the landless African population(Okoth-Ogendo, 1981). These schemes cover 2.6% of the area. A second category of small-scale farms results from land transfer to self help groups organized as companies or co-operatives. The aim was to subdivide the large farms into smaller plots among the members depending on their financial contributions. This category covers 24.3% of the area and therefore constitutes the most important group within the Africanised areas. The land use patterns comprising crop and animal production and the density of settlement varies widely (see Map 6).

Map 5

Laikipia District, Kenya

LANDUSE & LAND OWNERSHIP 1996



Legend

- Urban areas
- Government Land & Outspans
- Forest Reserve (Relatively intact)
- Disturbed Forest Reserve

Small Scale Settlements

- Government Settlement Schemes Set before1970
- Government Settlement Schemes in the Process of Subdivision.
- Small Scale farms (Purchased between 1960-69)
- Small Scale farms (Purchased between 1970-79)
- Small Scale farms (Purchased between 1980-89)
- Small Scale farms (Purchased between 1990-96)

Large Scale

- Large Scale Ranches
- Large Scale Farms

Mukogodo Pastoral area

- Mukogodo Pastoral area (Communal Ranching)
- Mukogodo Pastoral area (Private Ranching)

1 : 750,000

0 5 10 15 Km

Source: Laikipia Research Programme, 1997

Laikipia Research Programme

Table 3.3: Land-use patterns, Laikipia District

LAND USE TYPE	KM^2	%
Large-scale	2565	26.3
Small-scale	5540	56.9
Forest Reserve areas	842	8.6
Pastoralist area	702	7.3
Towns and local markets	80	0.8
Others	11	0.1
Total district area	9740	100

Source: District Development Plan, 1997

3.8 Specific Study Sites

3.8.1 Lamuria

Lamuria is situated on the eastern slopes of Nyandarua ranges between about 2100-2300m above sea level. On the western and southern side it borders the forest reserve while to the north and east it opens toward the savannah country of Central Province.

Rainfall and ecological potential: The area is rather marginal in regard to crop production. The area belongs to two different ecological zones and neither of which has a reliable agricultural potential. Soils in areas such as of Wiyumiririe are badly eroded with the top layer comprising by murram and rocks covered by bush and shrub.: In view of these ecological limitations the pattern of parcellation completely ignores the ecological potential of the area.

3.8.2 Mutirithia and Kariunga (M/K)

This area is located approximately 20 km North of Nanyuki, near Naibor trading centre.

Ecological conditions: Water is from three sources, rainfall, perennial river and ground water. Rainfall is received twice a year - March-May for the long rains and October - November for the short rains. The mean annual rainfall for Loldoto - De Week farm which borders

Mutirithia/Kariunga to the North is 655 mm falling over an average of 70 days (period 1951-90). The scattered rainfall pattern however reduces the effectiveness of the rainfall for plant growth. The collection of run off water is of potential interest to Agriculture. In Kariunga a dam has been constructed across an episodic river course. Ontulili and Nanyuki rivers bypass the study area, M/K to the northern borders. Given the high level of illegal water abstractions in the district, the river water resources are already over exploited. Nevertheless, there is a certain potential for storing river water during flood flow.

According to the Ministry of Water Development (1981), the water quality is in most cases not a limiting factor, but locally high fluoride concentrations and salinity could reduce the suitability for domestic purposes. Irrigated farming cannot be recommended over wide areas because the borehole water yields are generally insufficient. There are two boreholes in M/K, one of which is operational and in use for domestic water supply.

In the study area, the length of the crops growing period is determined by the amount of available water. The temperature are not a limiting factor to crop growth except for some rare frosts (FAO, 1977). The risk factor for crop failure is an appropriate criterion for the rain-fed agriculture in the study area. The risk factor not only incorporates ecological parameters but also economic parameters such as whether or not a family is capable of compensating for a certain risk etc. In M/K the risk factor is substantially below the limit, which means that in 50% of the growing seasons the farmers run the risk of crop failure. In addition to the climatic risk it was observed that in good years, like in 1994, wildlife could destroy quite a large part of the harvest, leaving crop farmers with no other option than to engage in charcoal burning to make minimal livelihood.

Soils: The dominant landscape feature is the extensive Laikipia plateau which is about 1790m above sea level, gently sloping and more or less parallel to the dip of the strata. This has influenced the drainage pattern of the area, with the river valleys dissecting the area in a more or less parallel manner. The river valleys of Timau and Ontulili rivers have developed a deep on shaped gorge.

The soils on the plateau are of medium to heavy texture, imperfectly drained, black to very brown. On the steep slopes the soils are shallower, tending towards rendicinas in character, but variable owing to the varying nature of the state on which they lie.

The main effect of soil erosion is to reduce the soil depth and hence its capacity to store the water and nutrients which plants requires for growth. Soil erosion depends on catchment size and shape as well as soil type, vegetation cover and management practices. In addition to physical factors, many social and economic a factors have contributed to soil erosion, the communal nature of much range land makes improvement difficult, since livestock owners have little incentive to manage the land better. The impact of population growth is greater in semi-arid areas because of the more delicate balance there between man and the environment. Increased felling of trees without replacement degrades the land further.

Vegetation: The dominant types of vegetation used on aerial photographs and observations on the ground are, reverie forests, leafy lowland bush and thicket, acacia and drepanolobium bush land and grasslands (Huber and Opondo, 1995).

History of settlement in M/K: After independence, Europeans settlers gradually withdrew from the ranches in Laikipia. Some ranches were sold to private individuals, others were bought by land buying companies. Some ranches continued as large-scale enterprises, others were sub-

divided into 100 or 1000 small farms of the small scale farming area. About 20% involved government settlement schemes and 80% settlement by private land buying companies. It is under this latter private land buying category that M/K falls.

The Rugutu Mutirithia farm-buying society was formed in 1964. Mutirithia farm was bought in 1968 by 400 members. The Kariunga Company was formed in 1968: the farm was bought in 1972. Mutirithia was managed as a company until 1979, but as a large scale ranch it did not make profit, Kariunga was managed as a co-operative company up to 1982, apparently with some profit. Mutirithia was divide into 10-acre plots in 1982 among 420 members; tittle deeds were issued in 1988. Kariunga was subdivided into 300 plots in 1984, no tittle deeds has been issued up to 1990. There is security of tenure and demarcation has taken place. However, it would seem that due to the slow settlement process only 10% to 15% of the area has been settled to date. Most of the land has reverted to communal use.

Infrastructure: There is lack of infrastructure development; water supply systems are either not available or in bad condition. Drinking water is scarce. Schools, roads and health infrastructures are either unavailable or in poor state. If such facilities were built with external resources, the impact and sustainability would be major concerns.

Population: The settlers in the Kariunga and Mutirithia areas of Segera Location, in Laikipia district, are Kikuyu people from Nyeri District. Those in Kariunga are mainly tea farmers from Magutu, Mathera Division and Gathuthi in Tetu Division. Those in Mutirithia are mainly from Mukurweini Nyeri, Kerichu and Kiganjo. Some of the farmers are former squatters, farmers' labourers and people evicted from gazetted forests. The settlers from Kariunga bought the land mainly for diversification into livestock and to make land available to be

inherited by their children. The settlers in Mutirithia are mainly landless people or people with little land and displaced people who failed to get land during the original demarcation in Nyeri.

In 1989, 60 plots were settled and the population stood at about 700 people. In 1991, 100 plots were settled and the population stood at about 1200. Between 1991 and 1994 a number of plots were abandoned due to problems with wildlife, insecurity, water and drought. In 1994 77 plots were settled and the population numbered about 550 (Huber and Opondo, 1995).

3.9 Conclusion

This section described the characteristics of the district. In order to make conclusions regarding the problem of the study based on the set objectives and the stated assumptions, this background of the area is crucial as it gives one the bearing regarding the kind of an area that one is dealing with. When one is seeking to understand the strategies of the small-scale farmers in Laikipia it is important to understand the characteristics of the area. From this description of the study area it is clear that immigrants from districts that are of a different agro-ecological setting inhabit the area and hence the resultant incompatibility between the strategies adopted for crop farming and the production. The farmers upon settlement had used the same strategies that they had used in the area of origin and the climate proved them wrong since the harvests were marginal if any. The area is classified as an ASAL region due to the low and erratic rain in the region. This means that the climate can hardly support rain fed agriculture yet the migrants in the district move into the area in search for agricultural land. It is therefore important to understand the survival strategies of the farmers as they try to adapt themselves to the area.

The fact that the land had been parceled into plots that were economically unviable is a fact that presents questions regarding the sustainability of the plots to support productivity and at

the same time guard against environmental degradation. The area has been undergoing tremendous land use changes occasioned by increased sub-division of the former large-scale ranches in the district. The trend is likely to rise given the increasing pressure on agricultural land in the neighbouring high potential districts.

The general conclusion regarding the area is that it is an area that is arid in the sense that rainfall is low and erratic. In addition the area is undergoing rapid land use transition. This being the situation on the ground, recommendations should fit in the situation so as to make the best of what is already on the ground. However all the suggested policies should augur well with sustainable development.

CHAPTER FOUR

EXTERNAL AGENCIES INFLUENCE ON SMALLHOLDER CROP PRODUCTION IN LAIKIPIA

4.1 Actors in Smallholder Crop Production Arena

4.1.1 External Actors

In the crop production sector there are external actors who through various ways influence the farming strategies of local actors. The external actors are mainly institutions that are engaged in agricultural research and extension. The institutions are either government, quasi-governmental or non-governmental. In Laikipia, they include: Arid and Semi-Arid Lands Programme Laikipia (APL) especially the Applied Research Unit (ARU) and Ministry of Agriculture Livestock Development and Marketing (MoALDM) particularly the departments of Soil and Water Conservation and the department of Crop Production. These institutions aim at improving the agricultural practices used by the farmers in their areas of operation. They reach out to the local actors through various ways such as monthly workshops, On-station open days, demonstrations and field days.

(a) APL - Applied Research Unit (ARU)

The Applied Research Unit (ARU) of the APL is instrumental in promoting drought-escaping crop in Laikipia District. This is an agriculture-based technological transfer arm of the ASAL Development Programme that was established in 1994. The broad mandate of ARU is to introduce Drought Escaping Crops (DECs) under low external input farming systems and to optimise farm produce utilisation through improved preparation, preservation and storage methods. The mission of the unit is to help improve the performance of farming systems and land use practices in Laikipia District. This is done by addressing the adaptive research needs of the productive sector that is agro-forestry, agriculture and livestock production in collaboration with researchers, line ministries, NGOs and farmers. By focusing on the

productive sector the unit attempts to enhance strong farmers - researcher -extension linkages and innovations. The unit encourages adoption of technical options that enhance self-reliance and self-sufficiency of farmers rather than dependency on external inputs among small-scale farmers and pastoralists.

The aim is to improve the living standards of the small-scale farmers. They have therefore introduced various packages including supply of Drought Escaping Crops (DECs), agro-forestry packages and fruit trees to the farmers. ARU provides assistance to farmers jointly with the line ministries such as the MoALDM. It mainly collaborates with MoALDM particularly the soil and water conservation department and the crop production department. The unit has developed a network of local community facilitators (LCFs). It has adopted a focal point approach that is people centred in the delivery and evaluation of different technological packages.

ARU has introduced its activities in all divisions of Laikipia district. However, ARU's activities have been concentrated in M/K area of Central division with DECs, fruits, and woodlots being the main packages transferred to the farmers. Since 1995, ARU has been in contact with the area farmers among whom they have introduced the new crops to and consulting with them where necessary regarding the packages. In 1996 ARU widened its scope of operations to include socio-economic, food utilisation, processing and marketing divisions.

In examining the extent of agricultural extension services to the farmers in M/K and Lamuria, the most important kinds of linkages under consideration are the research-farmer-extension linkage. The research-farmer linkage has linked the farmer directly to research institutions and takes the form of on-farm trials. ARU sources for technologies from within research institutions mainly Kenya Agricultural Research Institute (KARI), Kenya Forest Research

Institute (KEFRI), local non-governmental organisations (NGOs), International research institutions and local universities. The research-farmer-extension linkage was manifested in field days and demonstrations while the research extension linkage took the form of monthly workshops for the extension agents.

These external actors were the main sources of information to the farmers. In the DECs sub-sector, ARU was the primary source of information in collaboration with MoALDM. Since the study is limited to crop production sector, the analysis will mainly focus on institutions that either directly or indirectly promote crop production.

(b) Ministry of Agriculture Livestock Development and Marketing (MoALDM)

This is the Ministry charged with overseeing the agricultural issues in Kenya. The Ministry is divided into three departments namely: the department of crop production. The Department of Animal Production and the Veterinary Department. Under the Crop Production Department, the Extension Department is charged with the responsibility of providing agricultural extension services and advice to farmers.

(c) Provincial Administration

These are the civil servants who are engaged in overseeing the central government activities in their areas. They include the chiefs and the sub-chiefs. They pass agricultural messages in their barazas but this is mainly done through inviting agricultural extension officers to their barazas and letting them address the farmers.

(d) Farmers-cum-extension officers

These are those external actors who reside in the study area and hence are both local actors and also external actors.

(e) The contract /contact farmers

These are local actors who are considered to be external in the case where they visit other farmers and act as the primary source of information to them.

Table 4.1: External agencies' presence and frequency according to field response

	MUTIRITHIA /KARIUNGA		LAMURIA	
Agency	No of respondents	%	No of respondents	%
ARU /APL	27	67.5	22	55
MoALDM	7	17.5	15	37.5
Govt. (Provincial Administration)	0	0	3	7.5
Contact farmer	2	5	0	0
No response	4	10	0	0
Total	40	100	40	100

Source: Field survey, 1998

In Lamuria 55% of the farmers interviewed are aware that ARU /APL institutions are responsible for the new drought escaping crops introduced in the area, while 37.5% associate introduction of new crops with MoALDM, 7.5% cited the area chief and sub-chief as the persons associated with the new crops. These responses indicate that ARU /APL is the main agency associated with the transferring of the recently introduced crops in the study area. In M/K, of the farmers who responded, 67.5% reported that ARU /APL was the agency responsible for the recent introductions of new crops in their area. 17.5% mentioned MoALDM, while 5% mentioned the contract farmer. In aggregate therefore, it is evident that ARU /APL are perceived as the main agencies for promoting drought escaping crops in the

area either directly or indirectly by introducing technology that in the long run enhances crop production and the general well being of the farmers. While the external agencies in the area worked in collaboration with one another, it is evident that ARU /APL were popular among the farmers as a result of their primary role in disseminating the drought escaping crops. The MoALDM worked in line with ARU /APL by assisting in the dissemination of technology that enhances crop production. These include organic farming whereby double digging, basket-farming, compost making and natural pesticides technologies are disseminated to the farmers. Regarding water conservation the farmers are introduced to water harvesting techniques mainly through the construction of water pans on their farms. The majority of the farmers had taken up double digging farming technique and water harvesting technique through the building of water pans. The external agents reach out to the farmers through contacts of various kinds such as on- farm demonstrations, field days, individual farmer approach, group approach, farmer training courses, on-farm trials and through visits by farmers to the external agents.

The provincial administration is involved through distributing seeds to the farmers through the chiefs and sub-chiefs. In addition, farmers learnt the new technology from one another during farmer training courses or during study tours. Such farmers in turn became secondary sources of information to other farmers.

4.1.2 Local Actors

The local actors operating in the area are of three main categories, that is, ordinary farmers, contact farmers and contract farmers. These actors are the recipients of the introductions by the external actors. This is mainly through extension-farmer linkage whereby they meet during field days, demonstrations, chiefs' *barazas*, farmers' training courses and farmer tours. The sample size consisted of 80 local actors who were interviewed to determine the impact of the extension services in their farming activities.

4.2 Characteristics of the Smallholder Farmers

It is crucial to understand the background information of the actors in the local scene so as to be able to fully grasp the circumstances under which they operate in order to understand how such circumstances affect them in their bid to adopt external technology. These factors influence the way farmers set priorities regarding production issues. When the farmers make their decisions as to whether or not to adopt a new technology, the basic concern is survival and hence they evaluate the package presented to them and in their own way make decisions first and foremost ensuring that their survival is not threatened. The external agents should not therefore assume that they are operating in a vacuum as they attempt to introduce new farming techniques to the farmers. It is therefore important to understand the factors that influence the farmers in making decisions on the innovation to adopt.

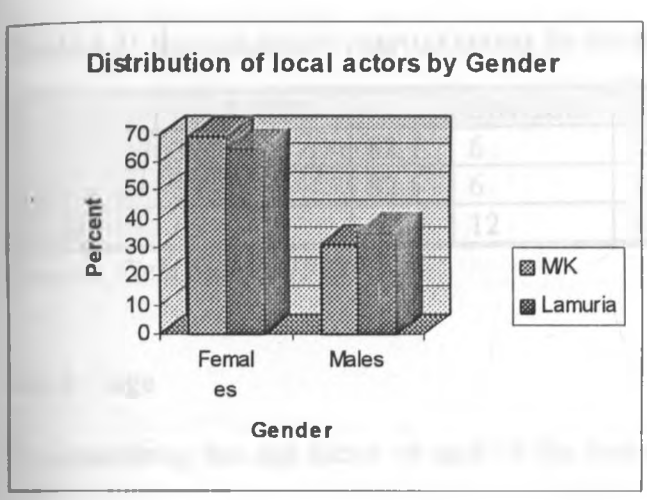
The local actors of the three categories mentioned above had varying characteristics in terms of the variables tested in the study. The local actors (small-scale farmers) are heterogeneous in their attributes and this is an important factor that the external agents should bear in mind. The assumption by some external agents that they are dealing with a homogenous population makes their transfer of innovations a failure. The diversity in the characteristics of the farmers is one of the factors that explain why adoption of external knowledge tends to vary among farmers in the same region. These characteristics of the local actors are addressed in the section below.

4.2.1 Gender Categorization

During the field study the household head or his spouse was the respondent. More female respondents were available during the survey. This could probably be explained by the fact that men tended to be away either engaged in off-farm employment away from home or within the home area but return in the evening. The husbands could be engaged in paid employment by offering casual services to other farmers especially the large-scale farms and those

practicing commercial agriculture. In total 67.1% 0f the respondents were female while 32.9% were males. Most females attended to their farms at home hence were available during the survey. In M/K most of the males were away engaged in charcoal burning while Lamuria, most of the males attend to their livestock or are engaged in off-farm employment.

Figure 4.1



Source: Field Survey 1998

For the analysis, it is important to understand the gender balance of the respondents since it is one the factors considered while examining the cultural aspects of the adoption of innovations. In the majority of the cases the male tended to be the household head who made most of the decisions.

