MLIMBIKO AS AN INDIGENOUS SUSTAINABLE WOODLAND RESOURCE MANAGEMENT SYSTEM IN TANZANIA

BY

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ABSTRACT

A survey on woodland resource indigenous management system was carried out in lowland areas of Same District, Tanzania. Interest in this study was promoted by the recognition that although there is an increasing number of studies on indigenous silvo-pastoral agroforestry systems, no studies have concentrated on the role of *mlimbiko* in the development of the indigenous silvo-pastoral agroforestry systems.

The purpose of this study was to assess the *mlimbiko* as a traditional knowledge that has maintained sustainable woodland resource management. Data and information for the study were collected through interviews of 90 households in six sub-villages.

The study results reveal that the study area had two agro-ecological zones: the semi arid lowlands and the relatively high rainfall highlands. There are two main activities identified in the area which are livestock keeping in the semi-arid lowlands and farming in the humid highlands. In order to cope with environmental hostility the local people have developed survival strategies the key ones being the *mlimbiko* and the *malambo*.

The major problems faced by local people were low rainfall, shortage of forest resources, fodder, and water. The *mlimbiko* seeks to conserve and maximise fodder supply, particularly during the dry season. The *malambo* is a water conservation technique. These strategies are based on well known strict rules. The *mlimbiko* and the

malambo embody a wealth of indigenous knowledge, which has been passed from generation to generation together with woodland and water resources.

The *mlimbiko* and the *malambo,* however, are facing a lot of challenges such as the increased human and livestock population, decreasing site productivity and uncertainty in land tenure.

The conclusion drawn from this study was that the successful use of *mlimbiko* system in natural resource management will depend on clearly defined ownership pattern, beneficiaries, the specific period of time of conserving the area, and the intended end use of the resource.

DECLARATION

I, Elice Jonathan Maenda, do hereby declare to the Senate of Sokoine University of Agriculture that except otherwise acknowledged, this dissertation is my own original work and has never been submitted nor concurrently being submitted for a degree award at any other University.

Signature : EJMaenda

Date : 20/9/99

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DEDICATION

This work is dedicated to:

- My beloved parents Jonathan Temu and Mary Mangare that they build up me in traditional agroforestry;
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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

a.s.l	above sea level
FBD	Forest and Beekeeping Division
DPO	District Planning Officer
Ha	hectare
NORAD	Norwegian Agency for Development
SPSS	Statistical Packages for Social Science
WCED	World Commission on Environment and Development
WCMC	World Conservation and Monitoring Centre
WRI	World Resource Institute
KVFP	Kilimanjaro Village Forestry Project
JICA	Japan International Cooperation Agency
CIDA	Canadian International Development Agency
TFTW	Training Fund for Tanzanian Women
MNRT	Ministry of Natural Resource and Tourism

CHAPTER ONE

1.0 INTRODUCTION

1.1 Historical background

About two thirds of Tanzania can be described as arid or semi-arid on the basis of having a probability of less than 25% of receiving 750 mm of rainfall per year (Nicuwolt, 1973 cited by Mwaseba *et al.*, 1994). Tree planting and agricultural activities in semi-arid areas are largely rainfed as is the case in the humid parts of the country Rainfall in semi-arid areas, however, has been described as relatively inadequate, highly variable and of great uncertainty (Mwaseba, *et al.*, 1994). The key factor limiting agricultural productivity and tree planting is rainfall shortage.

In many African countries, people of semi-arid areas have consequently adopted different indigenous farming systems which cater for their needs according to their surrounding environment. One of the coping strategies adopted by people living in areas where productive land is scarce is agricultural intensification (O'Kting'ati, 1985). Agricultural production in most Eastern Africa highlands has been under pressure of an ever expanding population. In most cases the results have been the practice of an intensive indigenous farming system. These indigenous land-use systems involve the mixing of trees and agricultural crops (Nair, 1989, 1993).

