COMMUNITY RESPONSE TO THE INTRODUCTION OF NEW AGROFORESTRY TECHNOLOGIES IN THE LWIIMBA RESETTLEMENT SCHEME OF CHONGWE DISTRICT, ZAMBIA

BY

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APPROVAL

THIS DISSERTATION BY MIKALA SIKAAZE BWALYA IS APPROVED AS FULFILLING THE REQUIREMENT FOR THE AWARD OF THE DEGREE OF MASTER OF SCIENCE (GEOGRAPHY) BY UNIVERSITY OF ZAMBIA.

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I, **MIKALA SIKAAZE BWALYA,** declare that this dissertation represents my own work and it has not previously been submitted for a degree at this or any other University. All published work or material from other sources which have been incorporated have been specifically acknowledged and adequate reference thereby given.

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DEDICATION

To my beloved husband, John, who has consistently given me the support I ever needed and to whom my success is joy. To my two sons, Mulumba and Nchimunya, whose time has come, so that they might aim high in their educational pursuits. To my parents, for having sacrificed so much in laying the foundation for me to get this far.

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LIST OF ABBREVIATIONS

AFRENA	-Agroforestry Research Networks for Africa
CF	- Conservation Farming
CTA	- Technical Centre for Agriculture
DACO	- District Agricultural Co-ordinator
ECZ	- Environmental Council of Zambia
FAO	- Food and Agricultural Organisation
GRZ	- Government of the Republic of Zambia
ICRAF	- International Centre for Research in Agroforestry
IUCN	- International Union for the Conservation of Nature
IRDP	- Integrated Rural Development Programme
LM	- Land Management
LRS	- Lwiimba Resettlement Scheme
NORAD	- Norwegian Agency for International Development
NGO	- Non-Governmental Organisation
PCA	- Principal Component Analysis
RSCU	- Regional Soil Conservation Unit
SADCC	- Southern African Development Co-ordination Conference
SCA	- Soil Conservation and Agroforestry
SCAFE	- Soil Conservation and Agroforestry Extension
SIDA	- Swedish International Development Authority
USSR	- Union of Soviet Socialist Republics

ABSTRACT

The purpose of this study was to assess the response of farmers in the Lwiimba Resettlement Scheme to the introduction of three agroforestry technologies namely improved fallow, contour vegetation bands and fodder banks.

The study involved a field survey in which all the 55 farming households including the agricultural extension officer in the resettlement scheme were interviewed. Informal discussions were also held with relevant authorities and, secondary data search provided additional information.

The study revealed that farmers in the resettlement scheme recognise the value and potential of the three agroforestry technologies introduced in improving their agricultural production. About 60% of the farmers have tried to implement at least one of the three agroforestry technologies that were studied. Improved fallow attracted the highest adoptions while fodder banks registered the least. Adoptions were found to be a function of several factors of which farm size, experience and awareness were found to have significant influence. Improved crop yields, control of both soil erosion and animal movement were reported among the benefits experienced by adopting farmers.

Based on the findings of the study, it was concluded that LRS farmers responded positively to the introduction of agroforestry techniques, since over half (60%) have attempted one or more of the techniques studied.

The adoptions could be increased and maintained by attending to the need for expert training on the propagation of tree nurseries. Organisational structures, also, have to be put in place to ensure that the techniques adopted continue being practised after the funding of the project ends.

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CHAPTER ONE

INTRODUCTION

This chapter provides background information on the main issues concerning the study of the response of farmers in Lwiimba Resettlement Scheme to the introduction of selected new agroforestry techniques by SCAFE.

1.1 Agroforestry: The Prospect of Third World Agrarian Revolution.

Agroforestry is a term increasingly being used in agricultural circles. In literature, it is often presented as a practice that has much to offer to rural agricultural societies, especially in Third World countries and Africa in particular. At the centre of the whole practice of agroforestry is the tree. All over the world, trees are symbolic of life but in Africa, they are more than symbolic as they hold hope for the restoration of life to barren landscapes, the provision of essential fuel, the enrichment and anchoring of the soil, the provision of food for both people and animals, the improvement of farm yields and the holding back of desert conditions from spreading.

In Africa, agroforestry as a science is only a few decades old while as a practice it has existed from time immemorial. It is the term agroforestry itself that is new. Among the various definitions of the term agroforestry, is one presented by Maydell (1982:7) as: "a science based on forestry, agriculture, animal husbandry, acquaculture and fisheries, land resource management, and other disciplines which all form the systematic background of landuse"; and as "an interdisciplinary approach to systems of landuse." According to Young (1994:11):

...agroforestry is a collective name for landuse systems in which woody perennials (trees, shrubs, etc.) are grown in association with herbaceous plants (crops, pasture) and/or livestock in a spatial arrangement, a rotation or both, and in which there are both ecological and economic interactions between the tree and the non-tree components of the system.

A more recent attempt to delineate what agroforestry embodies is given by Raussen (1997:122) as:

> *...a dynamic, ecologically based natural resource management system that, through the integration of trees in the farmland and rangeland, diversifies and sustains production for increased social, economic and environmental benefits for land users at all levels.*

The 1980s and 1990s have seen an emergence of interest in agroforestry that seems to have resulted from the growing conflict between foresters and agriculturalists, and between administrators of public lands and farmers at subsistence level who are continuously forced to look for new cultivable land once the old one is exhausted. This has created a need for sustainable agricultural production systems that would restore degraded soils, maintain and/or increase productivity of agricultural lands without damaging or exhausting them. Among the options available, agroforestry seems to have a higher potential to achieve increased agricultural production as well as ecological and socio-economic stability in many (particularly Third World) ecological and socio-economic settings than the other options. This is because many soil scientists are increasingly becoming aware that while a balanced plant nutrient strategy is required to ensure economical production levels on a sustainable basis, an equally important issue is the preservation of soil resources through erosion control measures, minimisation of nutrient leaching and the maintenance of organic matter (Deckers, 1993).

The potential of agroforestry is heralded by many writers. Kerkhof (1990), who studied various agroforestry projects in Africa, stated that agroforestry offers a way of tackling the combined problems of poor agricultural production, worsening wood shortages and environmental degradation by integrating tree growing with crop and livestock production.

The degradation of agricultural lands in the developing world has been observed to have been caused by 'an assault' of the environment due to poverty (Okgibo, 1991). Agroforestry seems to be the right technique for these lands in many parts of Africa and other Third World countries where soil erosion and degradation has resulted in decreased yields in the face of an ever increasing population that demands more food. In some parts of sub-Saharan Africa, the loss of vegetation, coupled with the declining rainfall and increased soil erosion, has led to desertification - the gradual drying up of once productive lands (Ajayi *et al.*, 1990). Here too, agroforestry is recommended as offering a solution to the spreading desert that threatens people's livelihoods. It is considered the best option for the Third World's poor farmers to achieve sustainable agriculture because it is said to have lower costs of establishment, compared to other methods used to improve stability and fertility of agricultural soils (Coombe, 1982). It is, therefore, a hope for Africa's poor rural communities for attaining agricultural sustainability. As Okigbo (1991:3) rightly observed :

> *...sustainability can only be achieved when resources, inputs, and technologies are within the capabilities of the farmer to own, hire, maintain and manage with increasing efficiency, to achieve desirable levels of productivity in perpetuity with minimal or no adverse effects on the resource base, human life and environmental quality.*

All the advantages agroforestry has, however, can only be realised when the right tree species combinations, management practices and people motivation and understanding are achieved (Maydell, 1982). In other words, agroforestry is only a tool whose good depends on the proper choice and use of agroforestry technologies by those who use it. It only offers a prospect for sustainable agriculture.

1.2 Historical Background to Agroforestry Activities in the Study Area

Although there were no organised external efforts to promote agroforestry activities in LRS before the 1990s, a few individual farmers planted trees in small plots near their homes. Most of these were fruit trees such as guavas, bananas and mangoes. Some of these farmers established orchards in the 1980s with the help of an agricultural landuse officer and later with the help of the agricultural extension officer for the area. A few farmers experimented with eucalyptus with little success.

In 1992, preliminary preparations for SCAFE activities in LRS began after the area was chosen for a SCAFE pilot project in Lusaka province. The choice of LRS was based on information provided by agricultural extension officers on agriculture related problems, such as decreasing yields and soil erosion experienced by farmers in the area. The SCAFE programme began its operations in Zambia in Eastern province in the 1980s and moved to Central province in the 1990s. One of its major objectives is to develop and integrate soil conservation, agroforestry and pasture technology packages into the various farming systems of an area. This, along with other objectives constituted the focus of a five-man implementing team that began its ground work in Lwiimba in 1995. The team was made up of an officer from each one of the following government departments: veterinary (animal health), fisheries, forestry, technical services and agricultural extension. However, only two officials - one from veterinary, the other from agricultural extension services - are said to have been in direct contact with the farmers in the implementation of the SCAFE project.

1.3 Statement of the Problem

Competing demands for land resources in heavily settled areas have often resulted in forest clearance leading to deforestation. In various parts of Lusaka province, forest clearance has taken place to such an extent that essential basic forest products such as fuel wood and building poles are scarce. The cleared land has often been overused and exposed to soil erosion which, if not controlled, damages the land so badly that it has to be abandoned (Beaumont, 1979). The LRS has experienced some of these problems related to overuse of cleared agricultural lands. Since experts have suggested that agroforestry has a potential to solve many such problems as those experienced in rural areas related to agricultural production, SCAFE was invited to introduce agroforestry techniques in the LRS.

A lot is said about agroforestry's potential and benefits in literature. It is sometimes praised as a "bright promise for Africa" (Kilimwiko *et al.*, 1992) and its, benefits when properly used, are often listed as proof of its viability. One would assume that if agroforestry is as beneficial as the literature claims, it would be readily accepted by farmers wherever it is introduced. This aspect was the subject of investigation in LRS (which is also part of Nchute Agricultural Camp), where both land management and soil conservation techniques have been taught to farmers by the SCAFE project.

1.4 Purpose of the Study

The overall aim of this study was to investigate the acceptability, in terms of adoption of agroforestry in a real life situation. The investigation was limited to three selected techniques, namely improved fallow, contour vegetation bands and fodder banks. Given that the people in the area are small and medium scale mixed farmers earning a living largely on exhausted soils, their response to the 'bright promise' was investigated in terms of whether or not the farmers welcomed the selected techniques as part of the solution to their agricultural related problems.

1.4.1 Objectives

The specific objectives of the study were to:

(i) Determine whether or not the three agroforestry techniques introduced address the problems/needs considered by the local community to require urgent attention;

(ii) Describe the adoption trends for the agroforestry techniques;

(iii) Identify the factors influencing the adoption of the agroforestry techniques;

(iv) Describe the impact of the adoption of agroforestry techniques on people's livelihoods.

1.4.2 Hypothesis

-There are factors that significantly influence the adoption of the three agroforestry techniques.

1.5 Significance of the Study

An evaluation of the factors that have affected the adoption of agroforestry techniques in LRS area will, in the first place, help SCAFE project planners, extension workers and implementers to adjust the programme where necessary to serve the community better. This is important if the project is to remain on course and farmers are not to lose faith in what the project is trying to do. In fact, it is one of the recommendations of agroforestry experts that assessments of such projects be done regularly by both internal and external personnel to help keep the project on course (Rocheleau *et al.*, 1988; Scherr and Muller, 1989).

Many studies in agroforestry concentrate on evaluating the impact and success of agroforestry projects in terms of area and numbers of trees planted. A few others have taken a cost-benefit approach in determining the success of agroforestry projects. This study takes an approach that puts the farmer's point of view at the centre. The farmers' perceptions and their response to the introduced techniques forms the basis for the interpretation of project success in this study. The study has also provided a forum for farmers to express their views concerning the techniques introduced, the problems they experience in implementing them and how they think the project could help them better.

Information about agroforestry adoption generated by this study is expected to be helpful when planning and starting similar projects in other areas. It will also add to the limited literature available in Zambia on local farmers' reaction to the introduction or promotion of agroforestry techniques. Most of all, it will help bridge the gap between theory on the prospects and benefits of agroforestry on one hand and practice with its problems of implementation on the other.

Positive findings of the study, such as the benefits of agroforestry enjoyed by successful adopters, may encourage the concerned organisation to invest more into such programmes and introduce them to other areas.

The Forestry Department is interested in knowing how popular and successful the integration of forestry and agriculture is with local farmers in the country. Therefore, the results of this study will be of great value to this department as well as to the Ministry of Agriculture.

1.6 Operational Definitions of Terms

Adoption rate refers to the speed with which people have accepted a technology over a period of time expressed as an average number of people adopting each year.

Agroforestry is used to refer to mixed landuse practices where there is a deliberate association of agricultural crops, animals and some grown or natural vegetation with the ultimate aim of increasing or sustaining agricultural production.

Agroforestry practice refers to a distinctive arrangement of components in space and time - either intercropping practice in same place at the same time or rotating practice in the same place at different times.

Agroforestry system is a specific local example of a practice characterised by environment, plant species and their arrangement, management and socio-economic functioning.

Contour vegetation bands are structures between fields across slopes with grass and/or woody vegetation grown on them to reduce soil erosion by run-off. Contour vegetation bands consisting of a special soil holding type of grass (vetiver grass) were considered as an agroforestry practice in this study.

Diffusion is the spreading of the adoption of a technology.

Fodder banks refers to vegetation deliberately left or grown for feeding domesticated animals.

Improved fallow is the practice of planting fast growing woody and preferably leguminous plant species in a field during the period the field is left fallow. In this study the growing of sunnhemp and velvet beans during fallow period was considered as improved fallow.

Innovation/technology idea or practice perceived to be new in a sense that people in an area have not yet developed favourable or unfavourable attitude toward it. In this context the selected techniques are considered as technologies.

Sustainable agriculture here is used to refer to a situation where agricultural productivity is maintained or increased without reducing the ability of the resource base to continue producing to meet present and future needs.

1.7 Organisation of the Dissertation

The adoption of the three selected agroforestry techniques in Lwiimba Resettlement Scheme, East of the City of Lusaka is discussed in six chapters.

The first chapter gives an overall introduction to the study. Chapter Two reviews relevant literature on the subject. It begins by providing the background to the development of agroforestry. This is followed by a discussion of the role of agroforestry in agricultural development. The chapter then explores various agroforestry practices before focusing on agroforestry activities in Africa and Zambia in particular. Factors that influence technology/innovation adoption, particularly agricultural technologies are also discussed. The chapter concludes by considering trends in agroforestry adoption studies.

Chapter Three provides a description of the study area. It outlines the physical and socio-economic aspects of the study area. Reasons for selecting LRS and the three techniques for this study are stated at the close of the chapter,

Chapter Four contains the research design which begins with a description of the target population. The chapter goes on to discuss the data collection process and the problems associated with it before it ends by stating the limitations of the study.