4.2.2 Respondents' Marital Status

During the field survey, 82.3% of the respondents interviewed were married, 15.2% single, while 2.5% were widowed. This is an important aspect to be considered when addressing the issue of decision making in the household since it is important in influencing adoption of new technology. In households where respondents are married, the issue of decision making is crucial for one has to establish who makes the decision and whether the decision maker

facilitates the adoption of new technology or is a hindrance to the adoption. Therefore in a bid to examine the extent of influence of the external actors on crop production strategies, it is important to focus on decision making depending on who is available when innovations are introduced. In addition, it is also important to determine whether there is a mutual understanding between the spouses or whether it is a just one member who makes decisions.

Table 4.2: Respondents' marital status by study site

	MARRIED	%	SINGLE	%	WIDOWED	%	TOTAL
M/K	32	82.1	6	15.4	1	2.6	39
Lamuria	33	82.5	6	15	1	2.5	40
Total	65	82.3	12	15.2	2	2.5	79

Source: Field Survey 1998

4.2.3 Age

In considering the age factor in each of the two areas, variations are evident. In M/K the age bracket between 31-40 years had most respondents representing 38.6% followed by 41-50 years category with 28.2%; 41-50 years with 17.9% and 18-30 years category with 15.4% while below 18 category had no representation in the area. On the other hand, in Lamuria, those respondents in the category 41-50 years were the majority representing 42.5%, 31-40 years representing 22.5%, above 50 years representing 22.5%, 18-30 category representing 7.5% and below 18 years representing 5%. Most of the farmers migrating to Laikipia were relatively young. Most of them had opted to settle on their own land especially because land was scarce in their areas of origin.

Age is an important parameter in understanding the influence of external intervention on the small-scale farmers. Studies have shown that the elderly people tend to be conservative about their way of life unlike the younger people who are dynamic in their worldview. The external agents should not just assume that the farmers are in need of innovations or that and they are

eagerly waiting for innovations to be introduced or that their problem could only be solved by the introduction of new technology. Questions that can be asked are: what is the average age of the target community; how has their response been in the past to new technology. With such questions in mind one can be able to identify entry points in the community.

Table 4.3: Respondents' age category

AGE CATEGORY	M/K	LAMURIA	AVERAGE
Below 18 years		5 (2)	2.5 (2)
18-30 years	15.4 (6)	7.5 (3)	11.4 (9)
31-40 years	38.6 (16)	22.5 (11)	30.4 (29)
41-50 years	28.2 (11)	42.5 (17)	35.4 (28)
Above 50	17.9 (7)	22.5 (9)	20.3 (16)
Total	100 (40)	100 (40)	100 (80)

Source: Field Survey 1998

4.2.4 Education Level

Of the farmers interviewed during the field survey, 67.1% of them have attained a primary level of education, 15.2% have had no education, 15.2% have attained a secondary level of education, while 2.5% have attained post-secondary level of education. The level of education is a major variable in evaluating adoption of extension services for the general assumption is that the higher the level of education, the more the chances of adoption of new technology. High level of education is assumed to open up ones mind to the dynamic nature of life hence non-conservative attitude toward new ideas. It is with this background that the education of the respondents is being examined to establish whether there is any relationship between education and rate of adoption of innovation. The majority of the respondents are literate since they can read and write having gone up to the primary level of education.

Table 4.5: Respondents' education level by area

CATEGORY	M/K	%	LAMURIA	%	TOTAL	%
No education	8	20.5	4	10	12	15.2
Primary	26	66.7	27	67.5	53	67.1
secondary	5	12.8	7	17.5	12	15.2
post secondary	0	0	2	5	2	2.5

Source: Field Survey. 1998

4.2.5 Average Household Size and Income

It was established during the field survey that the average number of siblings per household is six. Some of the children are living with their parents and attend school or stay at home while others are away from home mainly engaged in economic activities but assist their parents financially. The average rural household is 6 members (Welfare Monitoring Survey, 1994). It is important to understand the family sizes so as to have an idea as to how much food a family needs. The assumption is that the larger the family the higher the food requirements and hence adoption of extension services. One cannot therefore examine the influence of extension services without looking at the population one is attempting to change.

On average one member of each family was working. However, it was established that most of the children who were engaged in economic activities in most families were the male members. Most females would stay at home after the primary level of education while males would engage themselves in casual jobs either in the neighbourhood or away from home. The level of dependency was found to be high since there were many children who were not working and dependent on their parents for survival.

Income was a quite varied within households. The main source of livelihood as was established from the field survey is the farm. It was found that the farmers often sold their

produce even when it was not sufficient for their food requirements so as to raise money for urgent needs in the family.

However there are other sources of income besides the farm which are:- micro-enterprises located at the trading centres, casual work in large scale farms or in farms of the well to do small scale farmers especially those engaged in commercial farming, charcoal burning. Others supplement their income from formal employment either in either the public or the private sectors. For the purposes of this study, the average household income was arrived at by considering the main income generating activities as established from the field. These are:- livestock production in Lamuria which mainly consists of dairy cattle and charcoal burning in M/K. In M/K the average charcoal production per week was 20 bags that could fetch between Ksh. 2,000 – 3,000 per month. In Lamuria the average milk production available for sale was five 700 ML bottles and each fetches an average of Ksh. 18 thus giving an income ranging between KSh. 2,500 – 3,000 per month.

In addition to farm and off-farm incomes, it was established that in some households, accounting to 40% of the total respondents they had close links with relatives either living in areas of origin or working elsewhere including Nairobi. Through such links, it was possible for the relatives to remit financial assistance to their families in Laikipia and this added on to the family sources of income.

This discussion has shown the distribution of the main sources of household income. It is evident that though the farm production tends to be marginal in most cases, it is still the leading source of household income. The implication is that if the farmers accept to grow the drought escaping crops, the in-farm income could be increased.

From the field results, it is clear that farm income accounts for 38% of the total income sources, charcoal burning accounts for 15%, casual work accounts for 20%, while off-farm income accounts for 18% and working relatives account for 9%.

The average income established from the analysis is higher than the national poverty line average income of Ksh. 978.00 per household in the rural areas. This however does not mean that the income of the farmers is sufficient even if it is above the national poverty line.

4.3 Settlement History and Land Sizes

From the field survey, it was established that the farmers did not settle in Laikipia District at the same time. In M/K the settlements were from the late 1980s while in Lamuria most settlements were in the 1970s. The implication is that those farmers who settled earlier have already established themselves in terms of the economic activities and this has an effect on the adoption of innovations.

Table 4.6: Settlement trends

YEAR OF SETTLEMENT	M/K	LAMURIA
1963-1970	3 (7.7%)	-0
1971-1975	3 (7.7%)	-0
1976-1980	-0	8 (20%)
1981-1985	3 (7.7%)	11 (27.5%)
1986-1990	16 (41%)	9 (22.5%)
1991-1995	13 (33.3%)	8 (20%)
1996-1997	1 (2.6%)	4 (10%)
Total	39 (100%)	40 (100%)

Source: Field Survey 1998

The farmers had migrated to Laikipia in search of land for cultivation since there was land scarcity in their areas of origin. They acquired the land mainly through private land buying companies. The plot sizes fragmented from large scale farms did not take into consideration

the carrying capacity of the land so that minimum plot sizes would have been based on minimum plot sizes required to guarantee specified levels needed to maintain a given family bearing in mind ecological potential. The major consideration was ability to pay for minimum plot size based on cost of former European farms. Consequently, those who were able to purchase big portions of land got it while those who could not afford big plots settled for smaller ones. Laikipia district falls under arid and semi-arid conditions and hence not suitable for rain fed crop production, therefore, agricultural potential of the land ought to have been the priority criteria in the sub-divisions. From the field survey it was established that the average land size in M/K was 8 acres while in Lamuria the average land size was 4 acres. It was found that those who had smaller pieces of land had utilised most or all the land for farming purposes while those with larger pieces of land had left bigger portions idle. In M/K the land sizes were as large as 10 acres for most farmers while in some parts of Lamuria, the plot sizes were as small as 2 acres.

4.4 Changing Land-size under crop versus Extension Packages' Adoption

The land size is an important factor when it comes to issues of adoption of new technology since it is difficult to convince those farmers with small plots to set aside any piece of land for experimenting on a new crop. From the study it was found land size had a strong relationship with the rate of adoption. In those areas where farmers had larger pieces of land lying idle, such farmers were willing to increase the land under crop production.

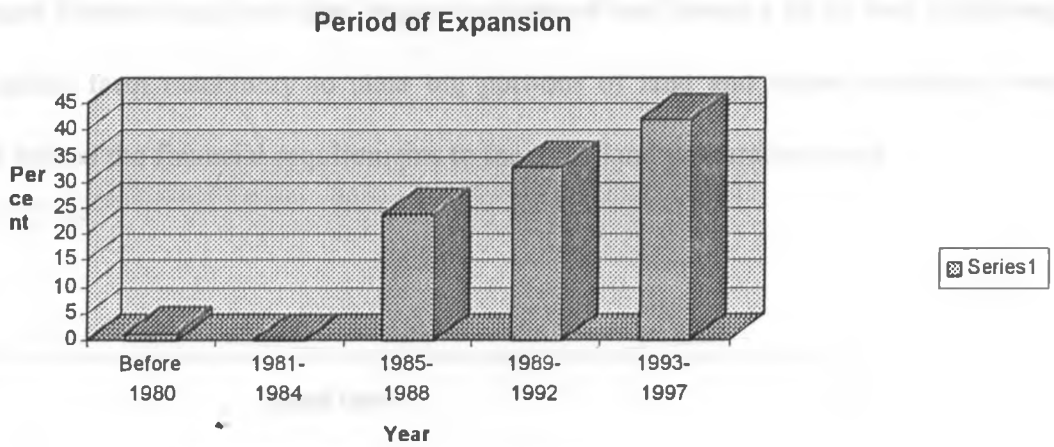
Plate 4.1 Land sub-division into small parcels which are mostly uneconomical

4.4.1 Cropland Dynamics

Soon after settling in Laikipia District, most farmers started farming on small sections of their land that were increased gradually. Of the interviewed farmers, 73.4% had increased their land under crop production since settling while 18.9% had remained with the same size of farm land under cultivation from the time they first settled in the area. In some cases, land under cultivation had declined.. From the analysis, 10% of the farmers had started with the cultivation of large portions of land soon after settling but due to crop failure they soon settled for smaller pieces of land. Although the expansion was gradual, it is noted that during some periods the land brought under crop production was more than in other periods. The period between 1993-1997 had the highest expansion rate of 26.7%. This was out of the desire to grow more crops so as to increase crop output per unit. This desire was mainly occasioned by the introduction of new crop varieties during that period of time. This is an indication that the land was increased so as to have more land under the introduced crop varieties.

However, 29% of the farmers expanded their land bit by bit yearly while 1.3% increased their cropland before 1980. Between 1981-1984 no expansions were reported. This could be attributed by the countrywide dry spell that Kenya experienced during that period. Of the interviewed farmers, 25% increased their land between 1985-1988, another 25% between 1989-1992. Expansion of land under cultivation during this period of time was intended to increase food production following a countrywide drought. Farmers had to do their best to increase crop production after the drought so as to enhance food security that had been threatened by the drought.

Figure 4.2



Source: Field Survey 1998

The land under crop production was expanded for various reasons as illustrated below.

Table 4.7: Reasons for increasing land under crop production

REASONS	RESPONSE FREQUENCY	%
No response	12	15
To grow more crops	13	16.3
To have higher output	33	41.3
To enhance food security	8	10
Crops do well on new lands	14	17.5
Total	80	100

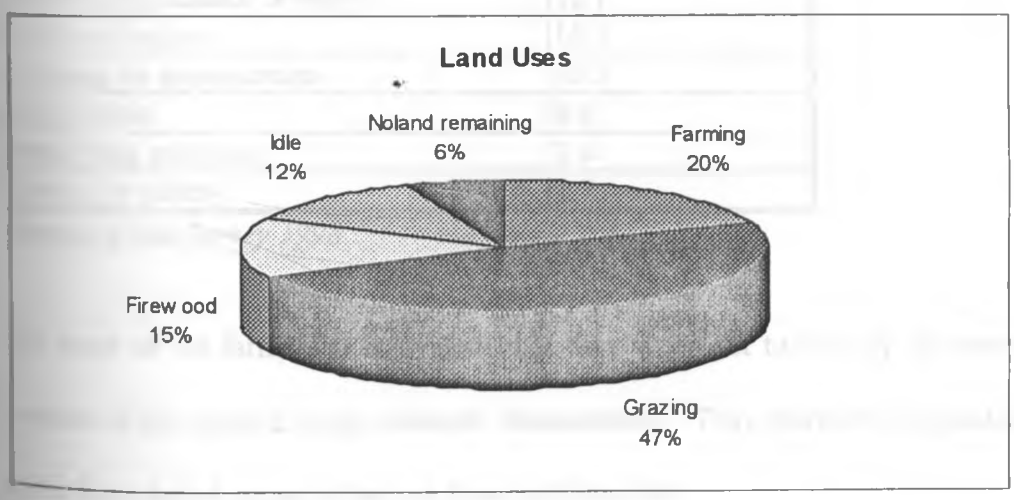
Source: Field survey, 1998

Analysis demonstrated that 41.3% of the farmers expanded their land so as to have higher output, 16.3% in order to grow more crops, 17.5% felt that crops do well on virgin lands and 10% so as to ensure food security at the household level.

4.4.2 Distribution of Land Uses

During the field survey, it was found that apart from farming, which took 20% of the total land use, the remaining area was used for grazing either by the household or other people as a source of firewood or left idle. Of the respondents, 49% used the remaining land for grazing, 15% of the land was used as an area to collect firewood, and 12% of the respondents left the land idle while 6.3% of the respondents did not have any land lying idle. Due to a number of constraints, most farmers could not clear bigger portions of land hence a lot of land remaining idle. They lacked farm machinery to clear big portions of land and where machinery was available they lacked the financial requirements to meet the land preparation costs.

Figure 4.3



Source: Field Survey 1998

4.4.3 Crop Type Production and Adoption Prompt

Having been introduced to the new crop varieties, the farmers chose to adopt them due to varying reasons as occasioned by varying social and economic factors. From the field survey, 20.7% of the farmers in M/K adopted the new crops for trial purposes, 13.8% for their drought escaping and fast maturing characteristic, 12.1% because they saw the experience of those who tried them was encouraging, 10.3% because the crops could be utilised in a variety of ways, another 10.3% because the extensionists introduced the crops and trained them on how to grow and use them upon maturity, 8.6% due to the high output per unit, 3.4% because they are better than what they are used to and 1.7% due to eagerness to have different variety of crops. This therefore shows that though the extensionists use the same approach to the farmers their reasons for adoption vary.

Table 4.8: Crop adoption prompt

ADOPTION PROMPT	PER CENT
Trial	20.7
Drought Escaping	13.8
encouraging results of others	12.1
Multi-utilisation	10.3
Training by extensionists	10.3
High output	8.6
Better than previous	3.4
Desire for variety	1.7

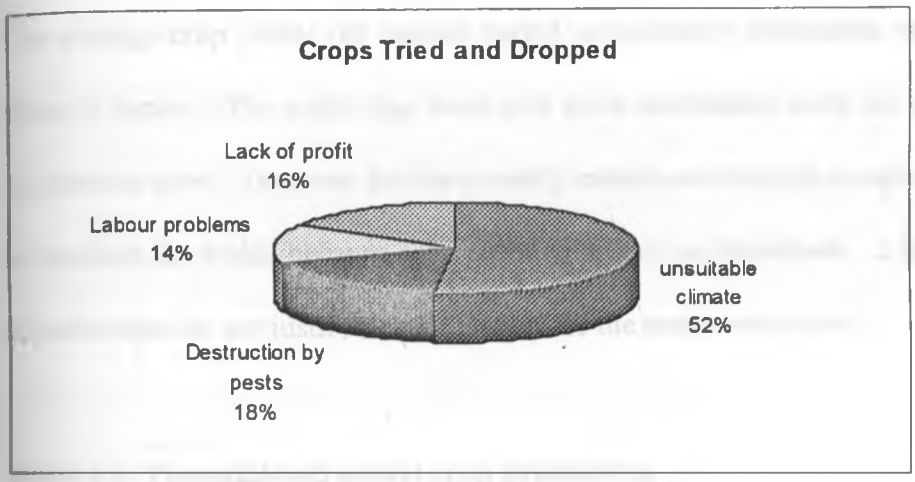
Source: Field Survey 1998

For most of the farmers it is evident that they were out to try out the new crops especially because of the crops drought resistant characteristic. They therefore adopted different varieties of the introduced crops to find out how well they did.

Trials on crops have been done by the farmers since settling. Upon settling in Laikipia the farmers grew those crops that they grew in their area of origin because they are the only ones

they have experience with. Due to climatic incompatibilities the crops tend to fail persistently. There are particular crops that do not do well at all in the area including bananas, tea and coffee, certain maize and bean varieties. The 600 series of maize varieties did not perform well. Farmers have tried these maize varieties with the hope that they could do as well as in the area of origin but with disappointing results.

Figure 4.4



Source: Field Survey 1998

The analysis of the two study areas revealed that 71.1% of the farmers in Lamuria have tried and dropped certain crops while in M/K the percentage of those who had tried different crop varieties is 55.6%. Most of the crops tried and dropped are mainly those that farmers were used to growing in their area of origin. However even some of the drought escaping crops in the area have also been tried and dropped by the farmers. The crop varieties that have been tried and dropped among the new crop varieties include chickpeas due to bad attack by pod borers, sunflower and sorghum due to constant damage by birds. Of the farmers, 62.2% tried and dropped certain crops due to unsuitable climate resulting in crop failure, 18% due to destruction by pests and diseases, 13.9% due to intense labour demands and, 16% due to lack of profit. Among the common pests in the beans are pod borers and aphids which badly

affected the chickpeas thus discouraging many farmers from growing it. The introduced oil crops like sunflower and cereals like sorghum were badly affected by birds thus discouraging the farmers from planting them. As for those farmers who adopted wheat they were discouraged by lack of combine harvesters and had to do the harvesting manually which proved to be highly labour intensive.

4.4.4 Crop Output

The average crop yields per season varied considerably depending on economic, social, and climatic factors. The yields that were able to be established were for the traditional crops that the farmers grow. However for the recently introduced drought escaping crops, it was not easy to establish the yields because crop production had not stabilised. It is noted that results from isolated cases do not justify generalisation for the entire study area.

Table 4.9: Potential and actual crop production

	TARGETED		ACHIEVED	
Crop	**Ha**	**Yield /Ha**	**Ha**	**Yield /Ha**
Maize	19,000	2.0	19,450	1.8
Wheat	6,700	1.8	8,800	1.125
Sorghum	70	0.9	66	0.9
Barley	190	1.8	240	1.7
Millet	20	0.8	18	0.8
Beans	10,900	0.54	11,450	0.27
Cowpeas	2.0	0.42	1.0	0.4
Green Grams	3.0	0.32	0	0
Soya Beans	3.0	0.50	2.0	0.50
Sunflower	5.0	0.8	14	0.75
Potatoes	2,270	9.0	2,436	9.0
Cassava	12.0	11.0	20	11.0
Sweet potatoes	25.0	11.0	30	11.0
Pyrethrum	250	0.6	254	0.5

Source: District Agricultural Office, Nanyuki, 1997

In 1996 the crops were affected by drought due to the long dry spell that was experienced while in 1997 the crops were damaged by the excessive rain that caused a lot of water logging. Hence even by the time the study was conducted the crops were still on trial stage and most farmers devoted only small pieces of land for that purpose. Of all the crops introduced, soya beans and chickpeas are the most popular among the farmers due to their multiple usage and high yielding rate.