In Latin America, Asia and Africa, indigenous agricultural systems have been and remains the characteristic features of densely populated hilly areas (Swaminathan, 1987). These include the indigenous homegardens which are often referred to as primitive or archaic type of land-use (Michon, 1983). In Tanzania about 72 % of the country's population is engaged in peasantry indigenous farming (FAO, 1994; Senkondo, 1992). Basing on this, it implies that indigenous agricultural production forms the basis for food supply and employment for the majority of the population (Ministry of Agriculture, 1983). Many of the indigenous farming systems are mostly practised in the highland areas. These include the Chagga homegardens (O'Kting'ati, 1985), the *Ngoro* systems of the Matengo highlands (Schimeid, 1989), the valley bottom gardens of the West Usambara (Moshi, 1997), and the traditional homegardens of Kerala (Jose and Shanmugaratnam, 1993).

The lowland parts of West Same, the study area, falls in the category of semi-arid areas of Tanzania. Deforestation is thought to have significantly contributed to the present state of this area (Kilimanjaro Village Forestry Project - KVFP preliminary survey, 1988). Other major factors which significantly contributes to further environmental degradation is the rising human and livestock population (Minako, 1996). Lack of adequate forest cover creates undesirable weather conditions. Deforestation as one of the major causes of desertification is likely to bring about environmental and socio-economic disaster since it alters the micro-climate particularly in hot and dry tropics (Mather, 1990).

In many arid and semi-arid areas where the main economic activity is livestock keeping the rising numbers of livestock, and human population exert an increasing pressure on the land. The environmental conditions in such areas keep on deteriorating (Barrow ,1991). The role of traditional natural resource management concepts and land use practices in developing sustainable agroforestry systems is becoming more important, especially in semi-arid areas. According to Barrow (1991), many of these areas are inhabited by agro-pastoralists that seek to make optimum sustainable use of the vegetation and water resources available to them through various management and survival strategies.

Livestock keeping is an old and very important tradition of the Pare people living in the study area. Initially these people were nomadic but later on they adopted a sedentary or semi-sedentary style. To cope with recurrent severe droughts, shortages of land, forest resources and water the Pare people have developed a set of management strategies (Maenda, *et al.*, 1996), the major one being the *mlimbiko*.

Formerly, the Pare people considered livestock as their main economic activities but they changed and started cultivating agricultural crops for food and cash. Livestock keeping as their main occupation was taken as a cultural activity and the most important form of heritable property. The lowland Pare people have the "cattle trusteeship system" which is an important factor with ecological as well as socio-economic implications (Kajembe, 1994). Also these people used to shift their common grazing from one area to another when there was enough land. The movement within and outside the lowland Pare is very

common. This implies that farmers have no security of tenure which may lead to land degradation or have no interest in improving the land, the same problem was also reported in Shinyanga (Maro, 1995; Msangi, 1995).

1.2 Problem statement

Early attempts to solve environmental problems without local people involvement has achieved very little success (Mnzava, 1980; Mgeni, 1992; Warner, 1993). Today the role of indigenous ecological knowledge in the management of natural resources has become a key component in the project formulation (Kajembe, 1994; Munyanziza and Wiersum, 1999). Although there is an increasing number of studies that has been done on indigenous silvo-pastoral systems, no studies have concentrated on the ***mlimbiko*** as an indigenous woodland resource management.

The *ngitiri*, an indigenous silvo-pastoral system practised in Shinyanga has been a source of traditional knowledge for researchers (Brandstrom, 1985; Getahum, 1992; Otysina, 1994; Kilahama, 1994; Maro, 1995; Msangi, 1995). Many of the indigenous agroforestry systems practised in the tropical Africa have not yet been studied in detail and documented and some of them are being lost (King, 1987). Very little is known so far on the ***mlimbiko*** systems. As a consequence many development planners and agencies have failed to incorporate the ***mlimbiko*** in their activities even though ***mlimbiko*** proved to be sustainable indigenous silvo-pastoral system. Similar observation have been reported by

Bandolin and Fisher (1991) who concluded that most of the indigenous agroforestry systems practised in North America have never been scientifically researched or catalogued.