Chapter Five presents and discusses the findings of the study. This is done in four parts: urgency of agroforestry technique, adoption trends, factors influencing adoption and impact of agroforestry adoption. A summary of the study findings concludes this chapter.

Chapter Six, gives conclusions of the study based on the findings. It ends with recommendations for re-adjustments of the project and implications of the findings on future policies in agricultural change.

CHAPTER TWO

LITERATURE REVIEW

2.1 Background to the Development of Agroforestry

Forests are some of the most striking features on the land surface. Their nature and extent vary from place to place and from time to time due to human and natural influences. Forests play an essential and critical role to the development of a country. They support rural livelihoods and ensure food security through soil and water conservation as well as having great potential for raw material production and woodfuel in addition to stabilising biodiversity (GRZ, 1998; FAO, 1978).

While the world's forest resource is said to be vast - 3 454 million hectares in 1995 (FAO, 1997), the rate of exploitation in many places is high, often resulting in deforestation and consequent soil degradation as the forest cover that protects the soil is removed. The degraded land, in most cases, is unable to support rural communities adequately unless measures are taken to plant trees and use suitable technologies to sustain the soil fertility.

Agroforestry was accepted as a system of land management in the 1970s after the re-assessment of development policies by the World Bank and the re-examination of forestry policies by FAO (Nair, 1993). The deteriorating food situation in many areas of developing countries, the increasing awareness of the spread of deforestation and soil degradation, and the energy crises of the 1970s accompanied by price escalation and shortage of fertilisers, stimulated the development of agroforestry technologies. World bodies such as the FAO recognised the need to incorporate forestry and agriculture into the farming system to facilitate meaningful development of rural areas.

The search for appropriate landuse approaches that would be socially acceptable, that would ensure sustainability of the production base and meet the needs for production of multiple outputs necessitated the formation of the International Centre for Research in agroforestry (ICRAF) in 1977 (Nair, 1993). Efforts by ICRAF in collecting data, conducting research and disseminating research results led to the recognition of agroforestry today as a landuse system capable of enhancing development in many ways. agroforestry represents an interface between agriculture and forestry and encompasses mixed landuse practices.

2.2 Agroforestry and Agricultural Development

According to Van der Pol (1993), agroforestry is one of the few options available at the time that can reverse the trends of soil erosion and soil degradation in the Third World particularly sub-Saharan Africa. This is because of the improvements agroforestry has proven to bring to the soils in experimental plots and the various benefits enjoyed by communities where it has been tried in fields. Scientific research and practice have shown that trees/bushes have powerful amelioration effect on the forces that decrease agricultural production. In the former USSR, for example, field-protective tree/bush strips of varying lengths and heights have been planted between strips of commercial field crops since the 1940s and have proved to have beneficial effects on crop growth leading to improved yields (Logginov, 1964). On the vast steppe agriculture, trees have protected agricultural crops from winter blizzards, reduced the effect of droughts and have controlled soil erosion on slopes resulting in increased yields.

Agroforestry is important to agricultural development in that it promotes soil conservation by maintaining soil fertility as well as preventing water and wind erosion. Trees and shrubs, if properly chosen and managed, have a great potential to conserve the soil's productive capacity in many ways. Agroforestry has been found to be helpful in maintaining physical and biological soil conditions that are favourable for crop growth thereby preventing crop yield losses (Young, 1994).

Whereas soil erosion causes substantial lowering of crop yields and loss of production due to loss of organic matter and nutrients, loss of run-off on sloping lands and lowering of available water capacity for crops, agroforestry has the potential to solve the erosion problems and restore soil fertility. A summary of the benefits of some agroforestry practices to soil conservation is given in Table 2.1.

Table 2.1 Agroforestry Practices with Potential for Soil Conservation

Practice	Control of Erosion	Management of Soil Fertility
Improved Fallow	+	+ + +
Trees in Cropland	+	+ +
Alley Cropping	+ + +	+
Wind Breaks	+ + +	N/A
Trees in Pasture	+	+ +
Reclamation Forestry	+ +	+ +

\+ quite effective, ++ effective, +++ very effective N/A non-applicable

Source: Adapted from Raussen, T. (1997: 122)

Other documented beneficial effects of trees/woody vegetation include the enhancement of nitrogen, nutrient addition and recycling, improvement of soil properties, moderating effect on acidity, salinity and alkalinity as well as ameliorating the effect of extreme climatic conditions (Young, 1994; Nair, 1993).

2.3 Types of Agroforestry Practices

There are various types of agroforestry practices that exist in the world. Some are associated with cropland, some with pasture, some with home compounds, some with public spaces and others with woodlands and woodlots (Rocheleau, *et al.*, 1988). These practices include:

Mixed intercropping/trees in cropland - where trees are left dispersed in cropland. This is known to have been practised in Africa before the introduction of 'new' agroforestry techniques. Here, trees that seem to increase the production of surrounding crops and improve soil and water conditions for the growth of crops are allowed to remain in the cropland dispersed or in clamps.

Contour vegetation bands - these are used to prevent/slow down soil erosion on sloping croplands. They "may consist of grasses or ground cover only" (Rocheleau, *et al.*, 1988:17) on conservation structures while the inclusion of multipurpose trees and other herbaceous plants is ideal.

Alley cropping/hedgerow intercropping - where rows of multipurpose trees are planted between wider strips of annual crops as hedges. These hedges provide mulch as they are cut and applied to cropped strips.

Improved fallow - involves the planting of herbaceous plants on fallow land so as to restore the soil nutrients of croplands much more quickly than if they were left to regain their fertility naturally. Specially selected plant species with, mostly, nitrogen fixing capabilities are used for this purpose.

Living fences/wind breaks - plants/trees are planted around kraals, fields, houses and other property as live fences to keep animals from particular places or as wind breaks.

Woodlot enrichment (taungya) - here, herbaceous ground cover crops are grown under commercial tree crops or other multipurpose trees "to provide a more diverse mix of products and services and sustain the soil and water resources of the site" (Rocheleau, *et al.*, 1988:22).

Sylvopastoral agroforestry/trees in pasture - involve the maintenance of woody plants with grasses and improved pasture where trees and grasses, in more intensive cases, are planted to provide animal feed.

2.4 Agroforestry in Africa

Africa experienced what has been widely described as the worst drought of the century in the 1990s whose effect on the African environment was devastating. This, along with the increasing deforestation levels, soil erosion and soil degradation led to poor crop yields threatening food security in many parts of the continent.

In the face of rapid population growth in most African countries, dramatic and rapid changes in the landuse patterns, economic conditions and the natural environment have occurred. These changes have often taken place at a rate faster than the development of new land use practices that support both the natural environment and the welfare of the local people (Rocheleau, *et al.*, 1988). Experts believe agroforestry can play an important role in solving some serious agricultural problems that African peasant farmers are experiencing if widely adopted. To some experts, agroforestry presents a bright promise for farmers and a hope for attaining food security in many rural areas.

African farmers have practised agroforestry long before the term agroforestry came into human vocabulary. The traditional shifting cultivation relied on leaving farmland fallow for years allowing vegetation to regenerate and restore nutrients naturally before it was cultivated again. Even after this practice was no longer used, farmers in many African countries, have always left selected tree species such as Acacia albida scattered in their fields because of the many benefits they observed it had for their crops and animals (Kilimwiko, *et al.*, 1992).

There are a lot of programmes and projects in various parts of Africa that promote tree planting and agroforestry. In Ethiopia, for example, multipurpose trees such as *Leucaena leucocephala* have proved to have considerable potential of improving livestock production after they were experimented on sheep, cattle and goats (Gizachew, 1992). Agroforestry research centres such as ICRAF have been established where experiments and trials are done before agroforestry technologies are introduced to farmers for adoption.

2.5 Agroforestry Activities in Zambia

In Zambia, the development of ideas on how to deal with problems of deforestation in the Forestry Department in the 1980s coincided with the coming up of 'new approaches' to soil conservation in the Department of Agriculture, resulting in close collaboration between the two departments that created interest in agroforestry (Kamara, *et al.*, 1993). Agroforestry activities in Zambia have existed since the 1980s, spearheaded by organisations such as ICRAF, AFRENA and SCAFE. There are agroforestry research stations in Eastern, Northern, Southern and Central provinces where trials and experiments in various aspects of agroforestry are carried out before they are introduced to the local farmers in these provinces.

A number of studies evaluating the impact of agroforestry programmes in Zambia have been conducted. Malesu and Luputa (1999) found out that the adoption of agroforestry technologies in Southern province is on the increase among small scale and medium scale farmers mainly because of the difficulties the farmers find in acquiring fertilisers. Also, a relatively higher production of crops per hectare was reported by farmers who adopted agroforestry techniques in that study area.

A survey of the SCA project experience in Magoye revealed that some agroforestry techniques such as alley cropping and planting trees in cropland have proved impractical to local farmers as they are highly labour intensive, in addition to requiring protection against fire and livestock. However, the project is said to have recorded some success in encouraging the planting of windbreaks, live fences, establishing small nurseries and in increasing the local farmer's awareness of the value of Acacia albida as a soil fertility tree. A lack of baseline data on the agroforestry needs of the area before the start of the project cost the project time and resources which could have been avoided (Kerkhof, 1990).

A study by Aongola (1993) assessing the SCAFE programme in Eastern province revealed that the farmers who adopted both the physical and biological conservation measures registered marginal positive benefits on the Cost Benefit Analysis although crop yield benefits were not evident.

2.6 Factors influencing Adoption of a Technology or Innovation

The introduction of agroforestry technologies in Zambia is based on the hope that their adoption will help improve the soils for sustained agricultural production as well as lessen pressure on existing forests. The success of agroforestry programmes depends on many factors that influence adoption of new techniques. According to Emerson (1995), there are five main factors that affect the rate of adoption of any innovation in an area. These are: type of innovation, communication channel used to diffuse the innovation, the nature of the social system in the area of potential adoption, the effort made by the change agent promoter and the perceived attributes of the innovation.

The type of innovation, whether it requires individual decision making or not and whether it requires a certain level of education to understand and accept it or not, will influence its adoption in an area. Innovations that require individual decision making have been found to be adopted more easily than those requiring collective decision making. Community forestry, for example, tends to take longer to get established and even to keep it going mainly because no one individual takes the responsibility to immediately make a decision for or against an action until the rest of the members of the community are consulted. A study by Lukama (1997) at Chinyunyu, East of Lusaka, revealed that though the community showed willingness to participate in planting woodlots, the project had a very low seedling survival rate because no one made effort to water them when they needed water. The project was, therefore, found to have lagged far behind the planned schedule.

The adoption of an innovation is also affected by the communication channel used to diffuse the innovation. Inappropriate channel for a particular innovation discourages adoption. For example, if the television was used to spread a new idea intended for poor rural communities which have little access to this channel, it would take long for that new idea to spread in the intended area because the channel used is inappropriate. Practical demonstrations, seminars, workshops and extension services have been found to be the most appropriate means of spreading agricultural technologies. A study conducted by Jha, *et al.*, (1991) in Eastern province of Zambia on the adoption of mechanical (animal traction) and biochemical (seed and fertilisers) among small scale farmers confirmed the importance of extension services and demonstrations in the adoption process.

Each society has its own established cultural system, with beliefs and values and norms. These too affect adoption of new ideas and practices. If the new practice does not fit well with the cultural system existing in the society where it is introduced, it will not easily be accepted. Agroforestry, however, has been found to be fitting well in traditional African farming systems where food crops are normally interspersed with tree crops and in other systems where certain species of trees are deliberately left in the field (Rocheleau, *et al.*, 1988). Blaikie (1997) argues that diffusion process of any innovation is controlled more by the structure of the society in which it is introduced than anything else. This includes the land tenure systems that exist in a society. Security of land tenure is considered a major requirement for the introduction and adoption of agroforestry (Akayombokwa, 1993).

Efforts of change agent promoters can influence the adoption rate either directly or indirectly. In the case of agriculture, extension officers are change agent promoters and the way in which they disseminate the information about the technology to be adopted can contribute to the adoption rate. In his survey of agroforestry projects in Africa, Kerkhof (1990) found that the long entrenched attitudes of extension officers towards trees in both agriculture and forestry have slowed down the speed at which agroforestry technologies are adopted.

Other factors that influence the rate of adoption include the availability of extension officers to offer personal help, supervision, and advice to the would-be adopters. The change agent promoter can use opinion leaders (people who are looked up to, respected and sought for advice by members of the community). These may be chiefs, headmen, church leaders, political leaders who can be used to increase change agent promoter's influence by interpersonal interaction with potential adopters. Once these opinion leaders accept the technology, others in the society will have contact from where to learn the new technology, thus ensure continued spreading of the innovation even to areas the change agent promoters may not reach (Emerson, 1995).

Perceived attributes of an innovation account for 49 - 87% of the variation in rate of adoption of any innovation in any area (Emerson, 1995). Perceived attributes are ways in which potential adopters view the new idea or practice to be profitable or beneficial to them. If the new technology addresses the social and economic needs of the community at the time it is introduced, it is likely to be readily adopted than if it did not. Kerkhof (1990) observed that most successful environmental initiatives and projects are those that address people's immediate needs along with long term goals. As reported by FAO (1978), many tree-planting projects have succeeded in areas where the local people had problems in obtaining firewood and other basic forest products. The severity of the problem being addressed by the technology being introduced has also got a great influence on the extent of adoption of the technology.

Innovations that require little inputs but have a lot of benefits are adopted much more readily than those that do not. In case of agroforestry technologies, the economic viability consists of how well the practice fits into the climate and other physical factors of the area in which it is introduced enabling it to meet the community's needs at low cost.

In his study, Hoeskstra (1994) found out that agroforestry systems that suited the soil and climate of the area in which they were introduced as well as the needs of the people and established social systems were adopted more readily than those that did not. This implies that research has to be done to see which agroforestry systems are suitable in an area in terms of both the physical characteristics of the area and the needs of the people before introducing the system for adoption. In Zambia, attempts have been made to collect data on tree species for agroforestry that have done well in local conditions and are likely to survive and flourish in different agro-ecological zones of the country as well as provide useful products (Kamara, *et al.*, 1993).

Innovations that have low initial costs involving low risks are accepted more rapidly than those that have high initial costs involving high risks. This, however, is also affected by the adopter's characteristics such as educational level which influences the farmer's ability to perceive the advantages, costs and risks involved in adopting an innovation. If the potential adopters have difficulties in perceiving the advantages of a technology, then the adoption will be affected (Emerson, 1995). However, this can be offset by the efforts of the change agent promoter in educating, demonstrating, and making the adopter aware of the advantages of the innovation. The adopter's awareness of his/her needs will also determine his/her response to an innovation said to be meeting those needs.