One of the interviewed farmers had this to say regarding the introduced legumes:-

I only got a handful from my neighbour who got them form the extension officer and I have harvested two kilograms out of so little. Therefore I cannot plant the ordinary beans anymore as long as these ones are available.

This was his output for each of the crops he planted.

Table 4.10: Isolated output for an individual farmer[1]

VARIETY	QUANTITY PLANTED	YIELDS
Soya Beans	1/2 KG	6 KG
Chick Peas	1/2 KG	5 KG
Sunflower	1 KG	3 KGs
Wheat	1kG	3 KGs
Sorghum	1 KG	3.5 KGs

Source: Field survey, 1998

The main crops that the farmers grow once they settle in the area are, maize, beans, and potatoes. The settlement periods are not the same for all the farmers as illustrated in table 4.9. The drought resistant crop varieties are grown by the farmers after they are introduced to them by the extension agents and this is mainly from 1995. The aim was to help the farmers achieve maximum productivity out of their farming activities by improving the performance of farming

[1] The figure shown on this table are not average figures but figures by individual farmers which could not be used as generalities for the entire small scale farming population.

systems through enhancing better land use. Also the DECs were meant to avert the risk of crop failure.

4.5 The Influence of Extension Services on Small-scale Farming

After examining the general characteristics of the farmers this section seeks to examine the influence of external actors on local producers strategies in crop farming. Under this section, the contact between the external agents and the small-scale farmers in the study area is examined.

4.5.1 Extension Service Approaches

Contact Group Approach: Group dynamics are important in social and rural development. This approach is preferable to the individual farmer approach since many farmers are reached in a shorter period of time and over a wider region (Kimenye, 1997). Training and education on group dynamics is therefore important as during the survey, most groups were found to be weak yet they are an important tool in facilitating contact with the extensionists.

Contact /Contract Farmer Approach: A few farmers had been selected as contact farmers so as to disseminate information to the follow-up farmers. However follow-up farmers hardly ever visited the contact farmers especially in Lamuria.

Field-days and Demonstrations: The purpose of these methods is to teach a specific skill or technique such as planting, spacing or pest control. Demonstrations are done to a group of farmers while field days are usually broader in the message conveyed and are targeted to the general farming community. About eight demonstrations and three field days are planned per location per season as reported by front line extension officers in the respective locations during the field survey. However few of these materialise as a result of constraining factors on

the ground thus hampering on the operations of the extension staff. Among the main constraints that the farmers encounter in their operations is lack of transport to the respective areas of operation, lack of funds and materials for demonstration. Consequently, the extensionists reported that they were unable to effectively plan for field days and demonstrations due to the constraints. Some reported that in such a situation the best they manage to do is random visits to the farmers mainly based on convenience on their side. This means that they visit those they can easily reach and this implies working with those who are close to the roads or close to the extension agents' areas of residence. This could probably be addressed by asking the farmers to contribute towards demonstration materials and transport for the extension staff.

Educational tours: These are organised for the farmers so that they can have a chance of visiting other places and comparing their experiences thus creating an opportunity for them to learn. In 1997, there were three educational tours targeted and they materialised.

Agricultural Shows: farmers also learn through attending agricultural shows as they get the opportunity to see what the other farmers are doing in other parts of the district and other parts of the country. Nanyuki show falls in May every year and farmers are encouraged to attend.

Farmers' courses /seminars: These give the farmers an opportunity to be introduced to new technology and improve on the technology that they may be currently using. Out of the ten targeted farmers courses in the district for 1997, three were achieved. The target was not reached due to a problem of funds.

Public Meetings: These are meeting that are organised by the locational chiefs and where the extension workers are given an opportunity to address the farmers. In the district, sixty meetings had been targeted for 1997 but forty were achieved.

4.5.2 Contact with Extension Services

(a) *Knowledge of Extension Services*

From the field survey it was evident that there are farmers who are not aware of extension services operating in their areas mainly because they had not been approached by extension agencies to adopt certain services or because they had not even heard about such services in the neighbourhood. Of the interviewed farmers, 87.3% had knowledge of extension services while 12.7% were not aware. Further, 54.3% of those who were aware of the existence of extension services either directly through the extension agents or indirectly through other farmers have gone ahead and adopted the services while 45.7% have not adopted the services. Some of these have knowledge about the existence of extension services but others had not yet heard about them. Knowledge about extension services exposed a given farmer to new technology and this gave them a chance to know of better ways of improving crop production and hence make informed choices. From the analysis of the field data, it was clear that knowledge of extension services like formal education played an important role in influencing adoption of technology.

(b) *Access to Extension Services*

The linkage between the farmer and extension agent is maintained through visits by the extension staff to the farm, the farmer going to look for extension agents, individual farmer approach, contact farmer approach, field days, demonstrations and farmer tours. Analysis demonstrated that 23.8% of the farmers reported that contact was through visits by extensionists to their farms while 76.2% of the farmers reported that they were not visited.

Further analysis reveals that of those farmers who were in touch with extension services, 10% of them took the initiative to search for the extensionists while 90% of those farmers visited waited until the initiative to visit them came from the extensionists. Of all the farmers interviewed on ways in which they were reached by the extension officers, 82.4% of the contacts was through demonstrations and field days. These approaches were largely targeted for groups rather than individuals thus ensuring that more farmers were covered within a short period of time.

(c) ***Extension Visits and Frequency***

Adoption and Access: Visits by the extension officers to the farmers were either, weekly, seasonally, or yearly. These visits as reported during the field survey were held regularly or irregularly. Seasonal visits were those visits that were held during the onset of a season and since the area has two seasons per annum, the seasonal visits were organised at the beginning of the long and short rain seasons, in April and October. These visits were the most common covering 21.3% of total visits. Yearly visits are those visits that occurred once in a year, that is, during only one planting season and represented 12% 0f the total visits. Weekly visits were the most rare kind of visits. Although ideally the extension officers are supposed to be in tough with the contact farmers on a weekly basis, this was found to be unachievable on the ground. Such visits therefore represented 7% of the total visits.

In Lamuria it was found that although the seasonal and yearly visits were reported, such visits did not reach many farmers and in cases where they did reach the farmers they were poorly timed. Extension officers would visit when the farmers had already done their planting for a given season. This was largely due to poor organisation on the part of the front line extension staff (FLES) who due to having large geographical areas to cover were not able to reach many farmers. For instance in some locations of Lamuria like Wiyumiririe, one FLES was expected

to reach a population of over 1500 households. Besides, they had no means of transport to ease their movement from place to place.

Non-adoption: The non-adopters of extension services had divergent reasons for not adopting the services. In M/K 73% of the farmers had adopted extension services while 27% had not adopted the services. Of those who had not adopted the services they reported that they had not had contact with the extension officers while 25% said it was because they had other commitments and had not extra time to try out the extension services. In Lamuria 51% of the farmers had not adopted extension services and reported a number of reasons for this. The reasons included lack of extension officers in the area, being too busy with other commitments to adopt the services, not being selected by the extensionists to try the seeds and the feeling that they could not follow what the extensionists taught as it was rather time demanding. Others felt that the extensionists were not portraying an exemplary image to be followed, and others feared the process of repaying in case of failure.

From the field survey, it was found that the farmers in the study area had high reliance on maize especially the 600 series yet it did not perform well in the area. Irrespective of this fact, the farmers did not adopt fully the cereals that are well suited for the area especially millet and sorghum due to the negative attitude of the farmers towards these traditional cereals. Wheat was gaining ground in Lamuria but the farmers were discouraged by the lack of combine harvesters during the harvesting season. As a result, they had to do it manually and this was a tedious exercise that discouraged many from adopting the cereal.

The oil crops especially sunflower were not popular due to constant attack by birds and lack of marketing channels even for those who had processed it. Processing of sunflower was done using a machine that had been availed to the farmers through ARU. By the time of the survey

one machine was availed to the farmers since the processing had not started on a large scale. Marketing of the produce called for at least 150 farmers to produce it so as to justify a marketing channel. Most of the farmers who grew it therefore used it as livestock and poultry feed. There are those who were introduced to ApproTEC-designed ram oil-press to extract sunflower oil for household use.

For the root crops, the most popularly grown tuber was the Irish potato which was intercropped with maize and beans. However they are susceptible to frost bites. A handful of farmers grew cassava and sweet potatoes. The cassava was not widely accepted due to the negative attitude that the farmers had towards cassava as the 'poor mans food'.

4.6 Attendance to Field-days and Demonstrations

In order for the introduced crops to reach the intended actors, field days and demonstrations are crucial, however regular attendance to them is vital for the dissemination to have any impact. In M/K for the majority of farmers, either the husband or wife attended field days and demonstrations but in Lamuria the attendance is much lower. This was because the farmers felt that the field days and demonstrations were not centrally located and hence the farmers had to walk long distances if they were to attend them, others said they had other commitments and hence could not find opportunities to avail themselves for the meetings while some found such days to be a waste of time.

Table 4.11: Field-days' attendance

AREA	NEVER ATTEND	ATTEND IRREGULARLY	ATTENDS REGULARLY
M/K	5 (12.5%)	3 (7.5%)	32 (80%)
Lamuria	12 (30%)	13 (32.5%)	15 (37.5%)

Source: Field Survey 1998

Reasons for not attending field days and demonstrations: Those farmers who never attended field days or those who did not attend regularly gave reasons for not attending as: lack of awareness about the functions, distance to the functions being too far, lack of interest or other commitments. Overall 53.3% of the farmers said they were too busy with other chores, 20% said they had family issues to attend to for instance young or sick children who had to be attended to, 13.3% said they were not aware of field days or demonstrations in the area while 6.7% said the extensionists were discriminative and did not consider them in the functions. Those who put it that the extensionists were discriminative reported that the extensionists visited only certain farmers especially those who were well off in the neighbourhood.

The implication from this is that the research -farmer-extension linkage is not as strong as it ought to be and hence should be strengthened so as to enhance transfer of new technology to the farmers. This could be addressed by attending to the reasons as to why the some farmers did not find the need to attend to the meetings called by the extension staff.

In this regard, the socio-economic, and socio-cultural backgrounds of the farmers ought to be considered by intervening agencies since the impact of their inventions can only be felt if these are clearly understood. It is therefore vital that before anything foreign in a community is introduced research should done so as to identify those unique characteristics of the farmers so that they can be addressed in the introduction of innovations. It is crucial for the intervening agencies for instance, to understand the cultural background of the people in terms of their feeding habits so as to be aware of those taboos and values that would impede the success of the innovations.

The ultimate beneficiary of the extension support efforts is the farmer. Means of getting to the farmer should therefore be enhanced mainly by securing co-ordination amongst all the actors

involved in the operations. Carey (1998), reckons that the gulf between the government researchers and extensionists is wide. In this regard the researchers and the extensionists ought to work closely together in a symbiotic relationship so as to impart positive changes in crop production. This would in the end enhance management of natural resources and preservation of the environment.

4.7 Local Crop Production Systems and Extension Services

4.7.1 Main Crops

The farmers in the study area grow two categories of crops. One of the categories comprises the traditional crops grown in the area of origin including: maize, beans and potatoes. These crops are the ones that are mainly grown in the area of origin and farmers have a sense of security by growing them in addition to other crops as they act as a safety net for them. Other crops grown include arrowroots, pumpkin, yams, cassava and bananas. The second category of crops in the study area are those crops that the farmers have been introduced to by external agencies after settling.

4.7.2 Extension Packages in Crop Production

Different varieties of crops have been introduced by the external agents to the farmers. They fall under four categories viz.:- Grain legumes, cereals, oil crops and root crops. The crops under each category are:

(a) Legumes - These include:- Soya beans, China beans, KAT B1, KAT B9, Dolichos lablab, chickpeas and pigeon peas.

(b) Cereals - These include:- Sorghum, millet, wheat and maize.

(c) Oil Crops - These include:- Sunflower, safflower and Soya beans.

(d) Root Crops - These include:- Irish potatoes, sweet potatoes and cassava.

In addition agro-forestry and fruit trees packages were introduced to the farmers. At present trees are planted in and around the farms with some farmers intercropping the trees with crops. The most predominant species was *Grevillia robusta* locally known as *Mibariti*. Other species introduced by ARU included Eucalyptus and Casuarina. These were introduced to break the over-reliance on Grevillia robusta and to diversify the tree-species planted to optimise the full range of utilisation potentials of tree crops on croplands.

Plate 4.2 Sorghum, a drought resistant cereal introduced to the farmers

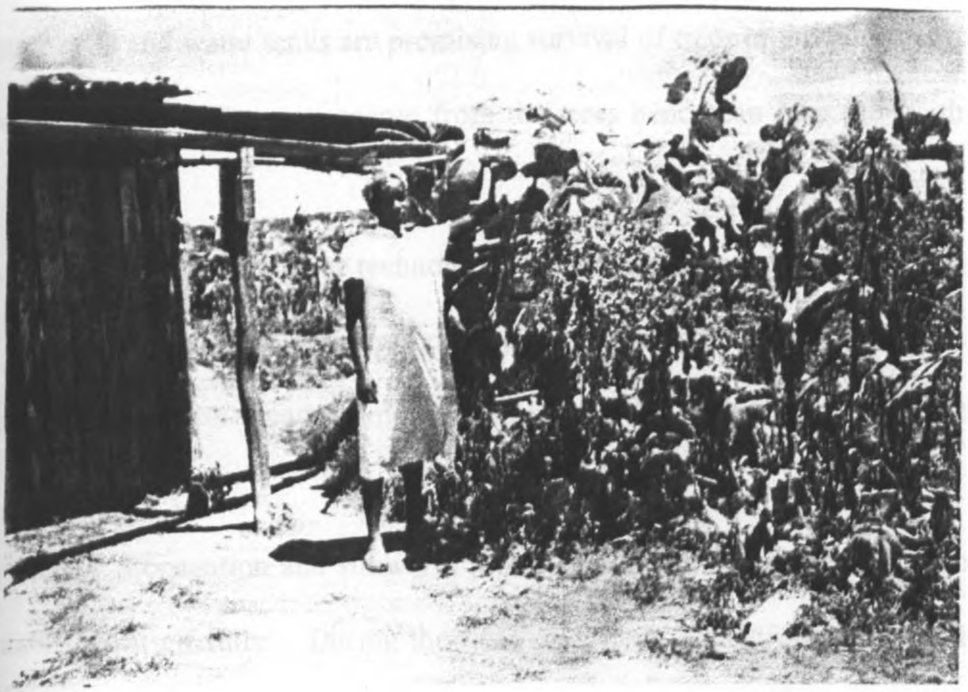


Plate 4.3 Sunflower, a drought resistant oil crop introduced to the small-scale farmers

The agro-forestry package was in five categories, viz.:-

(a) Woodlots for income - The objective was to sensitise the farmers of the potential of the tree crop as a source of income. It could be used as a source of fuel wood, poles, posts and sawn wood.

(b) Fodder production - This includes varieties that can be utilised as fodder for the livestock, fuel-wood and posts. In addition the trees enhance soil fertility.

(c) Trees under intercrop:- The practice of intercropping trees on crop land was observed to be picking up in the study area particularly in M/K. For intercropping there is over-dependence on Grevillea robusta. This is because it was established that the trees have a cultural attachment among the Kikuyu farming community. As an entry point therefore this variety could not be left out. The other tree species used for intercropping are fruit trees including apples, avocado, citrus, mangoes and passion. According to the field survey, though most farmers had adopted the fruit trees, the survival rate for the initial seedlings planted has been

less than 50% mainly as a result of adverse weather conditions. However the introduction of the water pans and water tanks are promising survival of trees in the future as the farmers have realised the benefits they can accrue from the trees hence can take the trouble to water the trees.

(d) Live-fences:- The live fence technology was introduced to perform dual roles of mitigating game damage of crops and optimise both the productive and service roles of live fences. This was a practice that was already common even before ARU intervention and so ARU introduced more varieties.

(e) Mulberry propagation and silkworm production:- This is a project that is on trial and has not established itself fully . During the field study only a handful of farmers had planted the crop.

Plate 4.4 Oranges, one of the fruit trees introduced to the small scale farmers

Overall 23.8% of the farmers had had contact with the extension staff. Of all the extension crops promoted the legumes had the highest adoption rate as compared to the other crops. This was mainly due its high nutritional value and high yielding capacity. For the legumes, ARU was able to get preliminary results of grain legumes adapted to Laikipia from LRDP the predecessor of Dutch-funded APL which operated in Laikipia between 1984 and 1993. Hence ARU activities focuses on on-farm rather than on on-station experimentation.

The traditional cropping pattern with maize, beans, and potatoes though existing in M/K has already been changed with most farmers experimenting on the introduced crops. The crops have however not stabilised as yet. Most crops were introduced in 1995 and 1996 and the output was so low that much of it was consumed at farm-level. The year 1996 was relatively a bad year and hence crop production was marginally low. The crop for 1997 was damaged by excessive rains country-wide occasioned by the *El Nino* weather phenomenon.

The crops were particularly accepted and grown by the farmers due to the high potential output per acre as shown in the table below. In addition, there is lower risk involved since the varieties are drought escaping. The extension agents are not for abandonment of the traditional crops but encourage the farmers to supplement them with the DECs to increase profitability and spread production risks over several varieties.