In order to increase the knowledge on the existing indigenous silvo-pastoral systems in the world and particularly in Tanzania, there was a need to carry out extensive research on *mlimbiko* systems. Such research will generate knowledge on the systems and serve as a useful basis for improving their productivity. The *mlimbiko* as an indigenous woodland resource management system of the West Same lowlands was therefore the main subject of this study.

1.3 Justification for the study

In many agro-pastoral systems, land degradation is a major constraint towards sustainability. The *mlimbiko* as an indigenous woodland resource management has survived generations. It has sustained livelihoods of a community living in a hostile environment.

The *mlimbiko* management system mobilises people for one common goal: the conservation and wise of natural resources. This can be a firm stepping stone for any other intervention geared towards rural development in the area. The research on the probably a lot to recommend for improvement.

1.4 Objectives

The main objective of the present study is to assess the *mlimbiko* as a traditional management system that has maintained sustainable woodland resource management at the sub-village levels in west Same.

More specific objectives are:

(i) to describe and evaluate the *mlimbiko* practise system;

(ii) to identify the major constraints which affect productivity and sustainability of woodland resources under this system;

(iii) to identify areas for improvement and assess local peoples' attitude towards this system.

1.5 Study limitations

It was difficult to get a random sample at household level given the population movement within the area and the pastoral nature of the people. Such a situation exists in many arid and semi-arid lands (Barrow, 1991). So the household surveyed were those which were around the sub-village leaders. Also the time during which survey was carried out was a peak time for farm preparation, therefore some members were not within the reach of the researcher. Further, the land size as expressed by the respondents was based on estimation since some of them did not know the exact size of their farms.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Indigenous knowledge on resource management

The definition of indigenous knowledge used in the present study is that adopted by Bodly (1976) who defines it as the practical knowledge of the environment and procurement strategies based on intimate experience accumulated over many generations.

Indigenous knowledge has been recognised as an important tool in the sustainable management of land use systems in the developing world (Timber Lake, 1985; Barrow, 1991). Indigenous techniques have evolved in different places in response to local agro-ecological and economic conditions. The designs reflect the relative availability and opportunity costs of different resources, including materials, human labour animal power and cash (Kerr and Sanghi, 1992).

In many African countries studies shows that it has been the practice to cultivate tree species and agricultural crops in intimate combination (King, 1987, Nair, 1989,1993). This has been observed when considering a traditional way of life for many upland farmers in the world and also the system still practised in many highland areas of tropical

Africa, Asia and Latin America (Swaminathan, 1987). The study carried in Kilimanjaro Region (O'Kting'ati, 1985) indicates that in areas where population pressure has reached a high peak, peasants developed indigenous agroforestry systems intensively on the managed land to sustain the needs of the growing populations. Different types of indigenous agroforestry systems such as tree plantation-crop combinations, multilayer tree gardens and homegardens are the common practices in such areas (Nair, 1989). The use of indigenous agroforestry systems in the highland areas has also been reported by Miehe, (1986) where by the people of Jebel Marra Massif of Sudan uses the traditional agroforestry systems of combining the trees of *Faidhebia albida* and other multipurpose trees.

In most arid and semi-arid areas, where environment is harsh, farmers have developed over time management strategies to overcome environmental stress. These strategies have been handed over to subsequent generations (Barrow, 1991). Such traditional systems were governed by indigenous knowledge on ecological balance, social/human interactions and environmental potentials.

The role of traditional natural resource management concepts and land use practices in developing sustainable agroforestry systems is becoming more important, especially in semi-arid areas. According to Barrow (1991), many of these areas are inhabited by agro-pastoralists that seek to make optimum sustainable use of the vegetation and water resources available to them through various management and survival strategies.

2.1.1 Indigenous agroforestry practices

There are different forms of indigenous agroforestry systems that are practised all over the world. The types of indigenous agroforestry practised mainly depend on the society involved. The studies conducted by King, (1987) and Nair, (1989) shows that throughout the world at one period or another in its history, it has been the practice to cultivate tree species and agricultural crops in combination.