The factors discussed above often work together to result in a certain response from the potential adopter to the innovation introduced. In any area where an innovation is being introduced, these factors play a more important role than others in encouraging or discouraging adoption. Steppler and Nair (1987); Baumer (1990) and Rudat, *et al.*, (1995) identified a number of socio-economic variables which overlap in their influence on agroforestry adoption in a particular area. These include: the incorporation of local knowledge and use of trees, land tenure system, local organisational support, labour, cultural organisational issues such as fire control, control of animal movement and inter-planting practices.

2.7 Trends in Agroforestry Adoption Studies

Scherr (1995) carried out studies in agroforestry adoption in three areas of Western Kenya and observed that adoption followed a process of incremental steps. The steps identified were actually stages in agroforestry adoption. In the first stage, farmers mainly engaged in small scale experimentation where they selected small pieces of land of lower quality and established a small number of trees for observation. Later, they established larger operational fallow plots, an average size of 500 square metres, which were maintained and managed to test the new practice for a period of years. After the completion of the production cycle in operational plots, farmers established new expanded agroforestry plots in the fields as the third and last step in complete adoption of a technology.

A study by Grewal and Singh (1992) in India revealed that farmers prefer using fruit trees in their agroforestry practices as fruits are a supplement in the diet and they provide a fall back during bad years when crops do not do well.

In Zambia, a few consultants and scholars have reviewed soil conservation and agroforestry extension projects in various parts of the country. In Eastern province where SCAFE activities began, Malesu and Luputa (1999) observed that there were very few adoptions and that pegging for contour vegetation bands was the main activity in the first five years. They also observed that an increase in adoption came after the introduction of group approach, provision of incentives and the formal training on nursery and tree propagation. A SCA project in Magoye yielded little in the way of local farmers growing trees in the cropland for soil fertility or fodder in five years (Kerkhof, 1990).

A report from Ruru Gitambaya in Kenya relates how the granting of title deeds to small scale farmers helped speed up the adoption of agroforestry practices that stagnated for a long time (Kilimwiko, *et al.,* 1992). A study at Kasisi, Zambia, revealed that communal land ownership discourages agroforestry adoption (Kabaso, 1995) as it does not give the farmer security to plant trees and be sure to benefit from them.

Research trials that were done at Chalimbana, near Lusaka on various multi-purpose tree species brought to light a number of helpful facts about species that do well in the Zambian environment. *Sesbania* species (*Sesbania macrantha* and *Sebania sesban)* were found to have a short life span (1 and .5 years respectively). They were also found to improve soil nutrient properties, making them ideal for improved fallow but not hedgerow intercropping (Kamara and Maghembe, 1994). *Leucaena leucocephala* and *Flemingia congesta* prunings were found to improve maize yields better than *Sesbania sesban* which does not respond well to pruning in hedgerow inter-cropping at Chalimbana (Kamara, 1992). Chirwa, *et al.*, (1994) discovered that *Flemingia congesta* is more profitable to maize yields than *Luecaena* species in hedgerow intercropping. Trials on *Gliricidia sepium* in Eastern province found the species more resistant to termite attack than *Leucaena* species (Kwesiga, 1994).

CHAPTER THREE

DESCRIPTION OF THE STUDY AREA

3.1 Introduction

This Chapter describes various aspects of the study area that have a bearing on the topic for the study. It also outlines points that determined the choice of LRS and the three techniques for this kind of study.

3.2 Physical Aspects

The LRS is found in Chongwe district in the Lusaka province of Zambia, (Figure 3.1). The scheme which lies between 28° 40' and 28° 45' East and 15° 31' and 15° 33' South, covers an area of about 1500 hectares. It is situated some 55 km east of the City of Lusaka and is connected to the city by two roads: the Leopards Hill road through Mikango Barracks and the Lwiimba road that branches off Great East road near Chongwe township going past Chalimbana.

According to Mackel (1971) classification of Zambia's relief, the study area falls within the gently undulating plateau that is between 914 to 1218 metres above sea level. It is drained by the Lwiimba and Kalanga rivers as well as the Nchute stream. The Nchute stream forms the scheme's boundary to the north. Towards the east it joins the Kalanga river that, in turn, drains south-east to form a confluence with the Lwiimba river. The Lwiimba borders the scheme in the south (Figure 3.1). The western border lies where the Leopards Hill road crosses the Lwiimba river up to the point where the road to Nchute primary school branches off Leopards Hill road. An isolated low hill, largely made of a rock outcrop, stands out on the western part where a primary school is situated.

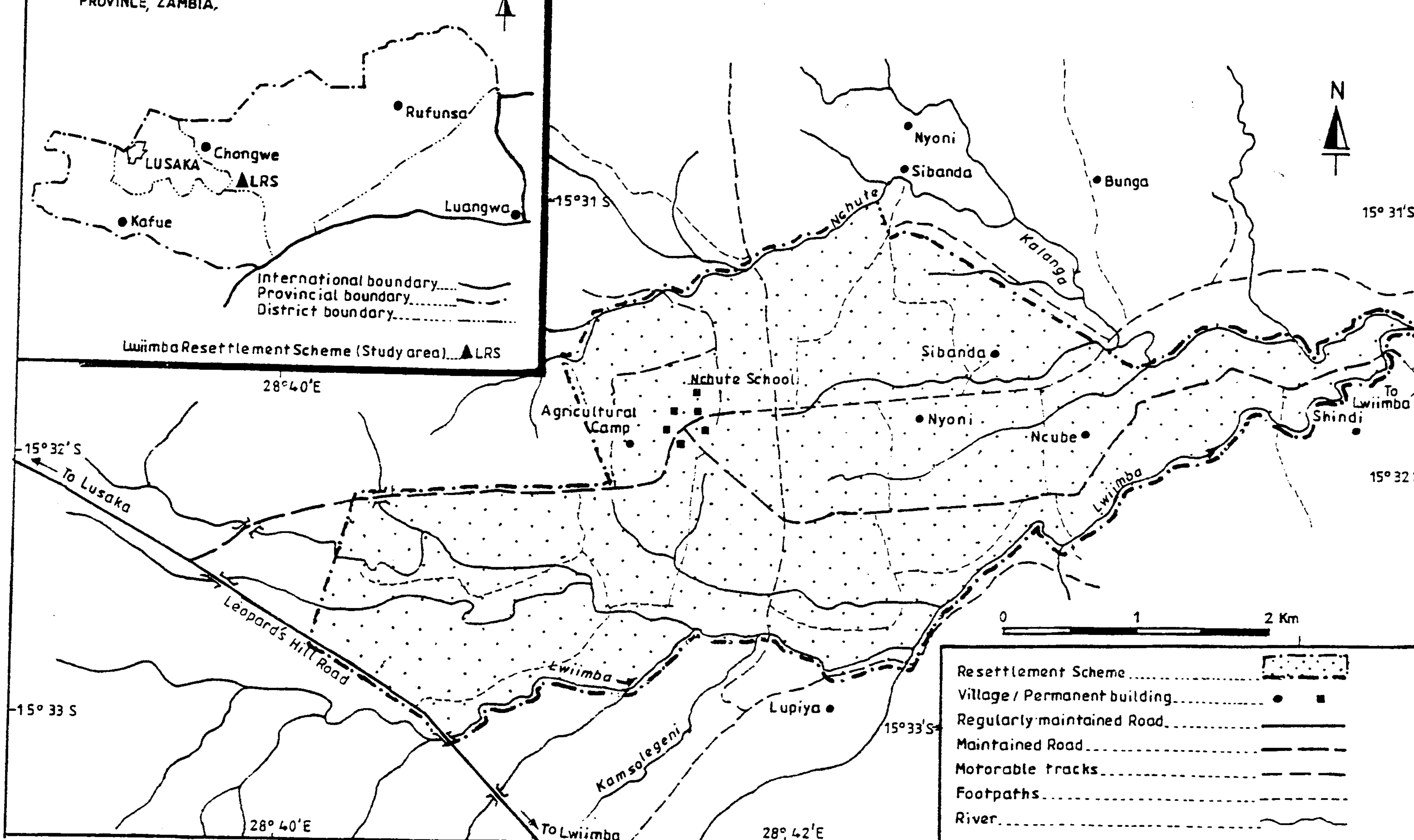

Fig.3.1. Geographical Location of Lwiimba Resettlement Scheme

The natural vegetation of the study area is largely the Munga woodland dominated by Acacia, Combretum and Terminalia species which grow among tall grass (Mackel,1971). Except for a few isolated clumps, most of the indigenous trees were non-existent at the time of the study as most of them had been cleared for various purposes.

Soils of the Lwiimba scheme are an extension of the Fersiallitic soils of the Central Province of Zambia (Mackel, 1971) whose texture ranges from clay to sandy clayloams. Mackel (1971) describes these soil as one of the most fertile Zambian soils that are suitable for a wide range of crops.

The study area, like the rest of Zambia, experiences three seasons: the hot dry season which lasts from about August to November, the warm wet season from November to April and the cool dry season from around April to August (Acher, 1971). The LRS falls in a region that receives between 800 and 1000 mm of rainfall and has average temperatures that range from 18 to 24° Celsius (Naidoo and Bwalya, 1995).

3.3 Socio-economic Aspects

There are 55 households in the LRS area all of which are basically mixed farming households. With an average household size of 8.9 persons, the approximate total population of the area is about 500. The settlers are from various ethnic groups. Despite the various ethnic backgrounds, the community largely uses Nyanja as a medium of communication. The various households came to the area in different ways. About 20% came to the area as farm labourers for the former owner of the farm. Some 35% of the housueholds are headed by people who underwent agricultural training in the 1970s and were resettled in the area by the government in line with the agricultural expansion policy that aimed at developing the agricultural sector in the country. Nearly 30% of the households were resettled into the scheme after their retirement from formal employment. The rest (15%) just bought land from earlier settlers who had bigger portions.

Most farmers own cattle and goats (an average of 5 per household) although there were larger numbers before Corridor diseases affected the area beginning the 1980s reducing them. At the time of the study, forty (40) percent of the farmers had no cattle. Yet most farmers depend on cattle for draught power as well as for milk that play an important role in the households' diet.

For a long time, annual sale of crops was the major source of income in the area. Agriculture in the area is totally dependent on the annual rainfall which is unpredictable in terms of its onset and duration. Most of the cultivation is done by ox-drawn ploughs although a few farmers use tractors. Maize is the major crop grown mainly for consumption and any surplus for sale. It, however, demands heavy application of fertilisers for one to obtain good yields. In the past, the settlers depended on government subsidies and loans to purchase fertilisers, seed and other farm inputs. These subsidies were phased out in the early 1990s. Other important crops grown are groundnuts, sweet potatoes, and cow peas. Sunflower and cotton are the two main cash crops grown by some farmers.

Another important source of cash for the households in the Lwiimba scheme is gardening which is the major activity during the hot dry season. Farmers grow rape, tomatoes and onions along the Kalanga and Lwiimba rivers which they sell in the nearby urban areas of Chongwe and Lusaka. Selling domesticated animals is another source of cash for emergencies although many farmers no longer have this fallback due to the Corridor epidemic that wiped out their animals.

The study area is served by one primary school known as Nchute which is situated on the western part of the scheme. Several motorable tracks criss-cross the scheme with two main outlets: one to the west leading into Leopards Hill road, the other to the east into the Lwiimba road (Figure 3.1).

3.4 Selection of the Study Area

Desiring to carry out a study that would have immediate practical application, the researcher consulted with the Provincial Forestry Officer for Lusaka province who recommended LRS for the kind of research proposed. Since no study of this kind had been carried out in that area, the researcher decided to take up the study in the suggested area. The limited finances available also had some influence in the choice of the study area that could be made. The LRS is accessible through the two roads mentioned earlier and this made it easy to travel for data collection as many times as necessary even after the onset of rains. The researcher's ability to speak Nyanja, the widely spoken local language of the area also contributed to its choice as the study area.

3 .5 Selection of Agroforestry Techniques to Be Studied.

The SCAFE project has introduced various techniques to the people of LRS all of which are aimed at developing the area by improving the living standard of the local people. The techniques introduced include the planting of trees/herbaceous plants as woodlots, wind breaks, fodder banks, live fences, field boundaries, for soil fertility (improved fallow) and as erosion control measure (contour vegetation bands). The research, however, focused on the following techniques: improved fallow, contour vegetation bands and fodder banks. These were chosen on the basis of a number of factors. The first factor considered is that almost all the households are engaged in agriculture for a living. Furthermore, most of them are mixed farmers, that is, they grow crops as well as keep livestock. The three agroforestry techniques, therefore, were chosen because they are more relevant to the people's main occupation - agriculture.

In addition, personal discussions with the DACO for the area during the preparation of the study gave the researcher an understanding that soil erosion and soil degradation were widespread in the area and were contributing to the problems farmers were experiencing in their attempt to increase their agricultural productivity. This knowledge influenced the researcher in choosing to study how farmers have responded to the introduction of improved fallow and contour bands that are meant to help them solve some of their agricultural related problems. The researcher also chose to include fodder banks in the study after learning that livestock play an important role in the people's lives in the study area.

CHAPTER FOUR

METHODOLOGY

4.1 Introduction

The methods and instruments that were used to collect data for this study as well as those that were used to analyse the data collected are described in this chapter.

4.2 Primary Data Collection

4.2.1 Target Population

The survey unit for this study was the household. A household in this study is taken to be referring to all people feeding and living together, subject to one head who makes final decisions that concern that particular household. The nature of the study dictated that the survey element be every farmer in the Lwiimba scheme which has only 55 farming households. As such the total population, not just a sample, was taken for this study.

4.2.2 Data Collection Instruments

Questionnaires were constructed and tested in the study area on eight farming household heads and one project worker chosen at random. Based on the findings of this pilot survey, appropriate and necessary adjustments were made after which the final Interview Schedules (Appendices 1. and 3.) for the farmers and project workers respectively, were developed. An additional questionnaire for farmers (Appendix 2.) was constructed later for more specific information on some aspects. The questionnaires for farmers (Appendices 1. and 2.) were meant to collect data on the following aspects:

(i) The needs of the community that were addressed by the agroforestry techniques under study;

(ii) The agroforestry adoptions from 1995 to 2000;

(iii) The variables such as labour, land tenure, awareness, age of the farmer, educational level of the farmer and farm size which are known to influence adoption of techniques; and

(iv) The impact of the adoption of the techniques as reported by farmers.

Extension and project workers' Questionnaire (Appendix 2.) was intended to get background information and gain insights into the activities of SCAFE project that could help explain findings of the farmers' questionnaire on the targeted objectives. Informal interviews with several other SCAFE and government officials involved in the project in LRS were done for the same reason.

4.2.3 Data Collection Process

Most of the data used in this study were collected during the fieldwork undertaken between September and December 1999. All the 55 households in the LRS and three project workers were interviewed during this period.

The time in which the farmers' questionnaire was administered coincided with the time of the year when farmers were relatively free from their on-farm activities. However, most farmers were busy with their vegetable gardens and so, where necessary, they were followed to their vegetable gardens and interviewed. The complementary data from key persons connected to the programme at district, provincial and national levels were collected at a time convenient to each interviewee.