Plate 4.5 Natural tree varieties in the area mostly cleared for cultivation and charcoal burning

Plate 4.6 The introduced woodlot varieties to the small-scale farmers

Plate 4.7 Agro-forestry practice introduced to the small-scale farmers

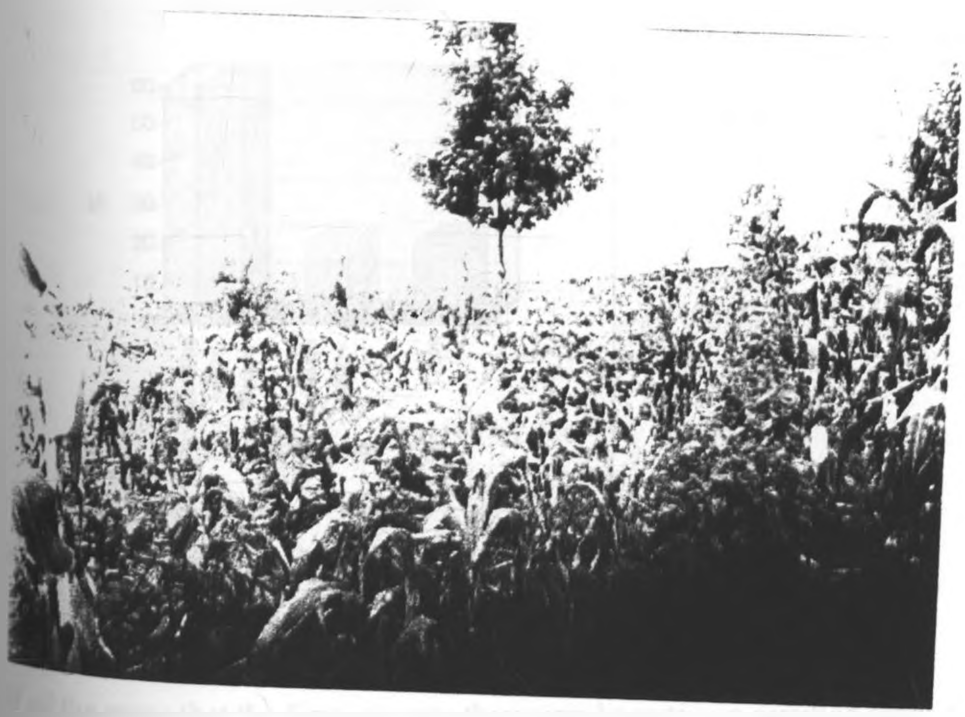
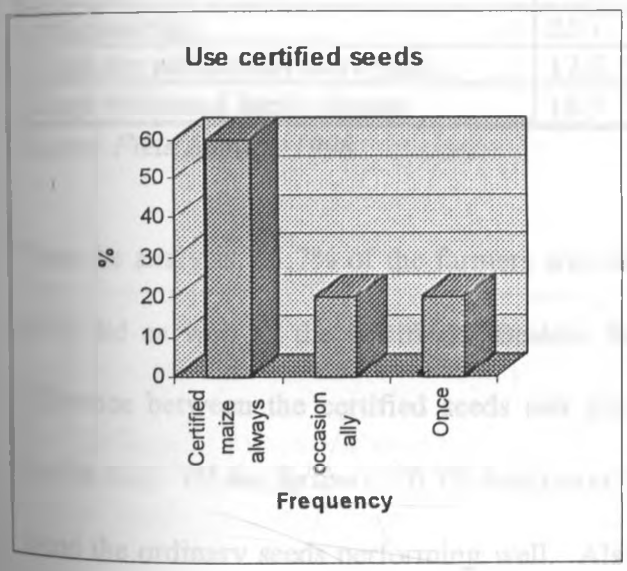


Plate 4.8 Mulberry, introduced to the small-scale farmers

4.7.3 Crop Production Inputs

Certified seed application and seeds access: In Lamuria 60% of the farmers use certified maize seeds, 7.5% do not use certified seed, 25% use certified seeds sometimes while 2.5% have used certified seeds only once. In M/K 61.2 % use certified seeds, 28.2% do not use certified seeds, while 10.3% use certified seeds occasionally. Overall 60% of the farmers use certified maize seeds always while 20% of the farmers use certified maize seeds occasionally and 20% have used them only once. The implication is that maize as a cereal crop is highly valued and therefore the extensionists should research for suitable maize varieties for the area in addition to the other introduced crops.

Figure 4.5



Source: Field Survey, 1998

Of all the crops that the farmers grew they were keen to use certified seeds for maize unlike for the other crops since maize was the main crop from which they derived their livelihood. In Lamuria 43.2% of the farmers used certified seeds for improved harvests, 21.6% because certified seeds withstand harsh climate hence minimising failure chances, 10.8% used them for

the healthy crops they give, 2.7% because they are fast maturing and 44% because the seeds are not destroyed by pests.

In M/K 55% of the respondents used certified seeds due to improved harvests, 17.5% for fast maturity, 12.5% for the crops were destroyed by pests when one used uncertified seeds and 2.5% for the crops withstood harsh climate. Overall, 49.1% of the farmers used certified seeds for improved harvests, 20.1% because they were fast maturing s 12.5% because they were not easily destroyed by pests and diseases and 18.3% because they withstood harsh climate.

Table 4.12: Reasons behind application of certified seeds

REASON	%
For improved harvests	49.1
Fast maturing	20.1
Crops are not destroyed by pests	12.5
Crops withstand harsh climate	18.3

Source: Field Survey, 1998

From the analysis, 21.7% of the farmers who did not use certified seeds felt that the ordinary seeds did as well as the certified. Besides they felt that in case of failure, there was no difference between the certified seeds and the ordinary ones since they were affected in a similar way. Of the farmers, 20.1% had never thought of trying the certified seeds since they found the ordinary seeds performing well. Also there were those who reported that they had never had the opportunity to be introduced to new seeds and hence had never tried them. Further, 6.2% of the farmers were not aware that certified seed existed since no external agent had ever approached them to introduce new seeds to them or to advice them to use certified seeds. Analysis demonstrated that 35% of the farmers felt that the certified seeds were expensive and hence they preferred to use uncertified seeds. Finally, 17% of the farmers had already tried the certified seeds and failed and hence had decided to give up using them.

Except for maize, the use of certified seeds was not common and this is probably as a result of the weak linkage between the farmers and the input suppliers and the expenses involved hence the farmers could not use certified seeds for all the crops.

Table 4.13: Reasons for not using certified seeds

REASONS FOR NOT USING CERTIFIED SEEDS	%
Never thought of trying	20.1
Not aware that the seeds are there	6.2
Certified seeds are expensive	35
No difference with uncertified	21.7
The seeds have failed	17

Source: Field Survey, 1998

Farm Implements and Tools: The farmers used hand tools including *jembe* (hoe) and *panga*, animal drawn ploughs and power driven tractors. There was a high reliance on hand tools since they were the most available compared to tractors and ox-ploughs which required higher costs if one was to use them. Besides they were not easily accessible or available in the area.

Use of farm machinery was not common and the farmers experienced a lot of problems in their effort to acquire the machinery. This is a service that the external agents ought to facilitate since the farmers sometimes even lack the knowledge of where to access the machinery. Even in cases where individual farmers took the initiative to look for the machinery, their efforts were frustrated since the machinery owners could only operate on large scale if they were to make any profits. Farmers growing wheat particularly got frustrated since they could not get access to the combine harvesters.

In Lamuria 89.5% of those who used tractors and ox-ploughs had always used them while 10.5% started using them at some point due to the need to increase agricultural production. In M/K 67.9% of those who used tractor and ox-plough had always used them while 32.1%

started using them at some point. In Lamuria those who started using them at some point started between 1995-1997. In M/K 40% started using them between 1992-1994 while 60% started using them between 1995-1997. This is explained by the introduction of new crops in 1994 that made some farmers expand their land to accommodate increased crops. Of the farmers, 50% in Lamuria used tractors and ox-ploughs. According to the response of these farmers, this was because:

- the implements mixed up the soil properly and softens it (21.5%)
- crop production and output was enhanced (14.3%)
- of the training they got from the extension officers and it motivated them(7.1%)
- these implements cleared bigger portions of land within a short time (7.1%).

Pesticides: In order to enhance crop production there was use of pesticides. Pests and diseases were a common cause of crop failure. Pest common especially on the beans were aphids, lower thrips, pod borers and the bean fly. Sorghum was most commonly attacked by birds. In Lamuria 40% of the farmers used pesticides to combat pests and disease affecting their corps. 50% of the farmer did not use pesticides. This was due to the high costs that were involved. However there was introduction of natural pesticides which the farmers themselves could prepare at home. This technique of preparing natural pesticide was introduced as a means of enhancing organic farming by ARU through the crop production department of the MoALDM. However, the farmers found it to be too demanding in terms of time since one had to spray very regularly. There is therefore need for intensified training on the application of the natural pesticide geared towards simplification of the technique so that more farmers can adopt it as it requires minimal costs in terms of finances. In M/K, 30.8% of the farmers used pesticides while 66.7% did not use pesticide. Being in an economically deprived situation, many farmers could hardly afford the use of pesticides.

Fertilisers: In order to enhance crop production and soil fertility, artificial fertilisers were in use amongst some of the farmers. However, a large percentage of the farmers did not rely on artificial fertilisers for a number of reasons. In Lamuria 17.5% of the farmers used artificial fertilisers, 72.5% did not use the fertilisers while 5% of the farmers used artificial fertilisers sometimes. In M/K 10.3% of the farmers used chemical fertilisers while 89.7% did not use the fertilisers. The main reason why most farmers did not use chemical fertilisers was due to the high costs involved in the purchase of fertilisers. However there was a large percentage that also feared double loss in case of crop failure due to unfavourable weather.

Farm-yard manure: Farm yard manure was used by farmers in order to enhance soil fertility and increase crop production output. This was a technique that the farmers used in the area of origin and since they had regular contact with extension officers while in their area of origin, they were aware of the advantages involved in the use of farm-yard manure. In Lamuria, 80% of the farmers were using organic manure while 7.5% did not use it while 5% used organic manure once in a while. In M/K 61.5% of the farmers used organic manure, 30.8% did not use it while 7.7 % used it occasionally. From the above figures it is indicative that the usage of FYM is higher than the other inputs. This could be due to the ease of accessibility and cost of proçurement. The extensionists have introduced the composite manure technology and it is still being tried by most farmers.

The inputs used to enhance productivity were mainly used for maize, beans and potatoes while few farmers used inputs on the introduced drought escaping crops as they claimed that the crops did extremely well without extra costs.

The extent of external intervention into the farming strategies used by small scale farmers in Laikipia from this study was found to be influenced by socio-economic, socio-cultural and

environmental factors. The way in which these factors inter-played determined the extent of adoption of new technology.

4.8 Relationship Between Local Actors Characteristics and Adoption

In this section the relationship between adoption and the socio-economic factors that influence adoption will be looked at. The relationship is going to be measured using the chi square test (x^2)

$$X^2 \text{ (obtained)} = (\text{sum of}) \frac{(f_o - f_e)^2}{f_e}$$

Where f_o = the frequencies observed

f_e = the frequencies that would be expected if the variables were independent

It was established that the socio-economic characteristics of the farmers played an important role in determining the extent of adoption of the extension services. The age was found to determine adoption since the older farmers were found to be hesitant to adopt the new extension services.

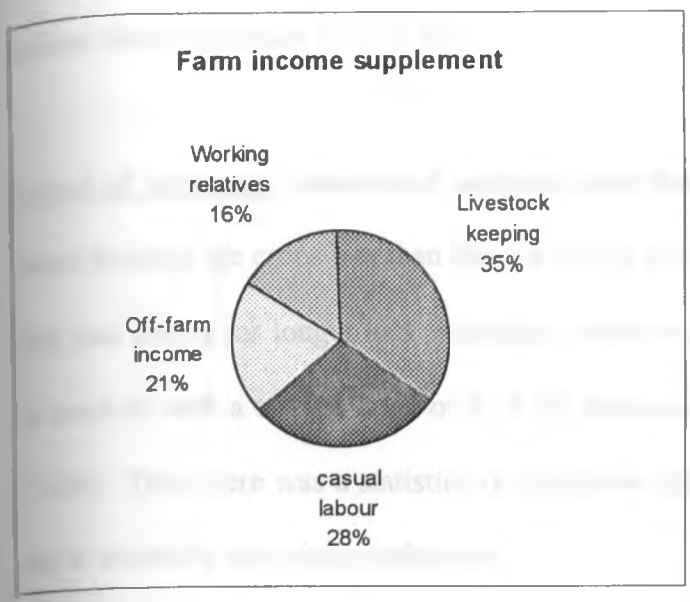
Farm Income: The farmers rely on farm and off-farm income to meet their needs. Farm income was normally inadequate due to low productivity as a result of harsh climatic conditions. In M/K 22.5% of the respondents indicated they had adequate income from the farm while 72.5% reported that incomes were inadequate for their needs. Of the farmers in Lamuria, 41.1% reported that their income from the farm was adequate for their needs while 56.4% found farm income inadequate. Overall 31.8% of the farmers reported that their income from the farm was adequate for their needs while 68.2% said that farm income was inadequate relative to family needs. There was need therefore to engage in off-farm economic activities some of which are detrimental to the environment.

Intensification of the DECs is expected to considerably increase the output hence the farm income. This will ensure more reliance on the farm income and creation of more employment opportunities in the sector in the long run enhancing the country's economy.

The farm income is supplemented through other means. In Lamuria, 18.8% of the farmers supplement family income through livestock keeping, 12.5% from casual work near or away from home, 7.5% from spouses income, 1.3% from bee keeping, and 2.5% receive assistance from working family members. In M/K 19.2% of the respondents supplemented their farm income from work as casual labourers, 6.4% through assistance from working family members, 38% from off farm income and 2.6% from livestock keeping. Overall 35% of the respondents supplement their income from livestock keeping 28% through casual labour 21% through off farm income and 16% through working relatives.

The Chi square test demonstrated that there is no statistically significant difference between adoption and income. At 1 degree of freedom at the critical level of 0.05 the calculated X^2 was found to be 3.205 while the tabular X^2 was found to be 3.841. Thus income level was not found to influence the farmers decisions to adopt the new crops. This however is due to the fact that the farmers were not required to pay for the seeds in cash. Even in the cases where they had to contribute financially the prices were subsidised at half price.

Figure 4.6



Source: Field Survey, 1998

Level of education: was found to have a significant relationship with adoption given that most of the respondents were found to have attained a basic primary level of education. The Chi square test indicated that there was a statistically significant relationship between the level of education and adoption of new technology. The calculated Chi square was 8.12, that was greater than the tabular X^2 of 7.815 at critical level of 0.05 with 3 degrees of freedom.

Land size: was found to have a significant relationship with adoption given that those who had larger pieces of land were found to adopt the new crops more than those who did not have large pieces of land. At I degree of freedom, at the critical level of 0.05, the land size calculated X^2 of 4.02 was greater is than the tabular X^2 of 3.841. Hence the relationship between land and adoption of new technology was found to be statistically significant.

Contact with extension: determined the rate of adoption since those farmers who did not have contact with extensionists adopted less than those who maintained contact with extensionists.

At 1 degree of freedom at the critical level of 0.05 the calculated X^2 was 4.64 which was greater than the tabular X^2 of 3.841.

Period of settlement: determined adoption since those who were established in the area were found to adopt the crops less than those who had settled in the area for a short tome since those who had settled for longer had established relatively stable economic activities. At 5 degrees of freedom with a critical level of 0.05 the tabularX^2 was 11.070 while the calculated X^2 was 11.145. Thus there was a statistically significant relationship between adoption and period of stay in the study area since settlement.

Age of respondent: Age was found to have a significant relationship with adoption given that those farmers who were younger tended to adopt more than those who were older. At 4 degrees of freedom at the critical level of 0.05 the tabular X^2 was 9.488 while the calculated X^2 was 9.764. Thus the relationship between the age of a respondent and adoption is statistically significant.

The rest of the factors that were analysed were found to be insignificantly related to adoption. These include marital status and family size. In this case the calculated X^2 for each of them was found to be less than the tabular X^2 at the critical level of 0.05.

There are certain questions that were asked in the course of the study. Some of them have been answered while others could be answered in other subsequent studies. As to whether the new crops have had any significant impact on the income of the farmers this is positive since the introduced crops were high yielding and could fetch high prices in the market. However since the crop production had not stabilised by the time of the study, there is need for subsequent studies to examine the issue further. This is because in examining the influence of extension

services on the farmers, it is crucial to establish whether the introduced varieties are more yielding than the previous crops. This is because the most influencing 'pull' in determining adoption is whether the crops are more yielding than the previous ones.

4.9 Lessons from the Analysis

Agencies: From this analysis, it has been noted that the role of other external agencies other than the MoALDM is becoming increasingly important in the agricultural sector in rural development. Traditionally, the government through its various ministries has been looked upon to provide support services in the rural areas. However, as a result of declining economic status in the country, the government's role in disseminating agricultural support services to the farmers has been fizzling out despite the dire need for such services by the farmers. Agricultural extension is faced by many constraints including lack of demonstration materials, lack of transport to reach interior places and lack of job motivation. Additionally, the FLES are overworked by being allocated areas without consideration of the population as a factor. As such some extension officers are assigned areas of high population density to cover. This situation has almost severed the link between the farmers and the extension agents.

This trend has resulted in a situation where the farmers who migrate to Laikipia lack advice on how to go about ecological adaptation and this results to minimal harvests if not total failure and environmental degradation. In such circumstances therefore, the farmers ought not to be blamed on perpetuating farming strategies from their areas of origin. Non governmental organisations in collaboration with the government are now providing agricultural support services to the farmers since all the support services cannot be left to the government given the deteriorating economic situation in the country.

The ultimate aim of these organisations should be to enhance self-reliance among the farmers so that they can carry on with whatever introduced technology even when the external agencies cease to provide further support. In this regard, strong farmer-research linkages ought to be strengthened mainly through collaboration with farm input suppliers in the rural trading centres so that they can stock inputs and information that are relevant to the farmers needs.

The dissemination of technology from farmer to farmer was found to be an important emerging issue from the study. From this perspective when considering sustainability of the strategies introduced this is an important way of ensuring that they last since there will always be people who are conversant with introduced technology.

Gender issues: From the analysis, it has been found that gender is an important aspect in influencing adoption trends. Women were found to be the key actors in the crop production systems since majority of men were away attending to non-farm activities so as to supplement the farm income if any. Majority of the respondents are married and this brings in the issue of decision making. It was found out that the women made decisions regarding crop production for instance issues pertaining to what to plant, when to plant and how to plant. The men on the other hand were involved in livestock production in addition to non-farm activities. This is an important fact to understand before disseminating the crops since decision making can be a hindrance to acceptance of new technology.

Age: Age as a factor is found to be crucial in influencing ones decision. The common assumption regarding age is that those in younger brackets such as below 45 years tend to be receptive to change as opposed to older people who prefer to cling to their established routine of doing things. This was found to be the case in the study area whereby the farmers above 50 years were not very receptive to the new changes. Analysis showed that there was a strong

relationship between age and acceptance of the crop packages disseminated by the external actors. In Lamuria, since most of the farmers fell in the age category of 41-50 years, this explains why adoption levels were lower in Lamuria than M/K. In M/K most of the farmers fell in the category of 31-40 years and since adoption was higher than in Lamuria, the implication therefore is that age played an important role in determining adoption of technology.

Education: Education, when looked at form the point of view of formal learning is seen to have an important impact on adoption of technology. It is assumed that the higher ones education level, the higher the acceptance of new technology. The assumption is that one is exposed and has a dynamic view of situations. In this study, formal education was found to have a strong relationship with adoption. Over 80% of the respondents were either of primary level of education or no education at all.

Contact with extension agents: The agricultural extension officers primarily disseminate their information through field days and field demonstrations. A strong relationship was found between adoption and contact with extension agents. The farmers who attend to the field days and demonstrations were found to have a higher adoption rate than those who did not attend to them. It is through such visits that the farmers get to learn more of the extent of the risks they could take and hence accept the disseminated technologies with full knowledge of what they are doing. This is why it is those who are in more contact with extension agents who adopt more since they are knowledgeable of what they are undertaking. However formal education is important since farmers can read written information and hence get more knowledge on the latest agricultural information.