In the lowland areas where there are consequent degradation of the natural resources which have changed from forest or woodlands to grasslands, people intend to use traditional system either to ensure nutrient cycling and/or production of the needed resources (Barrow, 1991). The above results are supported by another study carried in Zimbabwe (Campbel, *et al.*, 1991) which analysed that the woodlands of the grazing areas are mostly much changed from the climax woodland that formerly occupied the areas, also the same case was reported by (Wilson, 1986; McGregor, 1989).

2.1.2 Indigenous knowledge in silvo-pastoral systems

Most of the pastoral tribes of Africa have traditional systems that have been used to ensure sustainability in management of natural vegetation (Niamir, 1990; Waters-Bayer and Bayer, 1994). The Sukuma agro-pastoralists in Tanzania, in response to severe fodder shortages in the dry seasons lead them to develop land use and natural resource

management systems to provide needed food and tree products on a sustainable (Otsyina and Asenga, 1993; Kilahama, 1994; Otsyina, 1994; Maro, 1995; Msangi, 1995).

The study carried in Northwestern region of America by (Bandolin and Fisher, 1991) found that this region has traditionally used agroforestry systems on less productive lands to optimise productivity by combining forest and animal production. The indigenous agroforestry in this area mix pine tree and cattle and it is estimated that 40 million hectares in the states of Alabama, Florida, Gergia, and Lousiana are capable of supporting the pines and cattle mix. Other studies like those done by Raynor and Fownes, (1991) indicates that the traditional agroforestry system of Pohnpei provides many products for subsistence, sale and social use, while maintaining permanent soil and canopy cover.

Furthermore, the use of different indigenous agroforestry systems has been well explained in many places of the world where by the implementation of silvo-pastoral systems have resulted in sustainable and efficient land use alternatives. The study carried by Ormazobal, (1991) indicates that the silvo-pastoral system have been of enormous importance in achieving sustainable and diversified production on marginal lands especially in arid and semi-arid zones. The indigenous silvo-pastoral systems proved to be efficient in providing pasture in the most drier part such as in the northern Chile which is classified as a desert, and also in other areas with rainfall of 100 - 400 mm/yr (Ormazabal, 1991).

Other studies like those done by Campbel, *et al.*, (1991) in Zimbabwe found that there are four agroforestry systems including systems centred on main fields, grazing areas, small garden plots and homesites and home fields. The study carried in Bukoba indicates that homegardens are traditionally multi-storey agroforestry farming system based on mixed cropping of banana (*Musa* spp) grown for food and livestock keeping mainly cattle (Rugalema, *et al.* 1995).

2.1.2.1 Historical background of the indigenous silvo-pastoral systems in Tanzania

Many pastoral and agro-pastoral peoples throughout the African continent have traditionally conserved and managed woody plants and grasses in savannah grazing lands to produce fodder, fuelwood, building materials, and other products for domestic use and sale (WRI/ICUN/UNEP, 1992). The term `conservation' refers to the sustainable use or preservation of natural resources (Deshmukh, 1986).

Livestock production in Tanzania falls into two main categories namely the commercial and traditional sectors. The traditional sector accounts for approximately 99% of the country's cattle herd, and 85% of the chicken (Maeda, 1988). Traditional livestock keepers have ways of handling adverse situations when dealing with their livestock (De Wolf, 1979). They also efficiently managed resources at their disposal. They have well-established views, vision, beliefs, choices, like and dislike as regards livestock keeping.

All these have lead to development of indigenous silvo-pastoral management systems, which are different from one area to another depending on the prevailing climatic conditions.

The study carried in Shinyanga Region found that the Wasukuma have developed a traditional silvo-pastoral systems many years ago to cope with the shortages of obtaining pastures for their livestock; the *ngitiri* system (Otsyina and Assenga, 1993; Kilahama, 1994; Maro, 1995; Msangi, 1995).