4.3 Secondary Data Collection

Secondary data collection involved reading of books from various libraries on various aspects of agriculture and agroforestry. Material on agroforestry experiments that were done at Chalimbana near Lusaka and in Chipata were examined for useful insights, especially on the suitability and/or susceptibility of various tree species, some of which have been introduced in the study area. The secondary data search also aimed at identifying trends in agroforestry adoption in other areas that would help understand the situation in the study area. Data on factors/variables known to influence agroforestry adoption were obtained from the review of literature. This was an on-going exercise which began before the field work and continued after the field work.

4.4 Data Analysis and Presentation

The data collected were coded before being subjected to both descriptive and inferential statistical procedures. Principal Component Analysis was used to reduce the data on variables influencing adoption to identify the main underlying factors behind all the variables. Data for agroforestry related items on ranking of needs were summarised using percentages. Pearson's Product Moment Correlations were derived to identify relationships between adoption and the factors influencing it. Impacts of adopting the techniques as reported by farmers were listed. Tables, graphs, averages and percentages were used to present the results of the study.

4.5 Problems Encountered During the Data Collection Process.

A few problems were experienced during the data collection exercise. Some farmers were suspicious that the data collected were to be used in the then on-going land demarcation process where some holdings were being sub-divided into smaller portions and re-allocated to new people. This made farmers with large holdings to give false information about the size of their land holdings and the proportion of their land which was under cultivation.

The team leader for the SCAFE project implementing group who worked closely with the farmers was unavailable for interview despite many efforts to reach him. This deprived the study of vital insights and information concerning the project which no one else could give. Lastly, a few farmers (4) did not return filled questionnaires i.e. additional questionnaire (Appendix 2.).

4.6 Limitations of the Data

Agroforestry is a new science and methods of studying various aspects of it have not yet been fully developed. There is no established method of testing how the local people's priorities and urgent needs influence agroforestry adoption even if, as indicated earlier in literature review, these influence adoption. As such, need ranking was used to try and see if the techniques introduced addressed the needs and priorities of the community.

CHAPTER FIVE

FINDINGS AND DISCUSSION

5.1 Introduction

This chapter presents the findings of the study and discusses them in relation to the objectives of the study. The urgency of the agroforestry techniques in the study area is explored first, followed by a deliberation on findings on the proportion of agroforestry adoption and the factors influencing adoption of agroforestry techniques. Findings on the impacts of the adoption of techniques on the people's livelihoods in the study area are presented just before a summary of the findings of the whole study is presented.

5.2 Urgency of Agroforestry Techniques to the Community

Experts agree that farmers' needs and how the farmers prioritise their needs play an important role in determining their response to any new agricultural technique that is introduced. Farmers tend to embrace ideas/techniques that they perceive to contribute to their basic and immediate needs more readily than they do to those that do not seem to address these needs (Kilimwiko, *et al.*, 1992: Baumer, 1990).

To find out how urgent the three agroforestry techniques are perceived to be by the farmers in LRS, a list of fifteen items (Appendix 1.) that include items on the three techniques under study, was presented to each farmer to re-arrange from the most urgent to the least. This was done to get a general picture of the priority of needs from the farmers' point of view and get some insights into how this could have influenced the farmers' response to the agroforestry techniques introduced. Assessment of the urgency of the three techniques to LRS community was done in two ways: using percentages of actual rankings and using valued rankings.

5.2.1 Assessment of Urgency Based on Actual Rankings

Each farmer ranked each one of the fifteen community needs given on a scale from one to fifteen, starting with the one they considered to be the most important to them up to the least (Appendix 4). The rankings for items *2, 3* and *9* on the list of needs which relate to contour vegetation bands, fodder banks and improved fallow respectively were isolated. A summary of the rankings for the three items was derived by categorising them into three sections. The first section comprise the percentage of farmers, who ranked items among ranks 1 to 5, the second is that of farmers who gave ranks 6 to 10 while the third section is that of farmers who gave ranks 11 to 15 for each respective item (Table 5.1).

Table 5.1 Farmers' Ranking of Three Agroforestry Techniques

Section	Ranks	Improved Fallow	Contour V. Bands	Fodder Banks
1	1-5	34 %	59%	10%
2	6-10	46%	31%	20%
3	11-15	20%	10%	70%
Total 3	**15**	**100%**	**100%**	**100%**

Interpretation scale: Section 1 = most urgently needed; section 2 = moderately urgent; and section 3 = least urgent.

The highest percentage of ranking for each column determined the scale given to the column. Considering this, based on Table 5.1, improved fallow is considered to be addressing a moderately urgent need of the community since the highest percentage (46%)of the farmers gave it ranks among 6 to 10. This is in line with other findings of the study on aspects related to the technique. For example, 38% of farmers indicated declining crop yields to be a major agricultural related problem while in Table 5.1, only 34% of the farmers consider improved fallow, (which was intended to improve yields) to be very urgently needed. This implies that farmers who experienced decline in crop yields consider improved fallow to be an answer to their problem. The rest consider it less urgent.

As alluded to earlier in the study, the natural terrain of the study area is not flat but largely gently rolling making most of it susceptible to soil erosion by water. 53% of the farmers reported having problems with soil erosion (gullying across the fields, washing away of top soil and fertilisers by running water) before the SCAFE project. Considering this, the conclusion given by the percentage (59%) in Table 5.1, which shows that most farmers consider contour vegetation bands to be addressing one of their most urgent needs, is positive. This implies that contour vegetation bands are considered to be addressing one of the most urgent needs of the community.

Table 5.1 shows that only 70% of the farmers ranked fodder banks between 10 and 15. Only 10 % of the farmers ranked this technique between 1 and 5 implying that this technique is least needed by the community in the study area. This assertion is logical considering the fact that at the time of the study, 40% of the farmers owned no livestock. Besides, farmers in this area are not commercial livestock keepers. On the contrary livestock is largely used to provide draught power as well as milk which supplements the diet in many households.

5.2.2 Assessment of Urgency Based on Valued Rankings

The ranked community needs were further analysed by giving values to the ranks as follows: the first rank valued fifteen, the second fourteen and so on up to the fifteenth rank which got the lowest value of one (Appendix 5.). The values for each item for all the respondents were summed. The totals for each item were then ranked from the biggest to the smallest (Table 5.2) - the bigger the sum, the higher the rank. Interpretation was based on the assumption that items relating to more urgent community needs would be ranked higher the rank than those relating to less urgent needs. It should be noted again here that items *2,3* and *9* relate to the following agroforestry techniques respectively: contour vegetation bands, fodder banks, and improved fallow.

Table 5.2 Ranked Sums of Valued Community Needs

Item.	Sum of valued ranks	Overall Rank
1. Building an iron roofed house.	628	2
2. Controlling soil erosion in my field.	551	4
3. Providing additional animal feed for my animals in dry season.	245	14
4. Building a clinic in the area.	637	1
5. Controlling animal movement by fencing.	381	10
6. Finding money for fertilisers.	406	7
7. Improving roads in my area.	384	9
8. Making well for drinking water.	612	3
9. Improving soil fertility without using artificial fertilisers.	448	5
10. Controlling animal diseases.	436	6
11. Getting farm implements such as ploughs, planters.	387	8
12. Establishing a ready market for farm produce.	321	12
13. Assistance in restocking area with cattle since most of them have died.	273	13
14. Establishing facilities in the area from which fertilisers and seed can be bought.	343	11
15. Others.	68	15

Interpretation scale: Ranks 1-5 = most urgently needed; Ranks 6-10 = moderately urgent; and Ranks 11-15 = least urgent.

This treatment revealed that contour vegetation bands and improved fallow have high ranks (4,5 respectively). It implies that improved fallow and contour vegetation banks are considered urgent by the community while fodder banks are not considered urgent by the community. This supports results of the earlier treatment where contour vegetation banks are among the most urgent, and improved fallow is among the moderately urgent needs of the LRS community.

Among other items related to the most urgent needs of LRS as shown by Table 5.2 are item numbers 4,1 and 8 which are, respectively: building a clinic, building iron roofed house, and making well for drinking water. Building an iron roofed house seems immaterial until one is aware of the fact that SCAFE has encouraged it in the area, in line with the water harvesting technique being introduced. Considering the acute water shortage problem the community faces, it is understandable that the farmers consider it among the most urgent needs based on Table 5.2.

In conclusion, section 5.2 gives a picture that contour vegetation bands and improved fallow address some of the most urgent needs of the LRS community.

5.3 Adoption Trends for Agroforestry Techniques

In this study, incorporation of certain practices related to each one of the three techniques being studied into the farmer's farming system was taken to constitute adoption. Under improved fallow, farmers who planted soil fertility tree species, be it only one or two plants meant to propagate seed or in a plot, were taken to have adopted improved fallow. Also, if a farmer used sunnhemp or velvet beans to improve soil fertility he/she was taken to be an adopter of improved fallow. The use of vetiver grass on contour bands to control erosion was taken to constitute the adoption of contour vegetation bands. Farmers who planted tree species that can be used for fodder and those who grew fodder grass were considered to have adopted fodder banks.

5.3.1 Agroforestry Adoptions by 1999/2000

Based on findings of the study, more than half (66%) of all the farmers in the study area attempted to incorporate some form of agroforestry technique in their farming practices.

Only 34% of the farmers did not attempt any one of the three techniques investigated by this study. This shows that farmers are responding well to the introduction of the agroforestry techniques.

Taking the techniques individually, improved fallow seems to be a favourable technique as it has been attempted by more than half i.e. 60% of the total number of respondents in the study area. Of the three techniques, it attracted the highest adoptions. This could possibly be because farmers in the area, as stated earlier, have been experiencing declining crop yields but do not have the necessary cash to buy fertilisers that would enable them to improve the yields. Even the use of manure which some farmers once relied upon to improve yields is no longer an important alternative since the farmers have lost most of their livestock to diseases. Besides, livestock provided cash when needed. Therefore, now that most are dead, the farmers have fewer alternative sources of cash for fertilisers leaving them with little choice but to seek other ways of improving soil fertility in their fields. The benefits of improved fallow as taught by SCAFE workers must have given the farmers a hope for improved yields prompting a relatively bigger percentage of farmers to prefer this technique than the other two.

As mentioned earlier in the section on definition of terms, it should be noted that most of the improved fallow found to be practised in the fields involve the growing of sunnhemp (Plate 5.1) and velvet beans (Plate 5.2). The use of sunnhemp and velvet beans to improve soil fertility is, however, an old practice which farmers may have abandoned but is now revived by the SCAFE project. The use of soil fertility trees is still at experimental level where farmers just have a few trees near their homes meant to produce seed to be used on bigger portions in future.

Plate 5.1 A Lush Sunnhemp Fallow

Plate 5.2 Velvet Beans Fallow Flanked by Vetiver Grass Band

The species of soil fertility trees being experimented with are: *Leucaena leucocephala* (Plates 5.3 to 5.6), *Sesbania sesban* (Plates 5.7 and 5.8), *Sesbania macrantha*, *Tephrosia vogelli* (Plate 5.9) and *Cajanus cajan* (Plate 5.10). Most of the adopting farmers are still nursing seedlings for the experimental plots (Plates 5.3 to 5.6) while some have grown one or two of the trees near their homes (Plates 5.8 and 5.10). The plants seem to be doing well except that, in most cases, farmers have not weeded them, causing them to be choked by grass (e.g. Plate 5.6). Those that were weeded late are thin and weak (e.g. Plate 5.5). Attack by termites has been the greatest drawback reported by farmers.

Contour vegetation bands are the second in preference among the three techniques. However, despite a considerable number of farmers reporting having problems with soil erosion in their fields, only 37% of all the respondents have adopted contour vegetation bands as a soil erosion control measure in their fields. Asked why they chose to adopt this technique, most farmers said their fields are on sloping ground and are susceptible to soil erosion and gullying. Some farmers reported having fields where water swept away top soil and even fertilisers meant for crops. This, the farmers believe, reduced their crop yields. This could explain why a reasonable number (relatively bigger than that for fodder bank adopters) of farmers have adopted contour vegetation bands. It should, however, be noted that the vegetation used for the contour bands is largely the soil holding Vetiver grass (Plate 5.11) and that there were no farmers who had attempted planting trees/herbaceous plants or even interplanting trees with grass on contour bands as an erosion control measure.

It was observed that some farmers who have soil erosion problems in their fields preferred using contour band structures with no planted vegetation on them. Labour demands in transplanting the grass to the contour line was given in some cases as the reason for this. A few others reported receiving no assistance from the pegging group in locating the contour line along which to construct the bands as the reason for not adopting contour vegetation bands despite experiencing soil erosion in their fields.

Plate 5.3 *Leuceana leucocephala* Experimental Plot

Plate 5.4 *Leuceana leucocephala* and *Tephrosia vogelli* Mixed Experimental Plot

Plate 5.5 *Leuceana leucocephala* Plot

Plate 5.6 *Leuceana leucocephala* Plot Choked in Grass Behind A *Gmelina* Woodlot

Plate 5.7 One-year Old *Sesbania sesban* Tree for Seed Production Among Other Plants in A Woodlot

Plate 5.8 *Sesbania sesban* Tree Near A Homestead

Plate 5.9 *Tephrosia vogelli* in Seed

Plate 5.10 Two-year Old *Cajanus cajan* Grown for Seed

Plate 5.11 A Velvet Beans Field With A Vetiver Grass Contour Band

The percentage adoption for fodder banks was the lowest (29%) of the three. It is worth noting that livestock numbers in the study area at the time of the study were reported to have been reduced by corridor diseases that ravaged the area since the early 1990s. Cattle and goat numbers were averaging 5.0 and 5.3 per household respectively, which are generally perceived to be small by the farmers. A considerable number of farmers reported having lost most of their livestock while some lost all and therefore may not have seen the creation of fodder banks as necessary or even important at all. When asked, however, 42 % of the farmers reported not having adequate pasture for their animals particularly, in the hot dry part of the year, 33% felt they had enough pasture while 25% considered the question on pasture non-applicable to them. Some 38% consider the drying out of grass in dry season and unorganised, untimely burning of grass as the main problems leading to inadequate pastures. Despite this, in the section on the urgency of agroforestry techniques to the community discussed earlier, it was found out that 70% of all the farmers ranked the creation of fodder banks to be among the least important issues on their priority lists.

There are a number of possible reasons why creation of fodder banks for livestock does not seem popular among farmers in the LRS. One is the obvious fact that 40% of the farmers do not own livestock. Of the six 60% who own livestock, their livestock are in small numbers, as indicated earlier, so that pasture may seem not to be a problem. Moreover, the free movement of animals in the area from one farm holding to another, particularly after harvest, may contribute to the perception by 33% of the farmers that there is adequate pasture for their animals. On the other hand, the free movement of livestock could be a discouraging factor to fodder bank adoption as it implies that for one to adopt and successfully maintain their fodder banks, they will need to protect it from other people's animals. Another likely reason for low fodder bank adoption could be that the growing of fodder for livestock is foreign to local farmers as it is not a common practice in traditional society. Farmers have largely been feeding their livestock on natural pastures and crop residues. Besides, livestock have mainly been raised for reasons such as prestige and social functions rather than for commercial purposes. It takes time to change traditional attitudes that value quantity more than quality of livestock and only when these attitudes have considerably changed can such techniques as fodder banks become popular.