Income: New technology is generally viewed as a risk by farmers and the assumption is that only those who are economically well off can take the risk of experimenting on new technology. The average income of the farmers was derived from the main economic activities in the area which are charcoal burning and livestock keeping. In M/K the average charcoal production per week was 20 bags which could fetch between Ksh. 2000 - 3000. In Lamuria the average milk production available for sale was five 700 ML bottles and each fetches an average of Ksh. 18 thus giving an income ranging between Ksh 2500 - 3000. Since the family has several financial commitments such as paying school fees and social commitments, this income is hardly sufficient for the needs, yet the farmers still adopted the new crops. The analysis revealed a weak relationship between income and adoption rates. However, this was because of the fact that the innovations required minimal financial requirements. Indeed in most cases the farmers were not asked for financial contribution but to return the same quantity of seed to the extensionists once they harvested the crop. Income would therefore probably be crucial in cases where the farmers are asked to make financial contributions.

Household size: The household size is seen as an important factor in influencing adoption of new crops since it is assumed that labour at the household level is determined by the size of the household thus the larger the family, the more available the labour. The other argument is that the bigger the family size, the more the food requirements hence need to adopt new technology so as to increase food supply for the family. From the analysis a weak relationship was found between the family size and adoption level. In the study area, the average family size stood at six children per household. It was found that whether the family was large or small, the farmers still adopted new technology and hence the family size was found to be insignificant in influencing adoption of technology.

4.10 Conclusion

In this chapter the main objective was to examine the influence of the external actors on the crop strategies adopted by small-scale farmers in the study area. This was done by first understanding the characteristics of the small-scale farmers so as to establish how the factors influence the adoption of the new crop strategies introduced by the external actors. The general characteristics of the farmers that were considered for analysis are age, level of education, household head, household size, farm size, contact with extension, settlement history, crops (before and after adoption), soil enriching inputs, farm implements and tool, and the output.

Finally it can be said that the external actors have been able to influence the small-scale farmers since the farmers have adopted the new crop varieties and strategies and are continuing to adopt the crops. However the issues pertaining to sustainability still need to be addressed if the innovations are said to be sustainable and hence able to enhance the living standards of the farmers in the long-run. The marketing of the products especially has to be enhanced given that it is not sustainable for the external agents to buy from the farmers without introducing them to the market in case the external agents withdrew from the farmers. It is through sustainable development that social change can be achieved.

CHAPTER FIVE

M/K AND LAMURIA AREAS: A COMPARATIVE ANALYSIS OF THE IMPACT OF EXTENSION SERVICES

5.1 Introduction

This chapter aims at comparing the two different study areas, and as a first step, to establish the factors that hinder or enhance dissemination or adoption of new ideas or techniques by extension agents in two different area. The two areas fall within the same agro-ecological zone, that is low ranching zone (V) and have equal access to agricultural information offices since each of them is located at close proximity to its respective agricultural office.

The comparison will be based on several socio-economic aspects, which have been considered in the previous chapter. In the previous chapter, these aspects were considered but no special attention was given regarding their variations in the adoption of extension services process. These aspects include: crops, farm output, knowledge of extension services, economic activities, household income, history of settlement, crop land allocation, land sizes, age, and level of education. These factors will be viewed in light adoption rates for the two areas and chi square test will be used as the analysis technique to explain these factors.

5.2 Crops in Area of Origin

The main crops that a majority of the farmers were growing in the area of origin are the traditional crops, which are maize, beans, and potatoes. In addition, sweet potatoes, bananas, tea, coffee, wheat, peas and pyrethrum were grown in the home districts. The farmers in M/K and Lamuria had migrated from Nyeri mainly. In M/K majority of the farmers had migrated from Mukurwe-ini in Nyeri while in Lamuria they had migrated from different parts of Nyeri in addition to other adjoining districts. Upon settlement in Laikipia, the farmers' tendency was to continue with the farming strategies that they were used to in their home districts: grow

maize, beans and potatoes and keep livestock after settling. This is an indication that there was no variation in the type of crops grown upon settlement in the area since this is the knowledge that was at the disposal of the farmers upon settlement. They lacked knowledge regarding the farming strategies that are suited for the new area.

The farmers after realising that the harsh climatic conditions did not support specific food production strategies tried to adapt themselves to their new situations. The improvement responses by farmers ranged from cultivating a larger portion of the farm percentage or adoption of drought escaping crops.

In M/K the farmers history of settlement is relatively short compared to that one of Lamuria. On average, the majority of farmers in M/K settled in the area in the 1990s while those in Lamuria settled in the 1970s. The implication is that the Lamuria farmers had already established a way of earning income by the time Applied Research Unit (ARU) introduced its activities in the area in 1995. Consequently, adoption rates for the new innovations were not as high as in M/K. The success of the new crops in the study area is likely to depend on the impact that the new crops will have in M/K in terms of output per unit. Such success may be expected to spread to the other areas since they are near each other. This will mean that the new farmers who will migrate into the area in future may not have the problem of lack of knowledge on the crops suitable for the area. This then may diffuse to the rest of the farming community in Laikipia.

5.3 Crops Adopted

In M/K 70% of the farmers adopted extension services, while only 34% of the farmers in Lamuria adopted extension services. Adoption of extension services in this case refers to the acceptance of extension services by a given farmer. There was diversity in the type of crops

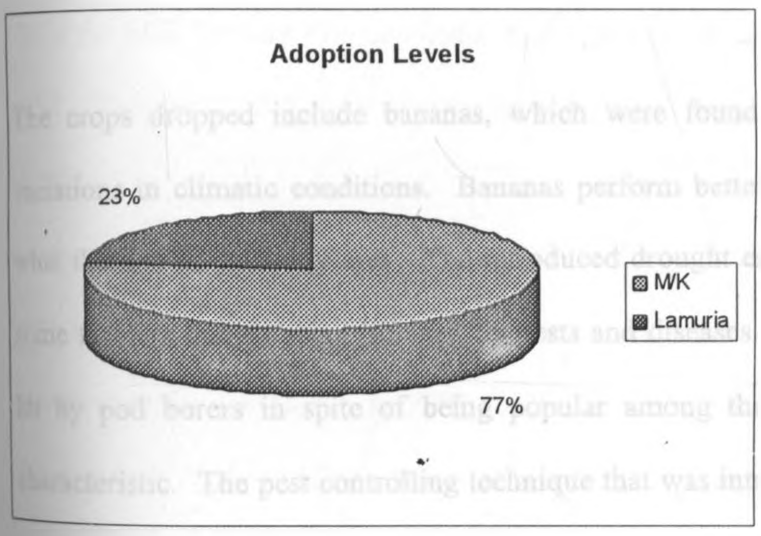
adopted after settling. Most farmers in M/K adopted the introduced crops which included legumes (Soya beans, chickpeas), oil crops (sunflower, safflower); root crops (cassava) cereals (wheat, millet, and sorghum) and high value fruit trees (oranges, lemons).

In Lamuria area, among all the introduced crop varieties, the adoption of wheat was higher than the rest of the crops. Wheat in the area was found to perform very well. However, due to the pieces of land that the farmers in the area have, the wheat production was not sustainable since the harvesting was a constraint. The combine harvester owners found it uneconomical to harvest isolated 1/4 acre pieces of land in the area. For the production to be sustainable, the farmers may have to devote most of their land to the production of wheat as a cash crop in the area. The survey showed that the majority of the farmers devoted only up to 10% of their land for wheat production. For the legumes the farmers in Lamuria preferred to grow the legume varieties they were used to in their area of origin, which are *Njata, Mukura Nooke* and *Kamahua*.

In M/K the adoption was mainly as a result of external intervention while in Lamuria, there was a good percentage that adopted on own initiative. In M/K diffusion of technology easily spread from farmer to farmer unlike in Lamuria where the farmers tended to learn little from one another. The Lamuria farmers had a tendency to operate as individuals probably because they were more established and one could easily do without the assistance of the others. On the other hand the farmers in M/K were still trying to establish themselves economically and the support from the others was critical. Each farmer took the initiative to find out what was happening to the neighbour probably to establish whether the neighbour had found an easier way to make ends meet. In Lamuria lack of enthusiasm to adopt extension services was also attributed to dissemination constraints whereby the extensionists could only reach certain areas and not others due to transport problems and also each front line extension staff having a large

area to cover in terms of the population density. This argument is supported by Chambers (1983) who put it that, "urban-based professionals visit only the accessible areas in the rural areas. They have *tarmac bias*". Apart from the infrastructural constraints, the farmers in Lamuria were found to have various reasons for not adopting extension services which included:- lack of awareness of extension visits in their area and having family commitments which made them not attend the meetings. Among the women, those who were particularly not able to attend was due to having a lot of domestic duties that were not flexible as regards the time when they were performed.

Figure 5.1



Source: Field survey, 1998

During the field survey it was found that the extension officers operating in M/K mainly targeted groups of farmers when introducing a new farming technology or when introducing a new crop rather than individual farmers while in Lamuria the extension officers mainly approached the farmers on an individual farm to farm basis. This is an indication that the appropriate approach to the dissemination of extension services is through groups rather than individuals given that more farmers are reached within a short period of time thus saving on transport costs, which happen to be a hindrance to extension dissemination.

5.4 Crops Dropped

In the process of trying to establish the appropriate crop for the area, the farmers tried several crops and dropped those that they found to be performing poorly. Poor performance in this case refers to total crop failure or partial failure. It was found that those farmers in Lamuria who had adopted new crop varieties especially legumes did it only for trial and were still growing the legume varieties they were used to in their area of origin which are *Njata, Mukuranooke* and Rose-coco. When they found that the adopted legumes were not perfuming well they dropped them. Crops that were dropped was either because they took too long to mature or were easily affected by pests and hence the farmers found that growing them was expensive in terms of the use of pesticides that one would need to apply.

The crops dropped include bananas, which were found to do poorly in the area due to variations in climatic conditions. Bananas perform better in cooler climatic conditions than what there is in the study area. The introduced drought escaping crops were also dropped by some farmers due to being infected by pests and diseases. Chickpeas for instance were most hit by pod borers in spite of being popular among the farmers due to its high yielding characteristic. The pest controlling technique that was introduced in addition to the crops was not widespread due to the fact that the farmers found it to be tedious given that one had to apply it constantly on a weekly basis and hence need for simplification of the technique.

In Lamuria there were farmers who dropped wheat due to lack of harvesting machines which made the harvesting work too tedious for most farmers since they had to do it manually. Since some farmers grew wheat on small parcels of land the harvesters' operators found it uneconomical to operate in the area. In Lamuria the analysis demonstrated that 57.6% tried and dropped due to lack of harvesting machinery, 10% due to the unsuitable climate resulting in crop failure, 19.4% due to destruction by pests and diseases, 13.9% due to the intense labour

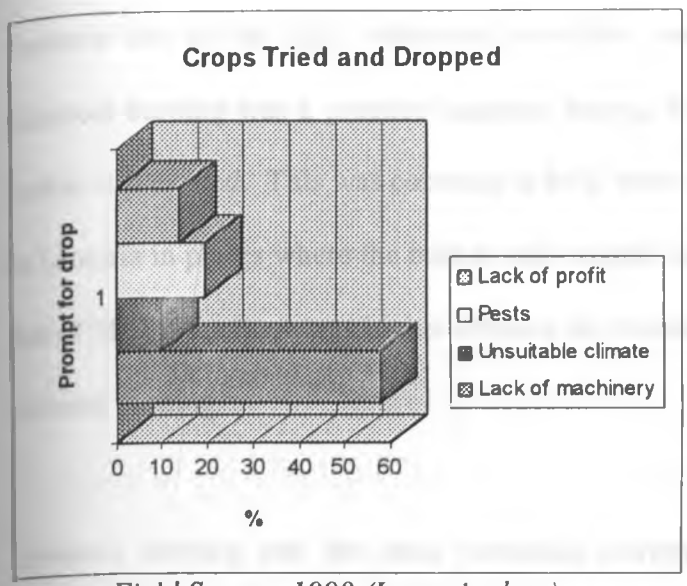
demanded of the crops and 14% due to lack of profit for the crops. In M/K 63.3% tried and dropped due to unsuitable climate, 16.7% due to destruction by pests and diseases, 3.3% due to lack of profits and 16.7% due to lack labour on the farm.

The percentage of adopted crops was higher in M/K as opposed to Lamuria while that of crops dropped was higher in Lamuria. This was due to the fact that the farmers in Lamuria have a longer settlement history as opposed to those of M/K hence they had tried several crop varieties during their stay and due to having tried crops and dropped them were reluctant to try out others. In addition, as a result of the farmers having a longer history of settlement, they have established crop varieties suitable for the area mainly through trial and error. On the other hand the M/K farmers who had had a shorter history of settlement and were still in the stage of trial. They were thus more willing to accept new technologies, which may promise higher yields.

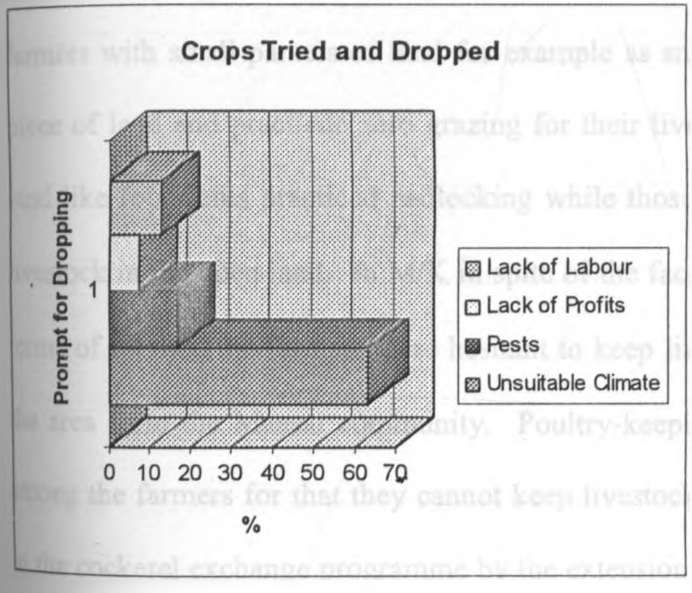
The farmers in Lamuria had a higher percentage of traditional crops, which they felt they should rely on for food. In M/K for instance the traditional varieties of beans including *Mwitemania, Njata* and *Mukuranoke* were gradually getting unpopular in favour of the drought escaping bean varieties including Soya beans, chick and dolichos lablab. In Lamuria it was clear that majority of farmers abandoned wheat which was the most adopted crop due to lack of harvesting machinery. In M/K the pressing reason as to why most farmers dropped any crops they had tried growing was due to unfavourable climate, which inevitably led to failure.

Crops that the farmers mainly dropped due to lack of profits were wheat in the case of Lamuria, and Soya beans since there was no market for the beans. Pod borers mainly affected chickpeas. Wheat was again dropped for lack of harvesting machinery. Unsuitable climate was for all the crops especially the varieties grown in areas if origin.

Figure 5.2



Source: Field Survey, 1998 (Lamuria data)



Source: Field Survey 1998 (M/K data)

5.5 Allocation of Land

The average land sizes in M/K were 8.8 acres while in Lamuria it was 6.6 acres. On average 80% of the land in MK was uncultivated while only 30% of the land in Lamuria was uncultivated. In Lamuria there was maximum use of the small parcels of land and any land remaining was used for livestock grazing. In M/K most of the remaining land was left idle used as a source of fuel or used for communal grazing. Cattle keeping in M/K was minimal

due to the high rate of cattle rustling in the area given that the area is sparsely populated. In Lamuria due to the high settlement rate there were no rampant cases of cattle rustling. Charcoal burning was a practice common among the farming community in the areas where bushes still existed. This was common in M/K where charcoal burning was a survival strategy. In Lamuria in places where the bushes still existed, the rate of charcoal burning was lower than that of M/K since there was higher reliance on livestock keeping for a livelihood rather than on charcoal burning.

Livestock keeping was the main economic activity in the area and hence although some farmers had huge chunks of land uncultivated, they used it for livestock keeping. Those farmers with small parcels of land for example as small as two acres cultivated on the entire piece of land and practicde zero grazing for their livestock. Those who had larger parcels of land like four acres practiced padlocking while those who had up to eight acres grazed their livestock in the open land. In M/K in spite of the fact that livestock keeping was promising in terms of returns, the farmers were hesitant to keep livestock due to the high rate of attacks in the area from the Maasai community. Poultry-keeping was becoming a widespread practice among the farmers for that they cannot keep livestock. This practice had been more effective in the cockerel exchange programme by the extension officers operating in the area. The other option was to depend on the crops and hence the higher rate of adoption as opposed to Lamuria.

5.6 Level of Settlement

The level of settlement was relatively lower in M/K than in Lamuria. The density was on average 30 persons per sq. Km while in Lamuria the density was on average 80 persons per sq. Km (See population density map). There were sections of Lamuria that had densities of as high as 150 persons per sq. Km while in M/K, in some sections it was as low as 25 persons per

sq. Km. This was because Lamuria had a longer history of settlement and hence more densely populated as compared to M/K. Consequently the people in Lamuria had established themselves in the area. The settlement history of M/K showed that majority of the farmers settled there between 1991 and 1995 while in Lamuria the settlement history dates as far back as the 1970s. There was therefore established social and physical infrastructure as compared to in M/K where schools were sparsely distributed and hence attracted fewer migrants. In addition, due to the low settlement rate in MK, the area was prone to wild animals which discouraged the farmers further due the crop damage hence contributing to crop failure most of the time.

We are just at the mercy of adverse weather and wild animals, which strike at their appropriate timing. There is noting we can do because the game office can only compensate if a person is killed and even this takes many years. This affects our progress because even the children cannot attend school when for instance elephants are spotted in the area. Several people have escaped death narrowly with others sustaining serious injuries.

This was what one of the farmers interviewed during the field survey had to say about the wild game attack, which was very common in M/K.

5.7 Other Economic Activities

All the farmers in both Lamuria and M/K practiced farming. However the practice was mainly at the subsistence level hence the need to be engaged in other activities so as to supplement the farm income if any. Of the farmers in M/K, 60% supplemented their income through charcoal burning while in Lamuria 10% of the farmers were engaged in charcoal burning. Casual labour on farms was also practiced by a high percentage of the farmers as a way of earning an income. This was higher in Lamuria since the acreage cultivated per farmer was high and

hence extra paid labour was required. In M/K due to the small parcel under cultivation labour at the household level was adequate.

Plate 5.1 Livestock is a major activity in Lamuria Division

Income supplement through charcoal burning was found to be too labour demanding by the farmers in M/K and hence they were more receptive to the new crop varieties since in good weather the crops did well and farming was less tedious and more rewarding. On the other hand, since the farmers in Lamuria were more stable in farming and livestock keeping, for them to accept the new crop varieties they have to be convinced that the crops were profitable enough.