The few farmers that adopted fodder banks are largely growing Bana grass and Rhodes grass as fodder for their animals. However, there are some farmers who are experimenting with *Leucaena leucocephala* with the intention of using it for both soil fertility and animal fodder (Plates 5.3 to 5.6).

The observed adoption percentages for the three agroforestry techniques could have also been influenced by the fact that farmers have many other SCAFE techniques to choose from. Some of these techniques attend to items that are higher on the farmers' priority lists and therefore, could have a greater attraction to the farmers than the agroforestry techniques being studied. For example, SCAFE also teaches water harvesting techniques that address the farmers' seemingly more urgent need i.e. clean water. At the time of the study, it was observed that many farmers were in the process of building iron roofed houses to enable them harvest clean rain water for everyday use, probably in the hope for improved health. In fact building iron roofed houses ranked second after the need for a clinic on the overall ranking of priorities (Table 5.2) of what farmers consider to require urgent attention.

5.3.2 Adoption Rates and Trends for the 1995-2000 Period.

The number of farmers who adopted a particular technique in each agricultural year was compiled. Cumulative adoptions were worked out by adding the number of adopters for a particular year to that of adopters of the same technology for the previous year. This was expressed as a percentage of the total number of respondents. Figures 5.1 to 5.3 give graphical representation of this information revealing adoption trends. Each one of the three techniques followed its own rate and trend of adoption.

5.3.2.1 Improved fallow

Fig. 5.1 shows a steady increase in the number of farmers adopting improved fallow from 1995 to 2000. On average, the adoptions increased at a rate of six (6) farmers per year. Among the three techniques, improved fallow had the fastest relative rate of adoption. Farmers seem to have been incorporating this technique in their farming activities more readily than the other two. It should, however, be borne in mind that some aspects of improved fallow, that is, the use of sunnhemp and velvet beans, take a shorter fallow period which could be one of the reasons many farmers have used the technique. Furthermore, improving soil fertility using sunnhemp and velvet fallow is not an altogether new technique to the farmers. It is a practice that had just been abandoned but was being re-introduced then. The planting of soil fertility trees is totally new to the farmers. However, there were more farmers who had adopted improved fallow technique than those who had not yet adopted.

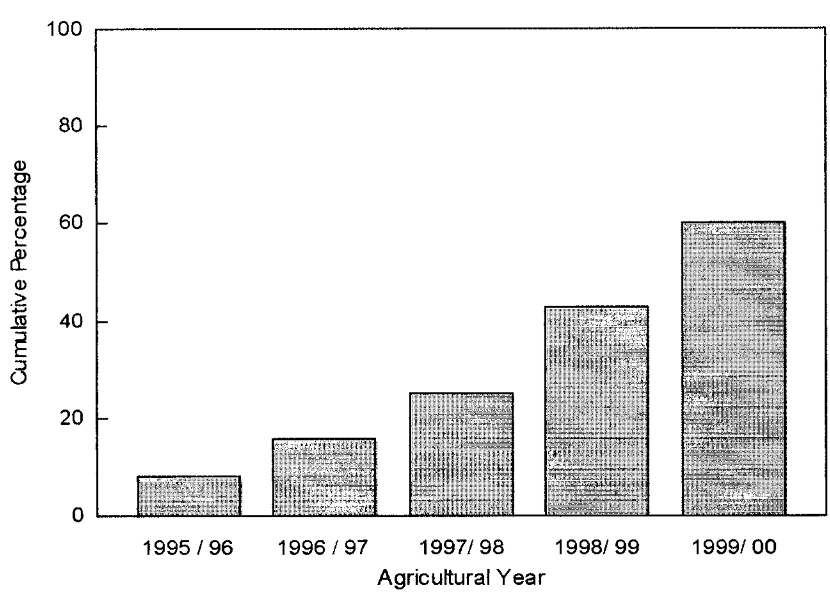

Fig. 5.1 Cumulative Adoption Percentages for Improved Fallow

5.3.2.2 Contour vegetation bands

The adoption of contour vegetation bands increased at an average rate of four (4) farmers each year. As shown in Figure 5.2, the increase in percentage adoptions was uneven over the five year period. Some years (1997/98) recorded minimal adoptions, others had substantial adoptions (1998/99) while the 1999/2000 year received no new adoptions but recorded a decline in adoption. A few farmers abandoned the technique due to frustrations related to land re-allocation by the council. The few affected farmers are those without title deeds to the land they work. This might have an effect on other farmers without title deeds who may have planned to adopt agroforestry techniques. Although a substantial number (37%) had adopted this technique, a larger percentage of farmers had not yet adopted.

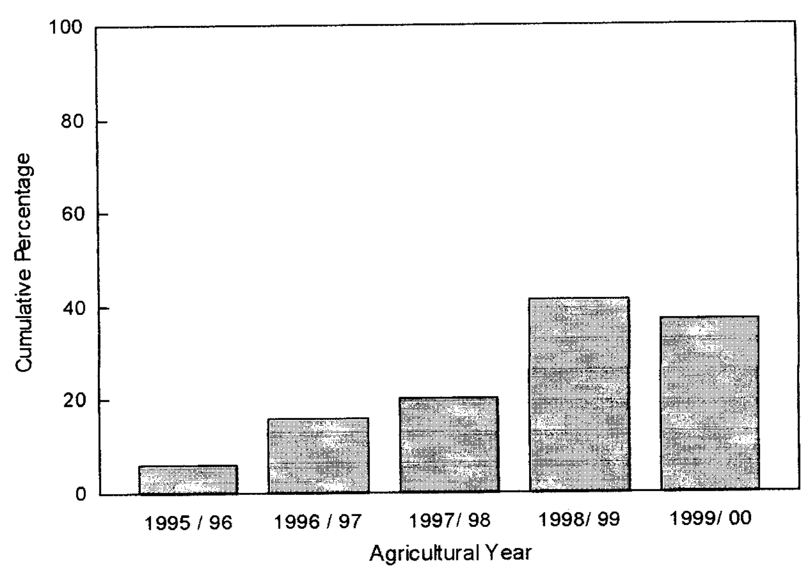

Fig. 5.2 Cumulative Adoption Percentages for Contour Vegetation Bands

5.3.2.3 Fodder banks

Figure 5.3 shows that fodder banks were not as popular as the other two techniques among farmers. This is shown by the absence of adoptions in the first and second years of the SCAFE project. The adoptions were few and increased at a low rate of 2.8 new adopters each year. There were many more farmers who had not yet adopted fodder banks compared to those who had.

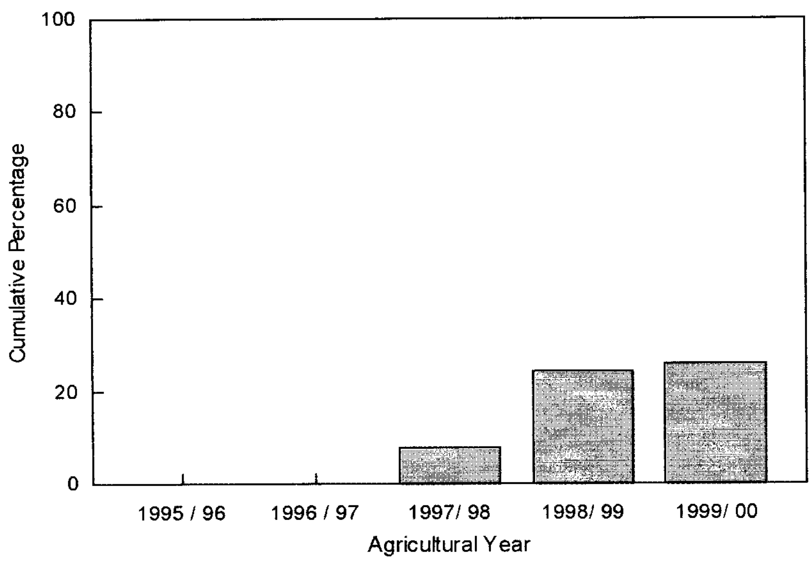

Fig. 5.3 Cumulative Adoption Percentages for Fodder Banks

Adoption rate and trends give an impression that improved fallow and contour vegetation bands were more favourable to the farmers than fodder banks. Again, this is in line with findings in earlier sections.

5.3.3 Distribution of Adopted Agroforestry Techniques

Figure 5.4 gives a picture of the spread of the adopted agroforestry techniques in the LRS. It also shows the farmers who had title deeds to their lots (i.e. farm holdings). From this map, the close relationship between adoption of agroforestry techniques and the holding of title deeds can be seen. Most of the farmers who had adopted some agroforestry techniques had title to their farm lands - at least 62% of all adopters had title deeds compared to a smaller 38% of adopters who did not have title deeds. This conforms with findings of other agroforestry adoption studies that found a relationship between adoption and possession of title deeds for the land the farmer works (Kabaso, 1995; Kilimwiko, *et al.*, 1992).

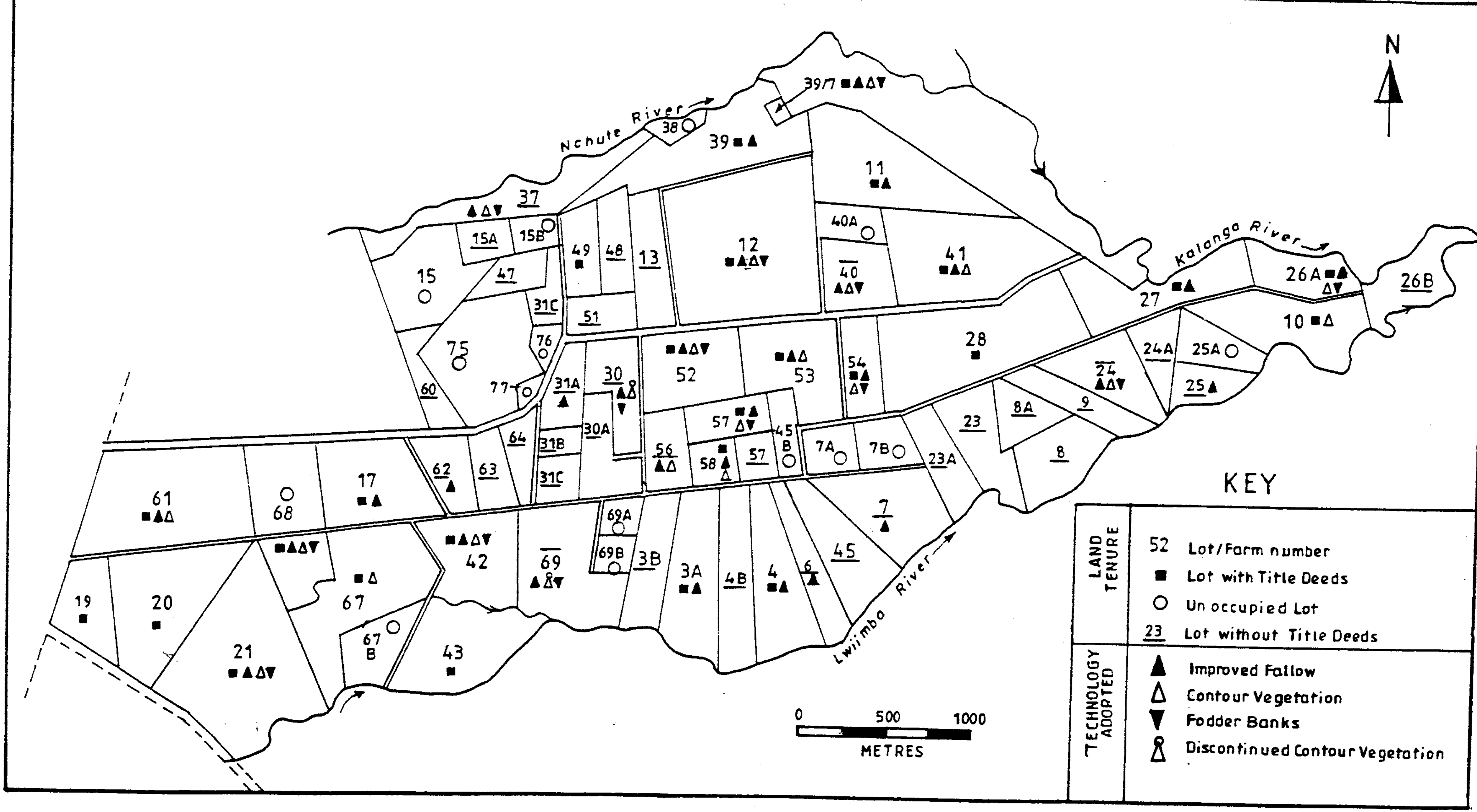

Fig. 5.4. General Plan of the Study Area Showing the Distribution of Agroforestry Technologies Adopted.

5.4 Factors Influencing the Adoption of Agroforestry Techniques

To find out the factors that influence agroforestry technique adoption in LRS, data were collected on variables known to have influenced agroforestry adoption in other areas in the world (Appendix 7.). These are: number of female and male adults, number of meetings, demonstrations, field days a farmer had attended, age of farmer, education level of the farmer, size of the farm, number of livestock owned and land tenure.

First of all, the raw data on the ten variables from the study area were reduced using Principal Component Analysis (PCA). The purpose of applying PCA was to compress the data bringing out the main underlying factors so as to give an indication of the factors that may have statistical influence on adoption. PCA only extracted four components/factors (Table 5.3) whose eigen values were found to be above one (Appendix 8.).

According to Table 5.3, the first component is a labour and farm size component because it loads highly on variables that relate to labour (number of adults (.852), number of females (.750), number of males (.657) as well as on farm size (.714). The second component is awareness component as it loads highly on number of meetings, field days, demonstrations attended (.507) as well as the number of years a farmer has practised an adopted technique (.549). Component three is draught power. This is because the number of cattle a farmer owns loads highly (.560) in this component. Age also loads highly in the third component although in a negative way i.e. it subtracts highly (-.684). Component number four shows education level since it loads highly (.715) in this component.

Table 5.3 Factor Loading for Four Components

Variable	Component 1	Component 2	Component 3	Component 4
Adults	.852	-.415	.059	.004
Age	.386	.041	-.684	.052
Cattle	.322	.421	.560	-.306
Education level	-.261	-.227	.340	.715
Farm size	.714	.114	-.106	.303
Females	.750	-.473	-.031	.081
Goats	.402	.511	.480	.141
Males	.657	-.398	.325	-.277
Meetings	.405	.507	-.315	-.213
Years	.487	.549	-.117	.402
% Variance	**31%**	**16%**	**14%**	**10%**

Key:

Adults - Number of adults in a household.

Age - Age of the household head.

Cattle - Number of cattle owned by farmer.

Education level - Educational level of the farmer.

Farm size - Size of the household's farm.

Females - Number of females in the household.

Goats - Number of goats owned.

Males - Number males in the household.

Meetings - Number of awareness meetings, demonstrations, field days a farmer attended.

Years - Number of years of adoption.

The PCA has highlighted the main factors (labour, farm size, awareness, draught power and educational level) likely to have an influence on the adoption of agroforestry techniques in LRS. This indication is further pursued by carrying out statistical tests to isolate the variables/factors that have significant influence on adoption of agroforestry techniques in the study area. Pearson Product Moment correlation analysis was applied on the raw data from the study area (Appendix 7.).

Table 5.4 Summary of the Pearson Product Moment Correlation Analysis Results

Variable Correlated with Adoption	Correlation Coefficient(r) Observed	Probability(p) (2-tailed)	Significance at 0.05 Level
No. of Adults	.118	.390	Non-significant
Age of farmer	.152	.268	Non-significant
No. of cattle owned	.236	.082	significant
Education level of farmer	-.076	.582	Non-significant
Farm size	.276	.042	Significant
No. of meetings, field days attended	.385	.004	Significant
No. of years since farmer adopted technique	.789	.001	Significant

Each one of the variables that make up the factors identified earlier in PCA was correlated with adoption (the number of agroforestry techniques adopted by each farmer out of the three considered in this study). Results of the correlation analyses are summarised in Table 5.4, while details of the output of analyses are given in Appendix 7.

The correlation results summary in Table 5.4 shows that there were positive relationships between the number of techniques adopted and the number of adults in a household; the number of techniques adopted and the age of the farmer; as well as in the number of techniques adopted and the number of cattle that a household owns.. These relationships, however, were not statistically significant at 0.05 significant level as their probabilities (0.390, 0.268 and 0.082, respectively) fell outside the region of significance at the specified level.

The relationship between the number of techniques adopted and the educational level of the farmer was found to be very weak and negative. It was also not statistically significant as its probability of being so (0.582) was outside the probability of significance (0.05) against which the relationship was tested. This was so, possibly, because the more educated farmers in the region were those that went through agricultural colleges where they learnt 'modern' farming methods that rely on artificial fertilisers. The less educated farmers, on the other hand, may have been more open to advice on how to improve their agricultural production since they had always relied on advice from extension workers as they had no formal education in agriculture.

The correlation between the number of adopted techniques and the size of the farm a household owns was found to be weak but positive (.276) and statistically significant at 0.05 level. This is shown by a probability of 0.042 that falls within the probability of the significance level. It means that the bigger the farm size the more likely that a farmer could adopt the agroforestry techniques being studied. Since the size of the farm can limit what a farmer can do on his/her farm, it could be the reason why a farmer with bigger land may choose to adopt some agroforestry techniques that occupy part of the land that may be needed for other agricultural activities and vice versa. The larger the farm, the more one could set aside some portions for experimentation. Although the correlation between farm size and adoption was significant, the relationship was weak possibly because some farmers had big farms but had several grown up sons with whom they share the land, limiting it largely to the production of food.

A statistically significant association (0.780) was found to also exist between the number of techniques a farmer adopted and the number of years the farmer had practised the first technique he adopted. The probability of significance for this relationship was 0.001, which falls well within the region of both the 0.05 and 0.01 significance levels. It implies that experience improves the farmer's attitude to agroforestry techniques making him/her more open to try other agroforestry techniques. Most farmers who adopted one technique at the start of the SCAFE project in 1995 had adopted all the three techniques considered in this study by the 1999/2000 agricultural year.

The relationship between the number of techniques adopted and the number of cattle that a household owns was found to be significant, too. Its probability also fell within the critical region. This could be because farmers in LRS largely us cattle as draught power. With draught power, a farmer has greater capacity for many practices and would, therefore, more likely to try new techniques.

The factors that were found to have significant influence on the adoption of agroforestry techniques in the LRS are number of cattle, farm size, awareness/ experience as well as the possession of title deeds to the farmer's land.

Some problems reported to be making it difficult for the farmers in LRS to incorporate agroforestry techniques, particularly improved fallow that utilise soil fertilising trees and contour vegetation bands, are: difficulty in propagating tree nurseries; termite infestation; high labour demand; unavailability of water for plants in dry season; and the damage of plants by animals, as well as fires.

Although some tree seedlings have been supplied by SCAFE workers for purposes such as woodlots, fruit trees, ornamental trees and those species for building poles, very few varieties of seedlings have been provided for such purposes as improved fallow and fodder banks. Interested farmers have, instead, been given seed to propagate and raise seedlings by themselves. Most of the farmers who received seeds for trees failed to raise nurseries due to varied reasons. Although group nursery raising was introduced in 1998, it has not been successful in propagating tree nurseries despite being located at the borehole. Inadequate watering facilities, pests and termite attacks were said to be major drawbacks.

At least 69% of the farmers that have tried to plant trees of some kind reported termite attack to be a major problem. Some tree species, such as *Leucaena leucocephala* that farmers had been given for improved fallow and fodder banks are said to be susceptible to termite attack. Some 31% of the farmers reported that damage to plants by livestock was another problem they faced in trying to implement the agroforestry techniques. About 40% of the farmers also indicated that most of their plants died during the dry season due to combined effects of lack of water and termite attack even if they were planted at the right time (beginning of the wet season). This necessitates the introduction of tree species better suited to the climate of the area and more resistant to termite attack.

5.5 Impact of the Adoption of Agroforestry Techniques on People's Livelihoods

Impacts are here considered in two categories: those pertaining to the change related to adoption and those related to benefits as a result of adopting the three agroforestry techniques.

5.5.1 Impact of the Introduction of Agroforestry Techniques

In the first place, the impact of the introduction of agroforestry techniques in LRS was discussed in terms of adoptions. There were 34 farmers (68%), more than half the total number of respondents, who have adopted one or more of the three agroforestry techniques. Of these, 31 (62%) have adopted improved fallow, 21 (42%) have adopted contour vegetation bands and 15 (30%) have attempted fodder banks. There are overlaps in the figures of adoption given here since farmers adopted more than one of the three techniques being studied in different combinations.

Although the adoptions are still in the early stages where small portions are devoted to improved fallow and fodder and only one or two contours have been planted with vegetation, many farmers have made adjustments to incorporate the techniques into their farming practices. In terms of use of tree species in the techniques adopted, Plates 5.3 to Figure 5.10 give examples of the species that have been tried as individual plants or experimental plots. Some of these are mixed in woodlots near homes.

5.5.2 Benefits of Adopting Agroforestry Techniques

Adopting farmers have enjoyed some benefits, especially from aspects of adopted techniques that take a short time to produce effects. The benefits, however, have not been quantified and statistically verified as relating to the use of the agroforestry techniques adopted. They are merely discussed as reported by the adopting farmers. It was observed that some farmers reported benefits that they knew (were taught) agroforestry could bring, and this does not necessarily imply that they had experienced them. This was realised during field observations which often followed the interviews with the farmers, and so as much of such information as possible was removed.

5.5.2.1. Improved Fallow

Most benefits enjoyed by farmers from improved fallow are those related to the use of sunnhemp and velvet beans that take a shorter fallow period (between seasons). Impacts from the use of soil fertility trees in the field were not yet experienced since this kind of improved fallow was still in the experimental stage with many farmers nurturing a few trees intended to produce seed for bigger portions.

Increased crop harvests with little to no use of fertilisers was reported as the main benefit by 55% of the adopters of improved fallow. About 45% of improved fallow adopters, however, indicated that they had not yet benefited from adopting the technique. Other benefits reported by a few farmers include the making of coffee from velvet beans, the extraction of oil from sunnhemp and the use of sunnhemp and velvet beans as chicken feed.

One other effect of adopting improved fallow was that some farmers were forced to sell their goats because they ate the trees that farmers tried to plant. The planting of trees also necessitated a more strict control of the movements of domesticated animals. Whereas, before, most farmers used to let the animals loose after harvest, they now were required to herd them all year round to keep them from destroying the trees planted.

5.5.2 .2 Contour Vegetation Bands

A large percentage (84%) of contour vegetation band adopters reported that run-off which used to wash away top soil and, sometimes, the fertilisers they applied on their crops was reduced or controlled by the bands. A further 11% of the adopters indicated not having experienced any benefits yet, while 5% of the adopters complained that the bands caused flooding in their fields. Some farmers reported better crop yields which they attributed to contour vegetation bands because they reduced the washing away of fertilisers after application which commonly occurred before they adopted this technique.

5.5.2.3 Fodder Banks

Of the 15 farmers who adopted fodder banks, 33% observed that their animals grew fat and strong when they were fed on the fodder grass they grew. A few other adopters of this technique (13%) found out that this technique helped them control the movement of their animals as the animals love grazing on fodder more than on the natural pasture. A further 47% indicated that they had not yet experienced any benefits. All of those who grew trees for fodder instead of grass have not yet benefited from their fodder trees as the trees are still small.

5.6 Summary of Findings

The study revealed that farmers in the study area have responded positively to the introduction of agroforestry techniques even if they have a few other issues they perceive to be more important/more urgent to their well being. The farmers, however, consider improved fallow and contour vegetation bands among their priorities, implying that the two techniques address the community's urgent needs.

In the five years that the SCAFE project has operated in the study area, adoption of the three agroforestry techniques has gone up to 66% among the farmers. The greatest proportion of these adoptions were for improved fallow which attained 60% adoption by the year 2000. Contour vegetation bands attained 37% while fodder banks achieved 29% adoption at the time of the study.

While aware that many different factors work in a complex interrelated manner to influence adoption or non-adoption of the techniques under study, it was found out that three of these factors have statistically significant influence on the adoption of the three agroforestry techniques. These are: experience, number of cattle owned, awareness and farm-size. Education was found to have a negative, though statistically insignificant influence on adoption of agroforestry techniques.

The adoption of the three techniques in the study area, though having effected some change in the activities of the adopters, has not yet brought many benefits. Many adopters have, however, expressed faith in the potential of the techniques to improve their agricultural production while some reported to be experiencing some benefits already.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

The first part of this chapter provides a summary of the conclusions of the study while the second part puts forward suggestions on ways in which the adoption of the agroforestry techniques studied could be enhanced.

6.2 Conclusions

This study sought to describe how the theoretical knowledge of agroforestry as a 'bright promise' for most rural agricultural communities of Africa was received and put into practice by farmers of LRS. Adoption was measured by the number of agroforestry techniques a farmer adopted out of the three being studied. Adoption of individual techniques was measured in terms of percentages of adopters out of the total number of farmers in the study area.

Findings show that the farmers of LRS are responding positively to the introduction of the three agroforestry techniques considered in the study. Contrary to the expectation that contour vegetation bands would receive the highest adoption, improved fallow was found to have the highest adoption of the three, followed by contour vegetation bands. Fodder banks had the least adoption.

Of the variables that were thought to be influencing adoption of the three agroforestry techniques, only three were found to have statistically significant association with adoption. These are: farm size, the number of awareness meetings which include field days and demonstrations a farmer had attended and the number of years the farmer has practised the first technique adopted. The presence of these factors in large amounts/quantities worked to promote adoption while small farm size, little or no awareness of the techniques were found to be working against the adoption of the agroforestry techniques.

Even though no physical measurements of the impact of the adoption of the three techniques in the study area were taken, it was found out, from what the farmers reported, that controlled erosion by running water, controlled animal movements and better yields have been the main benefits of agroforestry adoption thus far.

The study also revealed that many farmers have attempted to plant fodder and soil fertility trees, but they reported low survival rates due to termites, drying, fires, destruction by animals and lack of proper management. Some of the tree seedlings died because they were planted at the wrong time (near the end of the rain season) and they dried up for lack of water or they were destroyed by termites.

It was evident from the study (as evidenced by the absence of other SCAFE workers in the study area) that most of the SCAFE work in implementing agroforestry techniques in LRS had been left to the agricultural extension worker. The agricultural extension worker, however, indicated having limited knowledge in such areas as tree nursery propagation.

6.3 Recommendations

The project could register more adoptions of the three agroforestry techniques if the following were attended to:

1. Provision of more access to specific advice on tree seedling propagation, proper timing for transplanting seedlings and termite and pest control. The forestry officer in the implementing team ought to be actively involved in the agroforestry activities in the resettlement.

2. Termite and drought resistant plant species serving the same purpose as those used now should be introduced in the area in order to increase and maintain farmers' interest and faith in the feasibility of agroforestry techniques. This is because most of the trees farmers have tried to plant have been destroyed by termites while others have died due to lack of water even when they were planted at the right time. Therefore, if termite control cannot be achieved with the present species, different species have to be used.

3. Farmers ought to be taught water conservation methods so that they can manage their trees properly.

4. If farmers were assisted in eradicating livestock diseases and helped to re-stock the area, the SCAFE project would be more successful. This is because livestock plays an important role in the community's life as well as in the implementation of agroforestry techniques such as contour vegetation bands that require draught power. Other NGOs *that specialise in this kind of assistance could be called in to work in collaboration with* SCAFE.

5. The project could do well to encourage the use of soil fertility trees, such as the *Cajanus cajan* which also produce food. This can help provide a fall back of food to the farmers in years of disaster such as drought as well as supplement the farmers' diet.

6. The government (council) must speed up and complete its land re-demarcation program and promptly give title deeds to the farmers. The possession of title deeds encourages farmers to care for their land and make permanent structures on it such as contour vegetation bands. They can plant soil fertility trees on their fields and be sure to utilise the benefits of that endeavour after the appropriate number of years.

7. Project implementers should work more closely with the farmers by considering the farmers' tree preferences for their agroforestry activities and guiding their choices, rather than just imposing tree species to farmers to plant against their choice.

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APPENDICES

APPENDIX 1

Interview Schedule

Schedule No. ________________ Date ____________________

1. a) Age in years

 (i) 16-20 (ii) 21-35 (iii) 36-50 (iv) 51-65 (v) 65-80

 b) Sex (i) Male (ii) Female

 c) Marital Status: (i) Married (ii) Single (iii) Widowed (iv) Divorced

 (v) Separated

 d) Household size (i)adults above 16 years: male ______ female______

 (ii)children above 12 years: male ______ female _____

 (iii) children below 12 years ___________.

 e) Educational level of farmer

 (i) none (ii) primary (iii) secondary (iv) college (v) university

 f) Main farming activity (i) crops only (ii) animals only (iii) mixed

 g) Main sources of income for the household?

 (i) annual sale of crops from field

 (ii) sale of garden produce

 (iii) sale of animals when necessary (before they died)

 (iv) other (specify) ________________ .