Due to the fact that the farmers in Lamuria were more established, the penetration of extension services to be fruitful had to prove highly profitable. Since the MK farmers basically relied on

charcoal burning to earn a living especially in bad times they were eager to adopt any technology that could offer hope in their farming activities.

5.8 Awareness of Extension Services

The majority of the farmers both in Lamuria and M/K were aware of extension services operating in their areas. However, in spite of majority of farmers in Lamuria being aware of extension services, few had adopted them. The level of adoption in M/K was 70% showing the level of eagerness that the farmers had. This had a lot to do with the social organisation of the people in the sense that they had a stronger element of interdependency since they faced similar problems. No farmer wanted to exclude him/herself from communal activities due to fear of being isolated even in times of need. In addition, the population of M/K was lower as compared to that of Lamuria and hence the farmers tended to know one another by name. In addition, they came from the same area in Nyeri (Mukurwe-ini). Adoption in M/K was therefore more of a group activity rather than an individual affair. The implication was that the farmers despite having private ownership of land were influenced by the communal opinion.

On the other hand, in Lamuria due to higher population density than M/K there was a higher degree of anonymity and no farmer really cared what their distant neighbour was doing. Learning from fellow farmers was therefore more difficult in Lamuria than it was in M/K since the farmers appeared to be too busy with their own affairs with no time for others.

5.9 Output and Marketing

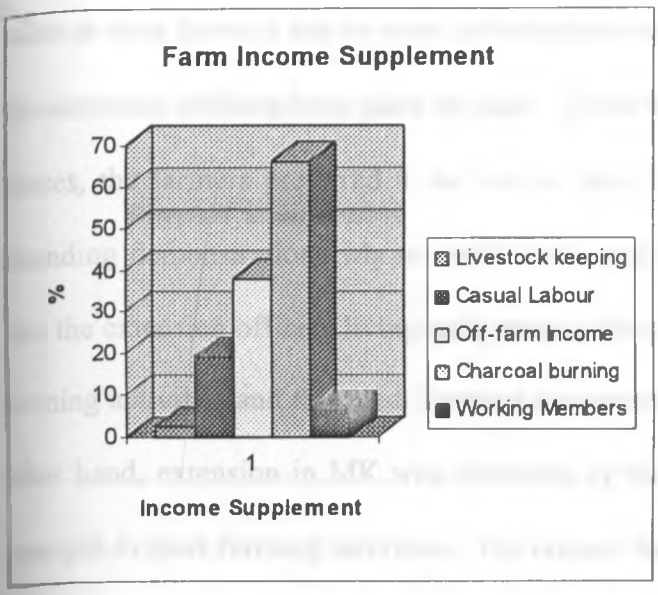
The output level for the crops could only be measured by the output of the traditional crops since the introduced drought escaping crops had not been established yet. There was marketing of crops as a way to supplement the income. Maize, beans and potatoes were the main crops that were traded with and surplus was realised only seasonally. There were farmers who did

not have surplus yet they sold any harvests that they made since their needs tended to be urgent. Maize had the highest output being 35% in MK while in Lamuria it was 30% followed by beans then potatoes. On average, judging by the output of the few farmers who had established their drought escaping crops, the output in M/K was higher than in Lamuria. This was an indication that the farmers in M/K will have higher crop output in the next two years after their crops have stabilised as compared to the Lamuria farmers who since they have not adopted the drought resistant varieties will have less output as compared to the M/K farmers. The crops are high yielding in addition to being drought escaping.

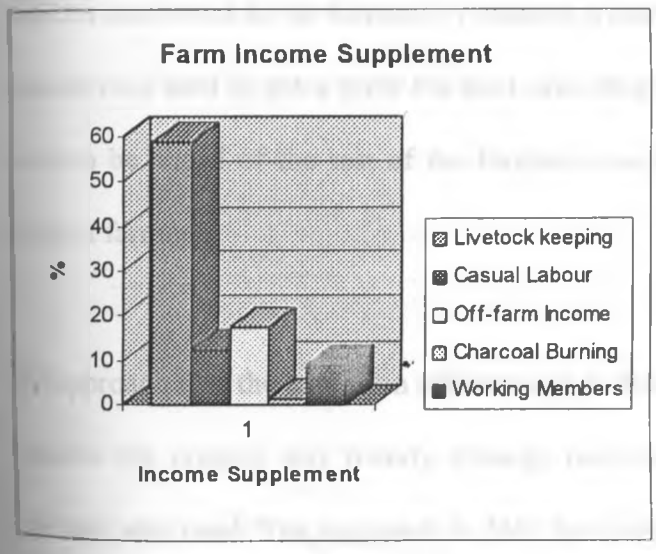
5.10 Farm Income

In M/K 22.5% of the farmers had adequate income from the farm relative to the family budget while 41.1% of the farmers in Lamuria found their income from the farm adequate. Those who hardly survived on the farm income supplemented it through various ways. In Lamuria 18.8% of the farmers supplemented their income through livestock keeping, 12.5% through casual labour, 7.5% through income from spouses, 1.3 from bee keeping and 2.5% got assistance from working members of the family. In M/K 19.2% supplemented their income through casual labour, 6.4% through assistance from working members, 38% from off farm income and 2.6% from livestock keeping.

Figure 5.3



Source: Field Survey, 1998 (M/K data)



Source: Field Survey, 1998 (Lamuria)

5.11 Access to Extension Services

Most farmers had contact with extension agents in the sense that the attendance to field days was high. Of the farmers in M/K, 83% attended field days and demonstrations and hence the high rate of adoption of extension services while in Lamuria the attendance rate was 54%. Most of the farmers in Lamuria gave their reasons for not attending field days as being

committed in other activities. Besides, the extensionists were not able to reach out far and wide to most farmers due to poor infrastructure and lack of vehicles to ease the movement of the extension officers from place to place. When the demonstrations were to be held in far off places, the farmers preferred to be out on their farms or grazing their livestock rather than attending demonstrations whose results were not immediate. There was also the perception that the extension officers living with them in their neighbourhood were not exemplary in their farming activities and this made farmers less motivated in pursuing farming activities. On the other hand, extension in MK was enhanced by the fact that the contact farmers were a good example in their farming activities. The contact farmers were motivated by the constant visits by the extension officers on their farms and did not want their farms to be found untidy. In addition those farmers who performed well on their farms were rewarded by being given prizes and this motivated all the farmers by creating a competitive environment whereby every farmer was striving hard to get a prize the next time they were on issue. The contact farmers always seem to be ahead of the rest of the farmers who felt there was something to learn from the contract farmers.

The approach that the extension officer used in the two areas was different in the sense that in Lamuria the contact was mainly through individual farmer approach while in M/K group approach was used. The approach in MK therefore included anybody who was interested and not a particular group of people in the society. Therefore everyone felt as part of the whole exercise and this organisation led to a higher rate of adoption.

5.12 Age of Respondents

Since the two study areas under comparison were settled at different periods of time, it was found that the farmers in Lamuria are relatively older than those in M/K. According to the analysis, the majority of the farmers in lamuria were in their 41 – 50-age bracket while those in

M/K were in the 31 - 40-age bracket. The chi square test revealed that the tabular X^2 in Lamuria was greater than the calculated X^2, hence the relationship between age and adoption in Lamuria was statistically significant.

5.13 Conclusion

Strong linkages between research, extension and the farmers are crucial in order to ensure that the technologies being promoted are relevant, appropriate to farmers' circumstances and that they timely reach and are utilised by farmers (Kimenye, 1997). Kimenye further says that strong linkages are particularly important for ASAL which are often remote, poorly served by extension and input suppliers tend to have crops that are ranked lowly in national research priority. In the study, it was found that the farmer research linkage was not strong. The researchers ought to understand the point of view of the farmers before going ahead to implement plans that do not take into consideration the priorities of the farmers. Historically, non-adoption of recommendations has been attributed first to farmers' ignorance, to be overcome through more and better extension, and then to farm-level constraints, with the solution in easing the constraints to make the farm more like the research station (Chambers, 1993). This is however not the case as the farmers have been found to be more knowledgeable and better informed than the agricultural professionals suppose. The farmer-extension-research linkage should be strengthened rather than the external intervenors acting like what Chambers described as "development tourists".

The main objective of this chapter was to compare two study areas, that is M/K and Lamuria in terms of adoption of new crop farming strategies and examine what variations exist in the adoption of new technology. Socio-economic factors influencing adoption were examined in terms of how they vary in the two areas in regard to adoption. The analysis demonstrated that, the economic activities, duration of stay in Laikipia, land size, contact with extension officers

were factors that brought about variations in the adoption of new crop farming strategies. M/K had a higher percentage of farmers who had adopted the new strategies that are suited for the area. External actors should therefore bear in mind these variation as they identify entry points among the farming community to introduce new farming techniques.

CHAPTER SIX

EXTENT OF SUSTAINABILITY OF THE INTRODUCED CROPS

This chapter endeavoured to examine the concept of sustainable development in the packages introduced to the farmers with the aim of finding out if they were sustainable. In order to accomplish that task, sustainability of the crops introduced was assessed in three dimensions viz.: - economic, socio-cultural and environmental. This was based on the realisation that any aspect had to be assessed in terms of its economic aspects, socio-cultural and environmental for it to be considered sustainable.

6.1 Economic Sustainability

6.1.1 Affordability of Extension Services

In considering economic sustainability, the study attempts to examine whether the crops introduced had an effect on the income and food sufficiency of the people and also affordable to the ordinary farmer in the long run or whether they left him/her more economically depressed and hence not worth adopting. One would therefore ask questions such as: do the new crops require such high input that the farmer is better off the way he is since he cannot afford the initial requirements? If the inputs in terms of financial resources are too high, is the farmer in a position to reap benefits that will positively offset his expenses in production thus making profit?

It is important to note that the crops are on a trial stage and most of the crops have not yet stabilised in the sense that it was difficult during the field survey for the farmers to tell what yields they had in the last season. However it was clear that the new crops were undoubtedly high yielding given that on average, for instance, for each half a kilo of Soya beans planted one could yield a minimum of 15kgs. And for each 10kgs of Soya beans one could fetch Ksh. 1,000. The produce however was bought from the farmers by the ARU extensionists. One of

their concerns according to the field survey was that they had no place to sell their produce in the event that the ARU extensionists did not buy from them. This aspects leads to the question as to whether there is sustainability regarding the market of the products. Besides, the price of each kilogram of Soya beans is cheaper in the market than the price of Ksh.100 per kilogram offered by the extensionists.

Other questions that could be asked are as to how much an average family requires to survive and how much they actually get from their economic activities. From the field survey it was established that on average each family earned Ksh. 2,500. According to the Economic Survey 1998, the poverty line in rural areas stands s at Ksh. 978. This is an indication that the farmers in the study area were able to earn an income that is above the national poverty line. However, given the many financial requirements that the farmers had and the harsh environment the income can not be said to be sufficient for their needs.

The new suitable crops and crop farming techniques are likely to have an impact on the income of the farmers. This will positively improve the social and physical infrastructure in the area since the farmers will be able to contribute towards their welfare in self-help groups. Improvement in education, health and nutrition will contribute towards eradication poverty and raise the living standards of the farmers. In the long run they will engage less directly in manual labour thus creating job opportunities and hence making the area attractive for settlement. This however will depend on whether the marketing will be enhanced in a sustainable way.

The input requirements as we established from the field were minimal given that the farmers did not have to buy extra inputs for production. In order to have the first crop for trial the farmers did not have to pay any cash for seeds supplied. Farmers who got the chance of getting

the seeds when they were first given out were supposed to give back the same amount of seed to the extensionists so that this could be given to other farmers who missed during the first round. A farmer who was to receive seeds in this kind of an arrangement i.e. seeds given from the farmers who got the seeds first were called the shadow farmers. This was an incentive to the rest of the farmers to adopt the new crops. Initially each farmer who was selected got half a kilogramme for each variety of crop and was in turn supposed to give another a farmer through the extensionists or the elected farmers representative, half a kilogram out of his harvests. The first batch of farmers to be selected for trial of the crops were selected on a basis of the extensionists giving all the farmers numbers then selecting all the odd numbers. Therefore when the extension agents introduced the crops they gave seeds to only a small section of the farmers who in turn shared with the rest of the farmers through the shadow farmer effect. This was more organised in M/K since there was one farmer representative who would receive the farmers contributions and in turn share out to the shadow farmers and this ensured that each farmer got their share at one time. In Lamuria the farmers were themselves to follow up to make sure that they got the seeds from those who were given by the extensionists and this made many disinterested in the whole exercise. This shadow farmer approach requires a high degree of social organisation and commitment on the part of the farmers to the objectives of the extensionists. Therefore the farmer-farmer linkage has got to be strengthened to ensure that the approach is successful.

Furthermore, the pesticide requirement for the new crops did not also cost the farmers a lot of money since the farmers were shown how to make a pesticide using a locally available weed. Among the introduced crops, chick peas variety was heavily infected by pests thus discouraging the farmers from growing it but those who applied the locally made pesticide still had something to reap. However research is still going on so as to improve the crop.

Since the introduction of the new crop varieties the farmers had more crops to depend upon and hence the risk of crop failure had now been spread over more crops and hence if one failed the other could supplement it, meaning that crop failure in this case is not total. Since the material security of the members of the society was enhanced by this package it therefore meant that the economic aspect of the package was well taken care of. In the long run, economic growth would be enhanced thus creating more opportunities for the people leading to economic development. However, marketing of the products is an issue that should be given a lot of weight so as to ensure that the farmers do not get stranded with their products after harvesting when production stabilises.

6.1.2 Accessibility of Extension Services

The economic aspects can also be looked at from the accessibility point of view. This is because if services are introduced yet they are difficult to access they serve no meaningful purpose to those they are intended to help. During the field survey it was established that the access to the seeds that ARU introduced was organised through the shadow farmer effect arrangement which ensured that each of the farmers got the seeds. While in M/K the framers were organised in such a way that the shadow farmers got the seeds from the farmers representative, the farmers in Lamuria were supposed to visit the contact farmers and this discouraged many from visiting the contact farmers. If a given farmer needed to see the extension staff they would look for them either as individuals or through the contract farmers. Upon request, the extension agent would visit the farmers. However, the extension officers would only fail to reach the farmers if the communication was bad otherwise they would meet the farmers upon request. The extension agents would travel on foot to the various destinations and this limited their activities only to areas where they could reach on foot. However, it was uncommon for the farmers to call upon the extensionists out of their own initiative. Most of the time they waited until the extension officers visited them. It is important to note that the

extension officers are not available all the time or as regularly as the farmers would want to see them due to constraints on the ground. The farmers should therefore upon recognising the important role played by the extensionists organise for a mode of transport for the extension officers to their areas or have the contact farmers visit the extension officers and then disseminate the acquired knowledge to the rest of the farmers.

6.2 Socio-cultural Sustainability; Culture and Innovations

Culture is a very important aspect when it comes to adoption of innovations. It is therefore crucial for the external agents to first understand the cultural aspects of the people to whom they intend to introduce changes to so that they can identify the areas of possible conflict with the new technology and find ways of addressing the conflict before introducing the changes to the people. Culture is all about a people's way of life and any introductions into the community must therefore take into consideration the social organisation of the people if the intended changes are to have any impact.

This section therefore aims at examining whether the crops introduced had any socio-cultural hindrances regarding the gender division of labour, eating habits planting times and the tools used. This is aimed at finding out whether the introduced packages were in line with the socio-cultural setting of the people. One would ponder: Do the new packages take into account the culture of the people? Have socio-cultural aspects hindered the adoption of certain crop varieties.

In answering the above questions it is important to note that the migrants in both Lamuria and M/K have maize, beans, and potatoes as the main crops which they have to grow in addition to the introduced varieties. Of the introduced DECs, legumes and tubers have a wide acceptance since they are familiar crops though of a different variety.

The crops do not conflict with the established practices since if it comes to farming tools there is no change since they use the same tools. However, animal drawn ploughs were introduced but they did not have a wide usage mainly not as a result of cultural aspects but because they were not easily accessible. In addition they were expensive since one had to have access to the animals and the plough. The farmers though they understood that this was an easier technique of clearing a larger piece of land in a short time, they found the implements expensive. In terms of labour requirements, it was established that the crops did not call for additional labour on the part of the farmers.

However there was an introduced kitchen garden for vegetables that had to be watered using water from a water pan. The problem was that the manner in which to draw the water from the dam was a dangerous exercise since one had to go right to the water pan and then draw the water using a bucket. Chances of slipping into the dam were high and hence this was a risk. However once the water pan is fully completed there will be installation of a simple water pump though the farmers may not like the idea due to initial costs involved. As for the kitchen garden the women were the ones who were largely involved in the production and hence this brought out an issue of gender division of labour.

Form the field survey it was evident that the farmers were not affected in terms of their social organisation. It was evident that there were no conflicts with their eating habits or their roles. In any case, they were impressed that certain varieties of the introduced crops were multi-purpose in the sense that they could be utilised in many ways. However the acceptability of certain crops as staple cereals was impeded by negative cultural attitudes. For instance, the farmers could not fully embrace sorghum and millet as the main cereals and grow them on large scale. The farmers had a strong fixation on maize as the staple cereal crop and could therefore not accept the millet and sorghum as substitutes despite the fact that they did well in

the area. It was found that most farmers planted them as boundary markings or for ornamental use. As for the root crops cassava was generally believed to be a crop that is used in situations where there is no other alternative for food and hence generally associated with poverty. This attitude influenced negatively its adoption.

As far as the planting time was concerned, there were two seasons just like in the high potential areas. However most of the crops were fast maturing but this was a welcome aspect to the farmers since they were able to reap before the weather became unfavourable.

6.3 Environmental Sustainability

6.3.1 The Environment and the Innovations

The environment is the most important aspect as it is the one that ensures whether economic and socio cultural sustainability are to be achieved. It is where we live and it affects us directly. Conserving it is therefore of paramount importance if farmers aim at reaping any benefits from their activities. Questions to ponder about are: Do the activities carried out enhance environmental conservation or do they degrade the environment further? If they degrade the environment further, is it done out of ignorance or is it done as the last resort to survival?

In order to answer these questions, it is important to assess the activities that the farmers carry out everyday as a means of eking a livelihood and how they affect the physical environment. In M/K the farmers were mainly engaged in charcoal burning as a means of survival and this practice as of now shows serious signs of degradation. They engaged in charcoal burning because they experienced constant crop failures and hence had to find a way of earning a living. There was a ready market for their charcoal in Nanyuki town and even Nairobi. From the field survey it was found that the farmers were not ignorant of the environmental impact of

their activities but they have to survive for today hence charcoal burning. Already they were complaining that the trees they used for charcoal burning were not readily available and they had to source the trees from far away unlike some years back when everything was readily available within the neighbourhood.

In Lamuria, the farmers more relied on livestock keeping for survival and since the settlement density was relatively higher than that of M/K they did not experience problems of cattle rustling. Environmental degradation in Lamuria therefore occurred in the form of removal of the vegetation cover as a result of over-grazing the livestock. There was a tendency to overgraze on the few unsettled plots in the area or on ones yard and this led to removal of the vegetation cover. This tendency leaves the soil exposed and it is easily carried by the rains or the wind further making the area more arid than it is. If this practice could be carried out in a moderate manner it could lead to the farmers benefiting from the organic manure that the livestock could produce and this would enrich their farmers with the required nutrients for increased crop production.

6.3.2 Important Measures Towards Enhancing Environmental Conservation

With the introduction of the new crop packages, there is the aspect of taking care of the physical environment. As a result, several low input soil and water management technologies have been developed and disseminated to the farmers alongside the crops. For instance the farmers had been trained on certain techniques like double digging as a measure to conserve soil and retain moisture in the soil. This was to create awareness on the part of the farmers that regardless of how much input they applied on their crops, if they did not take care of the soil, the crops were likely to perform poorly or fail altogether. The management technologies include:

(a) Planting trees. This was the most widely disseminated technology whereby the farmers

were encouraged to plant selected woodlots. This they were encouraged to inter-crop various trees with crops in order to conserve moisture and prevent soil erosion. The most widely used tree variety was the *Grevillia* locally known as *Mubariti* since this tree variety can co-exist symbiotically with the crops. Apart from the agro-forestry practice the farmers were also encouraged to plant the trees along the boundaries of their farms or to select a given section of their farm and plant trees exclusively. During the field survey it was found out that 92% of the respondents have planted trees on their farms. This they have done for various reasons: 42% have planted trees in order to replenish the vegetation cover, 37% for fuel 11% for fencing and 10% for wind break.

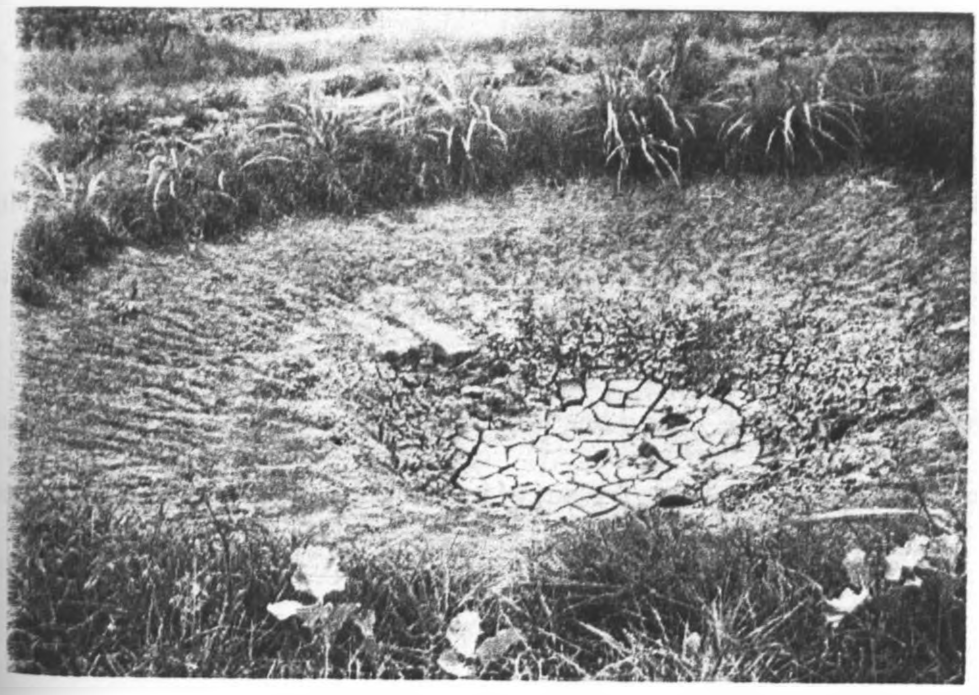


Plate 6.1 Water pan, a strategy to enhance ecological sustainability of the introduced packages

Plate 6.2 Roof catchment, a strategy to enhance sustainability of the introduced technological package

(b) Mulching. This method has been promoted so as to improve the soil and retain the soil moisture. Of the farmers interviewed, 37% practiced it. The soil and water department of the MoALDAM introduced it.

(c) Contour hedges and terracing to conserve soil and water. 45% of the interviewed farmers practiced it. This was as well introduced by the soil and water department so as to prevent further soil loss.

From this analysis it is evident that a package has to take into consideration the economic needs of the farmers, the socio-cultural needs and the environmental needs. This calls for intensive research by trying to understand the farmers conditions since the extent to which the farmers needs are taken into consideration determines the extent to which the introduced innovations will be successful. The tendency among external intervenors is to introduce crop varieties that take into consideration mainly the economic dimension while ignoring the socio-cultural and

environmental dimensions. In addition to being issued with seeds and soil and water conservation techniques, the extension officers also demonstrate the recommended crop technologies regarding planting time, spacing, seed rate, weeding and recommended pest and disease control measures.

It is therefore evident that the technology package by the external agents does not just involve issuing of seeds but also enabling measures for the farmers to perform their task efficiently. This is why several external agents had to be involved so as to manage disseminating the whole package. The chances of conflicts did not arise among the various actors since they were all administering different aspects of the same package. ARU disseminated the crops and demonstrated the requirements; ASAL Programme Laikipia introduced water tanks to harvest rainwater through the roof catchment and water pans.

6.4 Unsustainable Land-use

Unsustainable land use is used to refer to all those ecological processes that do not replenish the resource base after exploitation. Such practices include farming and over-grazing. The farmers who carried out charcoal burning as a survival strategy did not replant trees since the felling was done in the unsettled plots and hence the farmers did not find themselves obliged to replant the trees.

The farmers by growing unsuitable crops upon settlement yielded marginal harvests if any. Besides, since they did not take precautionary measures to prevent environmental degradation this led to increased degradation. Some farmers due to uncertainty found it a risk to adopt the new suitable techniques of crop production. In some cases, the land sizes on which the farmers produced their crops were uneconomical hence low output coupled with unsuitable farming techniques leading to low production.

Plate 6.3 Livestock grazing in unsettled plots which leads to increase soil erosion

6.5 Conclusion

The study set out to examine the extent to which the external actors have influenced the crop production adopted by small-scale farmers in Laikipia. The first objective was addressing the various variables that were being measured and how they influence the adoption of new crops, the second objective was comparing the impact of extension in two different areas while the third objective was examining the sustainability of the crop production in the area. In the first objective it was found that it is crucial to understand the socio-economic background of the farmers since factors like age, age of settlement, land size, income,area cultivated and attendance to agricultural field days and demonstrations were found to be important in determining the extent of adoption of agricultural services. Contrary to the expectation that income level would influence the adoption of the new crops, it was found that this factor did not influence adoption. It was found that even homes where the income was low the farmers still adopted the new crops.

The comparison of the two study areas revealed that the history of settlement and frequency of attendance to agricultural demonstrations determined the extent of adoption of new technology. Therefore, since this differed in the two areas, there was then a variation in the adoption of the introduced crop varieties. Regarding sustainability of the crops introduced it was found that the three dimensions of sustainability have to be taken into account. However during the field survey it was established that the crop varieties introduced had met with some cultural barriers.

CHAPTER SEVEN

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

7.1 Summary of Findings

The study focused on the influence that the agricultural extension officers have on crop production among the small-scale farmers in selected parts of Laikipia district. Influence of extension officers on crop production was studied through an examination of the extension services introduced in the study area, over a period of four years (i.e., since 1994), the agencies responsible for the dissemination of the services and factors that influence adoption of extension services by farmers.

The findings broadly fall under these sub-titles:-the extent of influence by external actors, sustainability of promoted crop packages and comparison of results in two different areas. All these were geared towards understanding why the farmers persisted in their use of traditional farming strategies with marginal yields yet there is external intervention aimed at improving or enhancing yields in the area.

The assumptions guiding the study are that the perceptions of the local actors regarding resource use and their exposure to alternative farm practices that can improve crop production are critical in small scale farmers acceptance and application of new packages promoted and disseminated by the extension officers. Another assumption is that as population increases in Laikipia district the need for institutionalised extension services is important since migrant farmers lack knowledge on the crops suited to the area. From the findings of the study, the first assumption was found to be true since those farmers who were exposed to extension services were found to be more receptive to extension services than those farmers who did not have the

exposure. The exposure to farming strategies suited to the area through farmer-extension linkage gives the farmers the confidence to try out new technology. The study demonstrated that those farmers who had more contact with extension agents adopted the new crops more than those who did not have the contact. This confirmation rejects the null hypothesis (H_o) that there is no significant difference between the adoption rate and the contact between the farmers and the extensionists. Thus regular contact between the external actors and the farmers is crucial if the introduced packages are to bear fruit.

In addition, the farmers will need institutionalised extension services once they migrate into the area since they normally undergo a process of trial in an effort to find out the suitable crops for the area. The second null hypothesis of the study is also rejected on the basis that it was stating that there is no statistically significant difference between the farmers' population increase in the study area and the need for institutionalised extension services. The fragile ecology of the district needs to be conserved and utilised in a sustainable way given that the population increase is inevitable. The district's population growth rate of 4.56 per cent per annum is higher than the national growth rate of 3.34 per cent per annum. It is costly to the environment to have the farmers continue utilising the resource base of the district on a trial and error basis and hence external actors must of importance work closely with the farmers.

The theoretical framework of the study was based on two propositions. First, that man is profit-maximising and secondly that acceptance and adoption of new innovations depends on the perceived profits bearing in mind the risks involved. If for instance an external agent introduces something new to farmers like new crop varieties, the farmer does his own cost benefit analysis and if he/she is not certain of any benefits (profits) then he/she is unlikely to

adopt the innovations. The innovations may call for more input for instance in terms of labour, fertilisers, farm tools and water than what the farmer is used to. In addition, the introduced packages may conflict with the existing cultural system for instance affecting the decision-making structure. If on the other hand the introduced package requires nothing more than normal labour that the farmer uses during the other times, chances of acceptance of the innovation are higher. Indeed the external agent may give the initial seeds for free or at a subsidised price. This may act as an incentive for the farmers to adopt for trial. The external agent ought to hinge his/her entry point on the profitability of the introduced package and the profits should prove to be higher than what the farmer is currently getting.

The second theoretical proposition is that farmers are risk averting and will avoid any innovations likely to increase risks. This proposition is closely related to the first one since the farmer is concerned about risk minimisation thus implying profit maximisation. However, in this proposition the farmer is not very keen about the profits as he/she is out to avoiding risks. In this case the farmer would rather remain with what he/she has rather than trying out something new which may be detrimental to his/ her survival. From this it is clear that the factors that influence the adoption of new technology are guided by risk aversion and profit maximisation.

7.1.1 Influence of External Actors on Crop Production

Agencies offering extension services to the farmers other than the government extension services showed significant opportunities for strengthening farmer-extension linkage and thus enhancing the dissemination of technology. From the analysis it was demonstrated that over 60 per cent of the external contacts that the farmers had with external agents were an initiative of

ARU-ASAL which is a quasi-government organisation collaborating with the government ministries. Traditionally the government has been the dominant agency in the transfer of extension services to the farmers. However, this role is changing with private organisations coming in due to the government's reduced capacity due to a decline in government resources.

However, the study revealed that the extension-farmer linkage is weak and if the introduced packages are to have any impact on the farmers, then the linkage ought to be strengthened. The extent to which the resources can be managed in a sustainable way entirely depends on the farmers since they are the basic resource extractors. Thus if left on their own the basic concern would be survival and satisfying individual needs irrespective of sustainability in resource use.

Diffusion of the introduced extension services was spreading from farmer to farmer. However for such diffusion to yield the desired fruits, of sustainable development, the farmers have to be exposed to the external agents. This is important an in the first instance so that when the farmers spread innovations to one another, the packages can be those that are geared towards sustainable use of the resources and to the positive impact and wider acceptance.

7.1.2 Factors Influencing Adoption of Introduced Extension Services

The study found that adoption of new technology among the small-scale farmers does not happen in a vacuum but is affected by socio-cultural characteristics of the farmers. These include: age of respondent; level of education, duration of stay in the study area since settlement, contact with extension agents, land size and economic activities. These are the factors that influenced the farmers as they evaluated whether a given technology was profit maximizing and thus were able to avert any real or perceived risks.

Age: Age was found to be an important factor in determining adoption of new technology. There was a statistically significant relation between the age of a given respondent and the adoption of new technology. In introducing new technology therefore the age dynamics ought to be understood so that areas of opposition to the introductions can easily be identified.

An elderly person has lived for long and thus established a routine way of doing things. Such people once they set their mind on a given thing are hard to change. In this case the introduction of new crop varieties was not eagerly received by the old people. Younger people are eager to try out new things.

In Lamuria, the majority of the farmers settled in the area in the 1970s and most fall in the age bracket 41-50 years. On the other hand, the farmers in M/K mostly migrated into the area in the 1990s and most of them fall in the age bracket of 31-40 years. Research findings showed that farmers in M/K adopted the new crops more than the Lamuria farmers indicating that age is an important factor in determining adoption of new technology in combination with other socio-economic factors.

Education: The research findings reveal that there is a significant relationship between the level of education and adoption of new technology. The majority of the respondents in the study area were literate with the majority having attained a primary level of education. However, education on its own cannot influence adoption of technology and therefore has to be seen in line with other factors.

7.1.3 Land Size and Land under Crop Production

Land size is an important factor in determining whether one would adopt a new technology. Research showed that if a farmer had a small piece of land, they were unlikely to give up much space for trial of new crops. In this study, it came out clearly that for a farmer to sacrifice a little space for trial of new crops, there must be convincing evidence that the undertaking is profitable. Farmers with big pieces of land over five acres were found to be willing to experiment on new crops as opposed to those with small pieces of land.

In Lamuria due to small land acreage, the farmers were unwilling to give up even a small portion for growing crops they were not sure about the productivity. This was made worse by the fact that the contact with extension was not strong enough to make the farmers assured that the new crop varieties would do well. In this area the farmers averted any risks by not trying the new crop varieties at all. On the other hand the farmers in M/K who had larger pieces of land when compared to Lamuria were willing to sacrifice a portion of their land for trial of the new crops. Besides, constant contact with the extensionists assured them that the crops would do well.

The research showed that those farmers who had large pieces of land cultivated only a small portion while those who had small parcels cultivated a large portion leaving only a small section lying uncultivated.

7.1.4 Contact with Extension Officers

Farmers who had more contact with extension officers through visits to agricultural extension demonstrations and field days had adopted the extension services at a higher rate than those

who had minimal or no contact with the extension officers. This implies that exposure to new technology is critical in determining the extent to which introduced extension services will be adopted. Adoption of new crop varieties that are suited for the area means that crop production would be higher.

7.1.5 History of Settlement

The duration that a given farmer has stayed in the study are since settlement was found to be important in determining the adoption of new technology. The relationship between the duration of stay and the adoption of new technology was found to be statistically significant. Those farmers who had settled in the study area for longer periods were found not to adopt the new technology as those who had settled for a shorter duration of time. This was because those who had settled for longer were found to have an established economic activity and thus were not eager to embrace new technology.

7.1.6 Comparative Analysis of Lamuria and Mutirithia /Kariunga

Given that the farmers who settled in the two study areas came from the same district of origin (i.e., Nyeri) adoption of new extension services in the two study areas was likely to have been influenced by variations in the settlement history of the two areas. Generally as people live longer in an area, they establish a way of doing things by trying as much as possible to avert risks. Without any external guidance on how to achieve adaptability in the area, they go through numerous failures and finally settle on a way of ensuring survival.

In Lamuria, the farmers have a longer history of settlement and mainly grow maize, beans and potatoes. In addition cattle keeping for milk production is a major economic activity. By

virtue of the higher settlement density in Lamuria than in M/K, it is more secure to keep livestock in Lamuria since the chances of rustling are not as high in M/K where the settlement density is low and where constant cattle rustling is a problem. On the other hand farmers in M/K are still in the adjustment stage and hence the ease with which new ideas are tried. As noted above, the majority of the farmers are much younger than those in Lamuria and have a higher level of education. The implication of this finding is that external intervention is more likely to be accepted by the new settlers than by older settlers. The emphasis should be on the need for sustainable land-use planning in the ASAL. The need for this undertaking is based on the land fragility.

7.1.7 Sustainability

The study addressed itself to the issue of sustainable development because unless resource users bear this principle in mind the resource base is likely to be depleted in an irreversible way. From the research findings it is clear that there are aspects of sustainability that have not been fully addressed. As for the economic sustainability, the issue of establishing an external market for the crops that are introduced has not been fully addressed. The farmers who are growing Soya beans for instance in M/K do not have an established external market for their produce. This is not a sustainable market system since in the event of the external agents withdrawing, the farmers will be left with no market for their produce.

The other aspect is the linkage between the farmers and the extensionists. The contact is not regular and if the introduced packages are to be considered sustainable the linkage with the farmers should be strengthened.

The external agent should also link the farmers to the researchers and input suppliers so that the farmer can have more contact with a broader spectrum of external agents and thus stay abreast with the latest technology in crop production. Thus researcher-input supplier-extensionist - farmer linkage which the findings revealed to be weak should be strengthened and all these actors should collaborate in their activities.

The study also found that the external actors are faced by many constraints and this hinders their effectiveness to the farmers. Thus for the initiated development to be sustainable, the initiators should also be free of any constraints. There is poor motivation of extension officers since the pay is poor, the chances of promotion are rare, individual effort is not recognised, there is lack of demonstration material, lack of transport and in some cases the extension officers are overloaded with work by being assigned many farmers. The ideal ratio of extensionist: farmer is 1:400-500. However there are many cases when a given worker is assigned up to 1500 farmers. Thus in order to achieve sustainable development, this matter should not only be looked at from the angle of extension officers and small-scale farmers but also from the most conducive conditions for the transfer of technology.

7.1.8 Conclusion

Most migrants currently settled in Laikipia District come from Central Province where land is scarce on account of rapid population increase. Farmers coming from those areas are not adequately equipped with appropriate knowledge and skills that would enable them to adapt in the ASAL environment. On their own, they expected that once they were settled in the new lands, they would start developing their new plots using the technologies they had used in their areas of origin and derive appreciable yields that would ensure household level of food

sufficiency and surplus.

Unfortunately, crop production activities proved to be disappointing characterised by constant crop failure hence persistent food shortages. Agriculture extension services have therefore endeavoured to introduce new crop varieties that are suited for the area and offer guidance on soil and water conservation measures. This intervention is an important step forward in the campaign for sustainable use of natural resources. If farmers are left to operate on their own without external intervention, their main concern is survival even when farming practices may result in environmental degradation.

However for external intervention to be accepted, by the farmers, the external agents must understand the factors that influence risk aversion among the farmers so as to find appropriate entry points.