2. a) How big is your farm?________________ hectares.

 b) What proportion do you cultivated each year? __________________ hectares.

 c) Crops normally grown each year? Give in order of importance starting with the most important/major crop: (i)__________ (ii)__________ (iii)__________ (iv) _______

 (v) __________ (vi) ______________ (vii) _____________

d) How many field days, workshops, demonstrations on agroforestry techniques have you attended?

(i) 0 (ii) 1 (iii) 2 (iv) 3 (v) 4 (vi) 5 (vii). more than 5

e) Have you adopted any of the new agroforestry techniques you learnt?

(i) yes (ii) no

3. Which agroforestry techniques have you adopted?

(i) improved fallow (ii) plant fodder banks (iii) contour vegetation bans

(iv) planting trees for woodfuel (v) trees for building materials (vi) creating live fences

(viii) other (specify) ________________, ________________, ________________

4. Why did you adopt the techniques above?

(i) advice from extension workers on benefits of adopting these technologies

(ii) field is on sloping land and is affected by gullying so I adopted contour bands

(iii) animals grew thin in dry season due to limited good pasture

(iv) I saw how they helped my neighbour

(v) extension officer expected all of us to at least try one practice.

(vi) Other (specify) ____

5. How long have you practised the techniques you adopted? (i) less than 2 years

(ii) 2-3 yrs (iii) 4-5 yrs (iv) more than 5 yrs

6. What problems did you have in your farming before you adopted the techniques you mentioned earlier?

(i) Soil erosion (gullies across the field)

(ii) Could not have good harvest without applying fertilisers

(iii) Inadequate pasture for animals

(iv) Other (specify)____

7. What problems have you experienced in implementing the new agroforestry techniques you have adopted?

(i) termites attack trees (ii) no water for trees in dry season (iii) animals damaging plants (iv) demand for a lot more work (v) ______________________________

(vi) ____

8. How are you addressing the problems in question 7 above?

____

____

____

____

9. Do you think it is worth practising the new agroforestry techniques you have tried?

(i) yes (ii) no (iii) not sure

10. What improvements have you observed with the use of each techniques you have adopted?

(i)____

(ii) ____

(iii)____

(iv) ____

(v) ____

11. a) Do you own livestock? (i) yes (ii) no

b) If yes, specify the type and numbers of animals you own.

Type	Quantities
Cattle	________
Goats	________
Pigs	________
Poultry	________
Other (specify)	________

12. Do you feel there is adequate pasture for your animal ?

(i) yes ____________________ (ii) no______________

13. If no to question 12, explain the problem and give the time of the year you experience pasture problems ____

____

____

14. How do you address the pasture problems you mentioned in question 13?

____

____

____

15. What advice have you received from extension workers on how to address grazing problem ? ____

____

____

16. What problems, apart from overgrazing, do you experience with livestock rearing?

____

____

17. Given choice and the resources, which problem concerning livestock would you address first and why? (give them in order of declining importance)

____

____

____

____

18. Are you involved in tree planting of any kind? (i) yes (ii). no

19. What types of trees, leguminous plants and herbs have you grown?

Name	Where planted(land, site)	Arrangement	Use

20. What inputs do you need to successfully grow the trees and plants above and how do you obtain the inputs?

Type(tree/plant)	input	how obtained
______________	______________	________
______________	______________	________
______________	______________	________

21. Rank the main participants for each farming activity on a four point scale.

Activity	Time of the year	Men	Women	Boys	Girls
Field clearing					
Ploughing/tilling					
Planting crops					
Planting trees					
Hand weeding					
Mechanical weeding					
Applying fertilisers					
Applying pesticides					
Harvesting					
Herding animals					
Watering plants					
Shelling maize for sale					

Scale: 4 - most involved; 3 - moderately involved; 2 -little involvement; and 1- no involvement.

Extension Services

22. a)What facilities/services do you have ?

(i) group nurseries

(ii) boreholes, water storage tanks

(iii) demonstration and training facilities

b) How accessible are these facilities?

(i) easily accessible (ii) quite accessible (iii) inaccessible

23. Do the facilities stock enough variety of new tree species that you want based on demand?

(i) yes (ii) no

24. Do you get all the help/advice/technical assistance you need from project and extension workers?

(i) yes (ii) no

25. What would you wish project and extension workers did to help you succeed with the new agroforestry techniques, which they are not doing now?

____

____

Perceptions on Potentials of Project

26. Do you think the new agroforestry techniques introduced are going to:

a) Increase your agricultural production (i) yes (ii) no (iii) I don't know

b) Decrease soil erosion in your fields (i) yes (ii) no (iii) I don't know

c) Insure household food security (i) yes (ii) no (iii) I don't know

d) Assist in reclaiming degraded land (i) yes (ii) no (iii) I don't know

e) Decrease grazing problems (i) yes (ii) no (iii) I don't know

f) Improve your standard of living (i) yes (ii) no (iii) I don't know

27. How have you benefited from the SCAFE programme as a whole?

____

____

____

____

For Non-implementors Only

28. Why have you not adopted any one of the new agroforestry techniques introduced by SCAFE? ____

____

____

29. a) Do you, in future, intend to adopt some of the new agroforestry techniques you learnt?

(i) yes (ii) no

b) If not, why?

____

____

APPENDIX 2

Additional Questionnaire

Name ______________________________ Male ________ Female _______

Answer all of the following questions.

1. Do you have title deeds to your farmland?

   i. Yes   ii. No   iii. in process of getting

2. Does having NO title deeds to your farmland affect your agricultural activities?

   i. Yes   ii. No

3. If your answer in question 2. above is yes, state how having no title deeds for your farmland affects your agricultural activities.

   ____

   ____

   ____

4. Look at the following list carefully then number each item starting with the one you consider most important/urgent to you up to the least.

1. ____ building an iron roofed house
2. ____ controlling soil erosion in my field
3. ____ providing additional animal feed for my animals in dry season
4. ____ building a clinic
5. ____ controlling animal movement by fencing
6. ____ finding money for fertilisers
7. ____ improving roads in my area
8. ____ making well for drinking water
9. ____ improving soil fertility without using fertilisers
10. ____ controlling animal diseases

11.____ getting farm implements such as ploughs, planters

12.____ ready market for farm produce

13.____ assistance in restocking area with cattle since most of them died

14.____ establishing facilities in the area from which fertilisers and seed can be bought

15.____ other (specify)

5. Indicate by ticking at the end of each item in question 4 above those items you already have in your area.

6. (a) For each one of the four items below, say whether you have used the technique by putting a circle around the suitable answer.

   i. Contour ridges with grass **yes** **no**

   ii. Contour ridges without grass **yes** **no**

   iii. Improved fallow (this includes growing plants such as *Sesbania sesban*, sunhemp, velvet beans in a fields during the time when you are not growing crops). **yes** **no**

   iv. Fodder banks (this includes growing plants/grass intended to feed domesticated animals in dry season). **yes** **no**

(b) For each technique in 6(a) you have **not** adopted why have you not adopted it i.e. what problems /difficulties have prevented you from adopting it?

   i. reasons for **not** making **contour ridges** with grass ______________________

   ____

   iii. reasons for **not** using **improved fallow** ______________________

   ____

   iv. reasons for **not** planting **fodder banks** ______________________

   ____

7. The four items in question 6 above are shown in a table below. Against each item indicate when you started using the technique and whether you are still using it. If you stopped using it indicate the year you stopped giving reason/s for stopping.

Technique	Year started using it	Still using it	Benefits being enjoyed	Year stopped	Reason for stopping
Improved fallow					
Contour bands with vegetation					
Contour bands without vegetation					
Fodder banks					

APPENDIX 3

Interview Schedule for Project and Extension Workers

A . General

1. What is your role in the agroforestry project in LRS?

____

2. When did the project in LRS begin? ______________________

3. How long is this project going to run in LRS? ______________________

4. How/Why was LRS chosen for this kind of project?______________________

____

5. What problems do you experience in your work LRS? ______________________

____

____

B. Project Concept and Design

6. Which is the target group of the project? ______________________

7. How large is the catchment area of the programme? ______________________

8. (a) What is the overall aim of the project? ______________________

   (b) What are the specific objectives of the project? ______________________

____

____

9. Who set up these objectives and why?

____

____

10. (a) What agroforestry practices have been introduced in LRS? ____________________

____

(b) Did the community participate in decision making at the inception of the project?

____

(c) If yes, how did the community contribute? ______________________________

____

____

11. (a) Who are the stakeholders ? ____

____

(b) What is the role of each stakeholder?

____

____

____

C. Implementation, Monitoring and Evaluation of Project

12. What are your targets in project progress?

____

____

13. (a) In your assessment, is the project on course? ____________________________

(b) If so what are the indicators? ______________________________________

14. What ways/method/activities have you used in introducing the new agroforestry techniques?

____

____

D. Effects of the Project on the Target Group

15. What was the **pre-project** community attitude toward the project?

____

16. Comment on the attitude and acceptability of the various agroforestry techniques introduced giving your assessment of the reasons for the observed response.

____

____

____

____

17. What benefits has the programme brought to the target group since its inception?

____

18. What measures have been put in place to ensure that the farmers continue with the new technologies even after the project has ended?

____

____

____

APPENDIX 4

Rankings of Selected Community Needs by Individual Farmers

Item Que.#*	*1.*	*2.*	*3.*	*4.*	*5.*	*6.*	*7.*	*8.*	*9.*	*10.*	*11.*	*12.*	*13.*	*14.*	*15.*
1.	01	06	10	02	09	03	12	04	13	05	07	11	14	08	15
2.	09	08	12	01	10	14	03	02	11	04	05	06	07	13	15
3.	01	02	04	03	05	14	09	08	06	07	12	11	13	10	15
4.	09	04	06	01	10	14	08	02	07	03	05	11	12	13	15
5.	02	06	07	05	03	14	09	01	08	04	10	13	12	11	15
6.	01	04	05	02	03	07	12	06	10	08	09	13	14	11	15
7.	06	04	14	01	13	02	10	05	03	07	09	11	12	08	15
8.	05	04	13	01	10	08	11	02	03	09	06	12	14	07	15
9.	02	07	14	01	09	04	11	03	08	06	10	12	05	13	15
10.	01	02	13	03	06	08	07	04	09	05	12	11	14	10	15
11.	05	03	14	04	13	01	06	02	08	10	11	12	07	09	15
12.	08	09	14	05	04	13	11	01	12	06	02	10	07	03	15
13.	01	06	12	02	05	14	07	03	11	08	13	09	04	10	15
14.	01	05	13	03	10	07	09	02	04	12	11	06	14	08	15
15.	01	02	10	05	14	07	08	06	09	04	12	11	13	03	15
16.	01	02	12	03	11	04	05	06	07	08	09	14	13	10	15
17.	02	04	01	09	03	10	05	06	08	07	11	13	14	12	15
18.	01	06	11	02	12	03	07	04	08	10	09	05	14	13	15
19.	06	01	12	08	07	14	11	09	02	13	03	05	04	10	15
20.	03	02	08	01	05	10	08	04	07	06	15	11	13	12	14
21.	06	02	14	04	03	07	10	01	09	05	11	13	12	08	15
22.	10	05	11	01	09	14	03	02	12	04	06	07	08	13	15
23.	01	11	13	02	10	07	12	09	03	04	05	14	06	08	15
24.	05	02	15	01	13	06	11	04	03	07	08	09	12	10	14
25.	02	05	14	03	09	06	12	04	01	08	10	13	11	07	15
26.	01	11	04	10	03	05	15	02	06	07	08	09	12	13	14
27.	04	06	12	08	02	11	01	03	05	09	10	14	07	13	15
28.	01	09	08	02	13	03	10	12	14	06	04	07	11	15	05
29.	06	04	12	08	07	14	11	09	02	13	01	05	03	10	15
30.	02	08	12	04	06	10	13	01	05	03	15	07	11	09	14
31.	10	02	14	05	03	01	07	08	06	04	11	13	12	09	15
32.	13	06	10	01	14	05	12	04	07	09	03	08	11	02	15
33.	01	06	14	02	12	05	09	03	07	04	08	10	13	11	15
34.	01	02	14	03	09	13	12	04	05	06	10	11	07	08	15
35.	13	06	14	07	15	08	01	02	09	11	03	05	10	04	12
36.	01	11	14	04	06	13	08	03	07	02	12	09	10	05	15
37.	01	03	14	04	13	12	11	06	08	10	02	07	09	05	15

38.	01	03	12	05	11	13	08	02	04	10	06	07	14	09	15
39.	01	02	11	03	10	09	05	04	12	06	13	14	08	07	15
40.	01	05	03	04	02	14	08	07	06	11	09	10	12	13	15
41.	08	07	12	02	09	03	04	01	14	06	13	05	11	10	15
42.	01	04	13	03	07	09	11	02	05	06	08	12	14	10	15
43.	01	07	12	02	14	03	04	05	06	13	08	10	11	09	15
44.	06	05	13	01	10	08	03	02	12	04	14	07	11	09	15
45.	08	12	07	02	09	03	04	01	14	06	13	05	11	10	15
46.	07	12	13	11	06	01	10	03	05	02	04	09	14	08	15
47.	04	01	07	02	06	10	09	08	03	14	13	05	12	11	15
48.	02	05	14	01	12	13	06	03	04	09	11	07	10	08	15
49.	01	06	12	07	10	13	04	02	05	11	03	14	09	08	15
50.	02	05	14	01	11	03	12	04	08	06	07	13	10	09	15
51.	13	06	14	07	15	08	01	02	09	11	03	05	10	04	12

Key

-Item* - the top row of numbers stands for these items (Appendix A_2 question 4).

1. ____ building an iron roofed house

2. ____ controlling soil erosion in my field

3. ____ providing additional animal feed for my animals in dry season

4. ____ building a clinic in the area

5. ____ controlling animal movement by fencing

6. ____ finding money for fertilisers

7. ____ improving roads in my area

8. ____ making well for drinking water

9. ____ improving soil fertility without using fertilisers

10. ____ controlling animal diseases

11. ____ getting farm implements such as ploughs, planters

12. ____ establishing a ready market for farm produce

13. ____ assistance in restocking area with cattle since most of them died

14. ____ establishing facilities in the area from which fertilisers and seed can be bought

15. ____ other (specify)

-Que.# - refers to the questionnaire number for individual farmers. *Note that only 51 out of 55 questionnaires distributed were collected.*

APPENDIX 5

Valued Community Need Ranks

Item* Que.#	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
1.	15	11	02	10	12	14	06	13	09	04	03	07	05	08	01
2.	07	08	04	15	06	02	13	14	05	12	11	10	09	03	01
3.	15	14	12	13	11	02	07	08	10	09	04	05	03	06	01
4.	14	10	09	11	13	02	07	15	08	12	06	03	04	05	01
5.	15	12	11	14	13	09	04	10	06	08	07	03	02	05	01
6.	10	12	02	15	03	14	06	11	13	09	07	05	04	08	01
7.	11	12	03	15	06	08	05	14	13	07	10	04	02	09	01
8.	14	09	02	15	07	12	05	13	08	10	06	04	11	03	01
9.	15	14	03	13	10	08	09	12	07	11	04	05	02	06	01
10.	08	07	02	11	12	03	05	15	04	10	14	06	09	13	01
11.	15	10	04	14	11	02	09	13	05	08	03	07	12	06	01
12.	15	11	03	13	06	09	07	14	12	04	05	10	02	08	01
13.	15	14	06	11	02	09	08	10	07	12	04	05	03	13	01
14.	10	15	04	08	09	02	05	07	14	03	13	11	12	06	01
15.	13	14	08	15	11	06	01	12	09	10	07	05	03	04	02
16.	06	11	05	15	02	07	13	14	04	12	10	09	08	03	01
17.	11	14	01	15	03	10	05	12	13	09	08	07	04	06	02
18.	10	12	04	08	09	02	05	07	14	03	15	11	13	06	01
19.	14	08	04	12	10	06	03	15	11	13	01	09	05	07	02
20.	06	14	02	11	13	15	09	08	10	12	05	03	04	07	01
21.	15	10	02	14	04	11	07	13	09	12	08	06	03	05	01
22.	15	14	02	13	07	03	04	12	11	10	06	05	09	08	01
23.	15	13	02	12	03	04	05	10	08	06	14	09	07	11	01
24.	15	13	04	11	05	03	08	14	12	06	10	09	02	07	01
25.	15	11	13	12	14	02	08	09	10	05	07	06	04	03	01
26.	08	09	04	14	07	13	12	15	02	10	03	11	05	06	01
27.	15	12	03	13	09	07	05	14	11	10	08	04	02	06	01
28.	15	09	04	14	02	13	12	11	10	03	08	06	05	07	01
29.	10	11	03	15	06	08	13	14	04	12	02	09	05	07	01
30.	08	04	09	14	07	13	12	15	02	10	03	11	05	06	01
31.	09	04	03	05	10	15	06	13	11	14	12	07	02	08	01
32.	12	15	09	14	10	06	07	08	13	02	03	11	04	05	01
33.	14	11	02	15	04	03	10	13	12	07	05	09	06	08	01
34.	15	10	04	09	06	03	12	14	11	05	13	02	07	08	01
35.	14	11	02	15	05	13	04	12	08	10	09	03	06	07	01
36.	15	10	06	14	07	13	04	12	03	11	09	05	02	08	01

37.	07	12	10	15	06	02	08	14	09	13	11	05	04	03	01
38.	11	13	02	12	03	15	10	14	08	06	05	04	09	07	01
39.	15	14	04	13	05	12	11	10	09	08	07	02	03	06	01
40.	14	12	15	07	13	06	11	10	08	09	05	03	02	04	01
41.	15	10	05	14	04	13	09	12	08	06	07	11	02	03	01
42.	10	14	02	12	13	09	06	15	07	11	05	03	04	08	01
43.	15	05	03	14	06	09	04	07	13	12	11	02	10	08	01
44.	14	11	02	13	07	10	04	12	15	08	06	03	05	09	01
45.	15	05	12	06	13	11	01	14	10	09	08	07	04	03	02
46.	12	10	04	08	14	05	15	13	11	07	06	02	09	03	01
47.	15	07	08	14	03	13	06	04	02	10	12	09	05	01	11
48.	03	10	06	15	02	11	04	12	09	07	13	08	05	14	01
49.	15	05	02	14	10	03	08	13	09	04	12	07	06	11	01
50.	15	14	05	13	06	07	11	12	04	10	03	02	08	09	01
51.	03	10	02	09	01	08	15	14	07	05	13	11	06	12	04
TI	**628**	**551**	**245**	**637**	**381**	**406**	**384**	**612**	**448**	**436**	**387**	**321**	**273**	**343**	**68**
Rn	**2**	**4**	**14**	**1**	**10**	**7**	**9**	**3**	**5**	**6**	**8**	**12**	**13**	**11**	**15**

Key

-Item* - the top row of numbers stand for these items (Appendix A [part 2] question 4).

1. _____ building an iron roofed house

2. _____ controlling soil erosion in my field

3. _____ providing additional animal feed for my animals in dry season

4. _____ Building a clinic in the area

5. _____ controlling animal movement by fencing

6. _____ finding money for fertilisers

7. _____ improving roads in my area

8. _____ making well for drinking water

9. _____ improving soil fertility without using fertilisers

10. _____ controlling animal diseases

11. _____ getting farm implements such as ploughs, planters

12. _____ establishing a ready market for farm produce

13. _____ assistance in restocking area with cattle since most of them died

14. _____ establishing facilities in the area from which fertilisers and seed can be bought

15. _____ other (specify)

-Que.# - refers to the questionnaire number for individual farmers. *Note that only 51 out of 55 questionnaires distributed were collected.*

Tl - refers to the row showing the sum for each column (item).

Rn - refers to the row showing positions of the sum of the values for each column (each item) when listed from the biggest to the smallest.

APPENDIX 6

Agroforestry Adoptions

	Improved Fallow		Contour Bands		Fodder Banks	
Agric. Year	Actual	Cumulative	Actual	Cumulative	Actual	Cumulative
1995/96	04	04	03	03	00	00
1996/97	04	08	05	08	00	00
1997/98	05	13	02	10	04	04
1998/99	09	22	11	21	09	13
1999/00	09	31	-2	19	02	15
Total	31	31	19	19	15	15

Note -2 means two farmers discontinued

APPENDIX 7

Data on Variables that Influence Adoption

Variable / Sch. #	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*K*
1.	12	06	05	01	03	04	00	00	01	02	04
2.	43	07	05	04	04	02	14	12	03	03	04
3.	47	05	05	03	05	03	07	09	03	02	03
4.	12	06	05	02	04	03	02	00	03	04	03
5.	93	10	05	00	05	02	07	00	00	04	06
6.	16	04	05	01	03	03	14	00	03	02	02
7.	30	04	05	03	05	03	04	00	03	02	02
8.	49	09	05	03	04	03	03	00	02	04	05
9.	20	04	04	03	03	04	25	09	03	02	02
10.	20	01	05	01	04	01	05	02	02	00	01
11.	17	06	05	03	04	03	05	04	03	03	04
12.	10	03	02	00	04	02	00	00	00	04	01
13.	21	03	05	01	03	03	12	06	03	04	02
14.	13	05	05	01	03	04	04	00	01	04	03
15.	32	05	05	01	04	04	00	02	03	03	03
16.	09	09	03	01	03	02	07	00	01	06	08
17.	10	04	05	00	04	02	00	07	00	02	02
18.	18	05	03	00	02	02	05	10	00	06	01
19.	21	05	01	00	04	02	00	00	00	03	02
20.	24	02	05	02	04	04	00	00	02	01	01
21.	27	06	02	00	03	03	03	00	00	06	04
22.	32	03	05	04	03	02	14	48	03	03	02
23.	12	02	01	00	03	02	02	00	00	01	03
24.	73	08	05	04	03	04	11	30	03	05	06
25.	41	05	00	00	03	04	00	00	00	02	04
26.	42	08	05	03	04	04	15	15	03	08	06
27.	29	05	05	00	04	04	02	06	00	06	02
28.	20	03	05	00	03	02	02	00	00	02	01
29.	17	04	03	00	02	02	07	04	00	03	04
30.	12	10	05	02	03	03	00	00	01	04	09
31.	60	07	05	03	04	02	00	03	01	04	05
32.	06	04	05	04	04	03	02	00	02	05	02
33.	10	04	05	00	05	03	00	00	00	02	04
34.	47	11	05	01	04	04	04	04	01	06	05
35.	32	07	05	01	04	03	04	00	03	03	07
36.	08	02	05	00	02	03	00	08	00	01	01

37.	12	05	03	00	03	02	00	15	00	03	03
38.	08	03	05	00	02	02	00	00	00	01	02
39.	08	04	04	01	04	03	00	00	01	02	04
40.	10	05	03	01	03	03	00	03	02	06	04
41.	10	02	05	00	05	02	00	00	00	92	00
42.	04	02	01	00	02	03	00	00	00	01	01
43.	28	02	03	01	05	02	08	15	01	01	01
44.	13	02	05	00	03	02	07	00	00	02	01
45.	30	12	04	00	05	03	00	12	00	15	09
46.	36	08	05	01	02	03	05	22	03	05	03
47.	8	03	05	00	04	03	02	00	00	02	01
48.	32	06	05	01	03	04	05	11	01	03	03
49.	17	03	05	01	02	02	00	05	01	01	04
50.	15	04	05	00	02	02	37	00	00	09	02
51.	10	02	05	01	02	03	02	00	01	01	01
52.	21	08	04	00	04	04	28	18	00	05	03
53.	25	04	01	01	02	03	02	03	01	04	02
54.	05	02	01	01	03	02	00	00	01	02	02
55.	06	02	02	01	03	02	00	10	01	02	02
Total	**1283**	**271**	**225**	**62**	**188**	**154**	**276**	**293**	**66**	**189**	**172**
Av.	**23.3**	**4.9**	**4.1**	**1.1**	**3.4**	**2.8**	**5.0**	**5.3**	**1.2**	**3.4**	**3.1**

Key

A is Farm size in hectares

B " Number of Adults above 16 years

C " Number of meetings/workshops/fielddays attended

D " Number of years of practising adopted technology

E " Age of the household head in years (coded)

F " Educational Level of the farmer (coded)

G " Number of cattle owned

H " Number of goats owned

I " Number of technologies adopted

J " No of males in the household above 12 years of age

K " No of females in the household above 12 years of age

Sch.# " Interview Schedule Number

APPENDIX 8

PCA Data Output

Communnalities

	Communalities	Extraction
Adults	1.000	.902
Age	1.000	.622
Cattle	1.000	.688
Edulevel	1.000	.748
Farmsize	1.000	.626
Females	1.000	.794
Goats	1.000	.673
Males	1.000	.772
Meetngs	1.000	.566
Years	1.000	.713

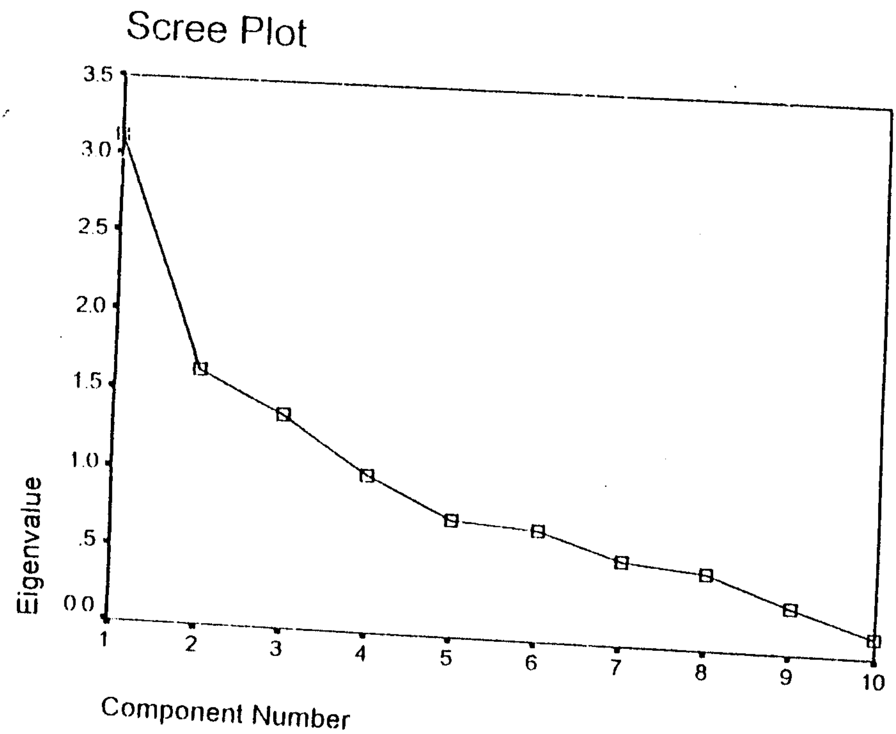
Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.114	31.143	31.143	3.114	31.143	31.143
2	1.618	16.183	47.326	1.618	16.183	47.326
3	1.361	13.610	60.936	1.361	13.610	60.936
4	1.010	10.097	71.033	1.010	10.097	71.033
5	.741	7.407	78.440			
6	.705	7.048	85.488			
7	.540	5.397	90.885			
8	.493	4.928	95.814			
9	.296	2.963	98.776			
10	.122	1.224	100.000			

Extraction Method: Principal Component Analysis.

Scree Plot of Eigen Values for each component.



APPENDIX 9

Pearson Product Moment Correlation Analysis Data Output

Correlations

		ADOPTED	AGE
ADOPTED	Pearson Correlation	1.000	.152
	Sig. (2-tailed)	.	.268
	N	55	55
AGE	Pearson Correlation	.152	1.000
	Sig. (2-tailed)	.268	.
	N	55	55

Correlations

		ADOPTED	CATTLE
ADOPTED	Pearson Correlation	1.000	.236
	Sig. (2-tailed)	.	.082
	N	55	55
CATTLE	Pearson Correlation	.236	1.000
	Sig. (2-tailed)	.082	.
	N	55	55

Correlations

		ADOPTED	EDULEVEL
ADOPTED	Pearson Correlation	1.000	-.076
	Sig. (2-tailed)	.	.582
	N	55	55
EDULEVEL	Pearson Correlation	-.076	1.000
	Sig. (2-tailed)	.582	.
	N	55	55

Correlations

		ADOPTED	FARMSIZE
ADOPTED	Pearson Correlation	1.000	.276
	Sig. (2-tailed)	.	.042
	N	55	55
FARMSIZE	Pearson Correlation	.276	1.000
	Sig. (2-tailed)	.042	.
	N	55	55

* Correlation is significant at the 0.05 level (2-tailed).

Correlations

		ADOPTED	MEETNGS
ADOPTED	Pearson Correlation	1.000	.385
	Sig. (2-tailed)	.	.004
	N	55	55
Meetings attended	Pearson Correlation	.385	1.000
	Sig. (2-tailed)	.004	.
	N	55	55

** Correlation is significant at the 0.01 level (2-tailed).

Correlations

		ADOPTED	YEARS
ADOPTEDt	Pearson Correlation	1.000	.780
	Sig. (2-tailed)	.	.000
	N	55	55
YEARS of practicing	Pearson Correlation	.780	1.000
	Sig. (2-tailed)	.000	.
	N	55	55

** Correlation is significant at the 0.01 level (2-tail

		ADOPTED	ADULTS
No. of techniques adopted	Pearson Correlation	1.000	.118
	Sig. (2-tailed)	.	.390
	N	55	55
No. of ADULTS	Pearson Correlation	.118	1.000
	Sig. (2-tailed)	.390	.
	N	55	55