7.2 Recommendations

From the study the major constraints that emerged in the crop production as far as dissemination of extension services is concerned are:

a) Lack of constant extension contact between the farmers and the extension officers
b) Unsustainable resource use
c) Human-wildlife conflict
d) Drought hence crop failure
e) Poor communication hence inability of extension workers to reach the farmers.
f) Insecurity

g) Lack of Information

7.2.1 Strategies to Address Lack of Extension Contact

From the analysis it was found that those farmers who had more contact with the extensionists had a higher adoption rate than those who had little contact or no contact at all. The agencies involved in the provision of extension services should therefore ensure that they enhance the contact through increasing the frequency of visits to the farmers. From the analysis of responses by extension officers in the field, it became clear that they were unable to reach as many farmers as they would have wanted as a result of being allocated large geographical areas to cover. Therefore the Government and other agencies involved in extension service delivery should increase the number of extension officer per give unit. Ideally, where mobility is guaranteed or assumed an extension agent, (that is) a front line extension worker is assigned 400-500 contact farmers. The implication of this is that the extension agent should be able to handle this number of farmers in his/her daily activities. Since extension officers do not have secure means of transport, the alternative is to reduce the geographical areas assigned to extension officers.

Field extension workers reported that they lack facilities for field demonstration. They also lack transport to the respective places they wish to visit. Motorbikes and bicycles should be provided to enhance movement. Demonstration materials should be available with the officers at the agricultural offices so that the field worker can have easy access to them when they need them for demonstrations. An alternative is to identify and train innovative local farmers as extension workers. This way, extension personnel would be working within their home areas thereby improving the possibilities of farmers being in contact with change agents on a

continuous basis. Extensionists should mobilize the farmers to use the new crops suited for the area through on-farm training, farmer tours, field demonstrations, field days, farmer visits and public meetings like chief's *barazas.*

The extension agents should also be trained to ensure that they are in touch with the latest information and practice in crop production.

7.2.2 Strategies to enhance Sustainability

In order to enhance sustainability of the introduced packages, the external actors should consider the impact of socio-cultural aspects, the economic status and the ecological knowledge of the people to whom the packages of innovations are introduced. Research should be carried out within the community where the external agencies wish to introduce packages so that likely constraints during the dissemination could be identified. Aspects like income, age, land size settlement history, contact with extension should be addressed so that the extension agents can find ways of dealing with constraints that are of socio-economic nature.

Due to unreliability of rainfall, extension agents should also engage in water conservation measures. Roof catchment and water pans are being encouraged at an individual household level but regional water management programmes should be enhanced to ensure water availability for upstream and downstream users. Marketing channels should also be enhanced so that the farmers can feel encouraged to produce more. Some farmers are frustrated due to lack of marketing channels.

7.2.3 Strategies to Address Conflicts

Damage of crops by wildlife is a major problem especially in M/k. This factor discourages the farmers in their efforts to increase crop production. KWS should therefore take measures to protect the farmers by erecting electrical fences in areas bordering the regions where there are wild animals so as to have a clear demarcation between the wildlife zones and the human settled area. The alternative is to introduce communities in the sharing of revenue from wildlife.

7.2.4 Strategies to Establish a Cash-crop for the Area

The farmers should be educated to appreciate that crops like Soya beans sunflower and mulberry can be used as cash crops. A problem regarding economic viability of the land is that after land sub-division the plot sizes were not economically viable for large-scale farming. The farmers have the option of land pooling so as to have bigger plots and embark on large-scale production of cash crops. If the farmers are to realize reasonable harvests by growing crops on a large piece of land and if sustainability were to be achieved, a land size of 200 acres would be required in the agro-ecological zone V.

7.2.5 Strategies to Improve the Infrastructure

One of the main problems affecting the smooth dissemination of extension services and marketing of produce is the poor infrastructure on the area. This affects the movement of the extension officers and services to the farmers. Input suppliers have problems trying to stock the seeds due to poor roads. During the rainy seasons even four wheel vehicles cannot move to some areas. The county council of Laikipia and the ministry of public works should ensure that the roads in the area are upgraded so that the input and output can flow smoothly.

7.2.6 Strategies to Enhance Farmer-extension-researcher Input Supplier Linkage

The farmer-extension linkage is enhanced through regular visits by the extensionists to the farmers. The farmer-research linkage is enhanced through on-farm innovation trials and visits by the farmers to the research stations. Such visits should be increased. The best strategy for establishing on farm innovations for groups of farmers is by encouraging all to participate in the innovations for instance by assigning them duties in the care of the trial crops planted. The extension agents have the tendency of using specific farms as demonstration farms. This should be changed so that extension officers can rotate from farmer to farmer each season so that all the farmers can feel truly involved in the extension exercise.

The extension-input supplier should be enhance by the extension agents collaborating with the farmers so that they (input suppliers) can also provide advise to the farmers. Currently they are operating as separate entities that are doing unrelated work. This could probably be as a result of the agents not appreciating each other's contribution towards the farmers.

7.2.7 Strategies to Improve on the Approach

The extension agents use individual farmer approach and group approach. The more ideal approach is the group approach since more farmers are reached within a short time. In cases where the farmers are supposed to visit the follower farmers, they do not do so. Groups should therefore be strengthened so that they can remain cohesive so that the extension agents can disseminate their information with ease through the groups. The group approach may have a different impact from the individual approach since the farmers may really appreciate the fact that the extensionists pay particular attention to them. Given the constraints on the ground regarding the dissemination of extension services the group approach is preferable since more

farmers are reached within a short period of time.

7.2.8 Strategies to Address Lack of Information

The migrant farmers do not have access to information that can assist them when they settle so that they can adopt suitable resource use strategies. There should be enough extension officers who are ready to advice the farmers on the appropriate farming strategies. Information meant for the farmers in the locational or divisional offices should be availed to the farmers in a language that they could understand and be available always at the request of the farmers. The alternative is for the extension officers to organize regular training for the farmers moving into the area, farmers' trips and mobilization campaigns so that the farmers can get information regarding the suitable resource utilisation strategies for the area. The extensionists should also stay with up to date information by attending seminar and courses.

7.3 General Conclusion

This research on the influence of external actors on crop farming strategies adopted by small scale farmers revealed that the success of the external agents is influenced by socio-economic and cultural factors of the local actors (small scale farmers). Farmers' decision to adopt the new innovations is primarily influenced by the satisfaction of the basic needs for survival. If the farmers find that their survival is not threatened by new innovations, they often adopt innovations. Variations in the household characteristics in the two study areas have been shown to influence the rates of adoption of the same crop and general farming techniques. For the new crop farming techniques to be said to be sustainable all the aspects of sustainability should be considered. These include economic, ecological and social cultural sustainability. Since all these aspects were not found together in all the cases then there is room for

improvement in order to achieve sustainable development. The external actors' influence can only be realised if it impacts positively on the small-scale farmers ability to not only survive but to realize profits from farming.

Areas of Further Research

The study could not fully cover a broad scope due to time and financial limitations. Consequently, the following have been suggested as further areas of research:-

1. The impact of settlements and farming on the environment. Though this was covered in this study, there is need for a detailed study on this aspect.

2. The role of deciding actors in natural resource use. In the current study, the main focus was mainly on one category of deciding actors, that is, the external actors in agricultural activities. There is therefore need to examine the role of the other deciding actors in detail and also do a comparative study of their roles in natural resource use.

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APPENDIX 1.0

The Influence of External Actors in Promoting Adoption of Crop Production Strategies among Smallholder Farmers in Laikipia

Smallholder Farmers' Questionnaire

Questionnaire Number .....

PERSONAL DETAILS

1. Name of respondent .....***.....

2. Location .....

3. Sub-location .....**....

4. Date of Interview .....

5. Gender
   - Male [ ]
   - Female [ ]

6. Marital status
   - Married [ ]
   - Single [ ]

7. Who is the household head?
   - Male [ ]
   - Female [ ]

8. Age of the respondent?
   - Below 18 years [ ]
   - 18 to 30 years [ ]
   - 31 to 40 years [ ]
   - 41 to 50 years [ ]
   - Above 50 years [ ]

9. Respondent's level of education
   - No Education [ ]
   - Primary [ ]
   - Secondary [ ]
   - Post secondary [ ] Specify .....

HOUSEHOLD CHARACTERISTICS

1. What is your household size by gender?
   - Number of males .....
   - Number of females .....

2. Of these, how many are married?
   Number of males .....
   Number of females .....

3. How many are working? (specify where)
   Number of males .....
   Number of females .....

4. How many are in school?
   Primary: Number of males .....
   Number of females .....

   Secondary: Number of males .....
   Number of females .....

   Post-secondary: Number of males .....
   Number of females .....

5. How many are currently living here with you
   Number of males .....
   Number of females .....

6. Are you paying fees for those in school? Yes [ ]
   No [ ]

7. If yes, how much (in total) are you expected to pay as school fees this term (first term)?
   ..... Ksh.

8. Do the working members of the family provide any support for the family?
   Yes [ ]
   No [ ]

9. What is your economic activity? Farm (specify) .....
   Off-farm (specify) .....
   Both (specify) .....

10. What economic activity does your spouse engage in?
    Farm (specify) .....
    Off-farm (specify) .....
    Both (specify) .....

11. What is the level of education of your spouse? .....

HISTORICAL BACKGROUND

1. What is your area of origin? ..... (District)

2. When did you (or your family) settle in Laikipia? ..... (year)

3. What prompted you to migrate into Laikipia?
.....
.....
.....
.....

4. Is this land better or worse than you expected?
Better [ ]
Worse [ ]

5. Please give an explanation for your answer above
.....
.....
.....

6. What is the size of your land in acres? .....

7. Do you own or rent the land?
Owned [ ]
Rented [ ]
Others (specify) .....

8. If you own the land, how did you acquire it?
Through inheritance [ ]
By share capital purchase [ ]
Others (specify) .....

9. If rented what are the terms of lease?
.....
.....

CROP PRODUCTION

1. What crops were you growing in your area of origin?
.....
.....

2. What crops do you grow in the farm-plot (here in Laikipia)?
.....
.....

3. What is the proportion of land under each crop in acres?
.....
.....
.....

4. What is the basis of plot allocation per crop?
.....

5. What other land uses are in the remaining piece of the land?
.....
.....
.....

6. Ever since you settled in Laikipia, have you expanded your land under crop production?
Yes [ ]
No [ ]

7. If yes, when did you expand it? ..... (year)

8. Why did you to expand the cropland?
.....
.....

9. What are the yields for the last four seasons per each of the crops mentioned above?

Crop	1996/season1 Bags or Kgs	1996 /Season 2 Bags or Kgs	1997 /Season 3 Bags or Kgs	1997 /Season 4 Bags or Kgs

10. Of these crops which ones did you start planting soon after settling in Laikipia?
.....
.....

11. Which of the crops did you adopt later?
.....
.....

12. What has prompted you to adopt these new crops?
.....
.....
.....

13. Are there crops that have been introduced recently in this area?
Yes [ ]
No [ ]

14. If yes which ones?
.....
.....

15. Of these crops which ones have you adopted?
.....
.....

16. Which agencies or departments are responsible for these recent introductions?
.....
.....

17. Are there crops you have tried growing here but later dropped?
Yes [ ]
No [ ]

18. If yes which are these crops?
.....
.....

19. What has prompted you to drop them? (Give an explanation per each crop dropped)
.....
.....
.....

20. Are all the crop varieties that have lately been introduced that are not acceptable in your culture
Yes [ ]
No [ ]

21. If no, which ones are not acceptable or valued?
Non-acceptable:
.....
.....

Less valued:
.....
.....

22. What aspects of culture do they conflict with?
.....
.....

23. Does the income from the farm sustain the family?
Yes [ ]
No [ ]

24. If no how do you supplement it?
.....
.....

25. Do you use certified seeds?
Yes [ ]
No [ ]

26. If yes, for what crops?
.....
.....

27. Where do you get these seeds from?
.....
.....

28. What amount of seed do you acquire per season on average for each crop?

Seed	Average quantity per season (kgs)

29. Are these amounts adequate for your planting needs?
Yes [ ]
No [ ]

30. If no where do you get the balance so as to plant enough?
.....
.....

31. Has the use of certified seeds improved your output?
Yes [ ]
No [ ]

32. If yes, in what ways?
.....
.....

33. Are there some crops for which you do not use certified seeds?
Yes [ ]
No [ ]

34. If yes which crops are these?
.....
.....

35. Why don't you use certified seeds for these crops (mentioned above)?
.....
.....

36. If no, what seeds do you use?
.....
.....
.....

37. Give reason for your answer
.....
.....

38. What farm implements do you use?
.....
.....
.....

39. Have you always used them or did you start using them at some point?
Always used these farm implements [ ]
Started using these farm implements at some point [ ]

40. If you started using these farm implements at some point, when did you start?
..... (year) ..... (season).

41. What led you to start using these farm implements?
.....
.....

41. Are there notable changes you have found associated with the application of these farm implements?
Yes [ ]
No [ ]

43. If yes, which are these
.....
.....
.....

44. Do you use the following on your farm;
(a) Pesticides /chemical inputs:
Yes [ ]
No [ ]

(b) Artificial fertilisers:
Yes [ ]
No [ ]

(c) Organic manure:
Yes [ ]
No [ ]

45. Specify for which crops you use them (tic the appropriate box)

Crop	Pesticides	Artifical Fertilisers	Organic manure

46. For how long have you been using these inputs (years)?
    (a) Pesticides /chemical inputs .....
    (b) Artificial fertilisers .....
    (c) Organic manure .....

47. What improvements have you noticed as a result of using them?
    .....
    .....
    .....
    .....

48. What is the total cost of your inputs per season?
    .....
    .....
    .....
    .....

49. Do you irrigate your farm?
    Yes [ ]
    No [ ]

50. Where do you get the water from?
    .....
    .....

51. What crops do you irrigate?
    .....
    .....

52. What problems do you encounter in the crop production sub-sector?
    .....
    .....
    .....
    .....

EXTENSION SERVICES

1. Are you aware of agricultural extension services in this area?
    Yes [ ]
    No [ ]

2. As a result of your knowledge, have you adopted the extension services on your farm?
    Yes [ ]
    No [ ]

3. If yes, please expound on the extended services you have adopted?
    .....
    .....

4. What prompted you to adopt extension services?
.....
.....
.....

5. When did you start using the extension services? ..... (year)

6. How do you compare your experience while using the extension services and before adoption?
.....
.....

7. Would you say your farming techniques have improved as a result of your access to extension services?
Yes [ ]
No [ ]

8. If yes, in what ways?
.....
.....

9. Do you have problems in getting access to extension services?(specify)
Yes [ ]
No [ ]

10. If yes, please explain:
.....
.....

11. Are the extensionists available when you need them?
Yes [ ]
No [ ]

12. Give reason for your answer
.....
.....

13. Do they come to you or do you look for them?
Extensionists come to the farm [ ]
We go out looking for the extensionists [ ]
We meet during farmer /filed days [ ]
We only have an exchange in demonstration plots [ ]
Any other (specify) .....

14. How often do you meet the extensionists? .....

15. How often do extension personnel visit your farm? .....

16. How would you describe your relationship with the extensionists.
    Friendly [ ]
    Indifferent [ ]
    Others [ ] (explain) .....

17. How would you describe the extension services
    Helpful [ ]
    Unnecessary [ ]
    Others [ ] (explain) .....

18. How often are farmer /field days organised in this area? .....

19. Have you been attending all the farmer /field days?
    Yes [ ]
    No [ ]

20. If no, please explain the reasons:
    .....
    .....

21. Would you carry on with the adopted packages even on the event of the extensionists' withdrawal?
    Yes [ ]
    No [ ]

22. Give reasons for your answer:
    .....
    .....

23. Have you ever attended a farming course in a Farmers' Training College?
    Yes [ ]
    No [ ]

24. If yes, where did you attend the course? .....
    when was this? ..... (year)

25. What did you learn in the course
    .....
    .....

26. Are you applying what you learnt in the course on your farm ?
    Yes [ ]
    No [ ]

27. By comparing yourself to a farmer who did not attend the course, would you say you are better off?
    Yes [ ]
    No [ ]

28. If you have not attended a course in FTC, give reason for this case:
.....
.....

29. Would you be interested to attend such a course in future?
Yes [ ]
No [ ]

30. What would you like to learn to improve your crop production systems through such a training?
.....
.....
.....

NON-ADOPTERS OF EXTENSION SERVICES AND PACKAGES

1. If you are not using extension services on your farm, give reasons for this.
.....
.....
.....

2. What aspects of your crop farming systems would you need assistance in?
.....
.....

3. Would you like to adopt some new extension packages on your farm if you were give a chance?
Yes [ ]
No [ ]

4. Give reason for your answer:
.....
.....

5. By comparing yourself to some farmers around (or elsewhere) you know who have adopted some extension packages on their farms, how would you rate yourself in crop production?
Better-off [ ]
Worse-off [ ]
Indifference [ ]
Others [ ] (specify) .....

6. Give reasons for this:
.....
.....

7. What is your view regarding the extensionists and their role in the crop production sub-sector?
.....

OUTPUT AND MARKETING

1. Do you have crop surplus from your farm?
   - Yes [ ]
   - No [ ]

2. If yes for which crops mainly?
   .....
   .....
   .....

3. How often do you get the surplus?
   - Daily [ ]
   - Weekly [ ]
   - Monthly [ ]
   - Seasonally [ ]
   - Others [ ] (specify) .....

4. Specify for which crops and frequency:
   .....
   .....
   .....

5. How do you utilise the surplus?
   .....
   .....

6. Are there crops that are grown exclusively for sale
   - Yes [ ]
   - No [ ]

7. If yes, which ones?
   .....
   .....

8. If you sell your surplus do you experience marketing problems?
   - Yes [ ]
   - No [ ]

9. If yes, what do you attribute to the marketing problems?
   .....
   .....

10. What possible options do you suggest can be put in place to address the issue?
    .....
    .....

11. Have received any assistance from the extensionists to address the marketing problem
    - Yes [ ]
    - No [ ]

12. Give an explanation for your answer:
.....
.....

ENVIRONMENTAL ISSUES

1. Apart from crop production, what other economic activities are you engaged in?
   - Livestock keeping [ ]
   - Charcoal burning [ ]
   - Commercial business [ ]
   - Formal employment [ ]
   - Others [ ] (specify) .....

2. If charcoal burning is one of your other activities, how often do you undertake it?
.....

3. Where do you source the required trees for burning the charcoal?
.....

4. What wood species are commonly used for this practise?
.....
.....
.....

5. How available are these species in the neighbourhood?
.....
.....

6. Would you go ahead with a farming strategy that degrade the environment but gives high yields?
   - Yes [ ]
   - No [ ]

7. Give an explanation for your answer:
.....
.....

8. What major environmental problems do you encounter in your farm-plot?
   - Soil erosion [ ]
   - Depletion of wood-cover [ ]
   - Human - wildlife conflicts [ ]
   - Others [ ] (specify) .....

9. How do you go about solving each of them?

Problem	Approach 1	Approach 2	Approach 3
Soil Erosion			
Depletion of wood cover			
Human-wildlife conflict			
Others			