The above results are supported by another study carried in Maasai areas (Morris and Hartfield, 1982) which analysed the traditional semi-nomadic production systems which have been used for many years and have been proved to sustain livestock feeds. Other studies like those done by Minako, (1996) who explain that the Pare and Maasai people in the lowland areas of Same District have their own traditional ways of ensuring pasture availability during the dry months of the year. Also the study done by Maenda *et al.*, (1996) analysed the different traditional *mlimbiko* systems which have been practised by the Pare people in the lowland areas to overcome the pasture/fodder shortages.

2.2 Indigenous knowledge in sustaining biodiversity conservation

The WRI/IUCN/UNEP, (1992) defines biodiversity as the totality of genes, species and ecosystems in the region. However, in simple words biodiversity could be defined as the

great variety that exists in living organisms, plants, animals and microbes on earth (Jain, 1994).

The importance of protecting wild flora and fauna has been globally emphasised (WRI/IUCN/UNEP, 1992). The threatened plants include tree and grass species. The conservation of plant species can be achieved by protecting their habitat through control of land use and habitat alteration. This has been explained by Gadgil and Meher-Homji, (1996) cited by Ambasht, *at al.*, (1994) in their analysis of India's biological diversity and its conservation. These authors felt that it was important to conserve the biodiversity and the best way was to conserve a few habitats of each of the vegetation types in order to maintain biodiversity.

It has been estimated that about 1.4 million species of animals have been described. There is no doughty that a lot is still to be discovered. According to (WRI/IUCN/UNEP, 1992) many species disappear before the are described. The potential value of biodiversity for humanity is great (Jain, 1994).

A study carried out in India shows that the conservation of habitats and individual species has been practised since time immemorial (Jain, 1994) when they started to protect all living creatures. However, the global concern for preserving the biodiversity for immediate as well as future use has gained momentum after the historic Rio Convention (Mehrotra and Kushalapa, 1994). Other study done by Ambosht, *et al.*,

(1994) shows that it has been an Indian tradition to preserve biodiversity despite the high population pressure.

In the tropics the conservation of biodiversity has been biased. More efforts have been on the protection of national parks, game reserves and others, while they might not be necessarily the most important sites for conserving threatened, endangered or endemic plants (WRI/IUCN/UNEP, 1992). In some areas, smaller and less known sites may be more important than bigger and well known ones. Some endemic plants are disappearing due to disturbances caused either by human beings or animals or sometimes by environmental changes (Munyanziza, *et al.*, 1997; Munyanziza, 1999).

In agro-pastoral areas of Same district, headers used to graze small ruminants on indigenous plant species which germinated soon after rains. However, the species disappeared decades ago (Maenda *et al.*, 1996). The conservation of nature reserves in any country is very important and should cover different agro-ecological zones (Jain, 1994). In some areas, protection of threatened flora can be achieved simply by giving the nature the chance to regenerate itself. However, in some areas the protection of a site from external disturbance may not be sufficient to restore original fauna and flora. In extreme cases enrichment planting might be imperative.

Indigenous techniques play a vital role in conserving plant species in many areas. A study from Sudan shows that people on lower slopes and highlands used traditional agroforestry systems based on the Acacia species (*Faidhebia albida*) over centuries

(Miehe, 1986). This species sustained a densely settled population and was protected at the same time.

Other studies like those done by Foly and Bernard (1985) cited by Ayling, (1991) indicates that people plant trees or protect and manage naturally occuring trees for a variety of benefits in areas where they have resource control. This has been proved in Sub-Sahara Africa whereby the retention of *Faithebia albida* in cropland is highly practised. The tree provide shade, fuelwood and protein-rich animal fodder in the dry season, and loose their leaves before the onset of the rains and the planting of the crops.

The protection of trees of *Acacia* species have also been reported in the lowland areas of Pare whereby people use traditional technique *(mlimbiko)* to protect the useful fodder tree species. *Acacia tortilis and other Acacia species* are protected using *mlimbiko* rules whereby people are not allowed to cut these trees. They retain the species for different roles mainly for small ruminants' fodder. The *Acacia tortilis* pods are very nutritious for goats and sheep (Maenda, *et al.*, 1996). According to local peoples' experience it is believed that the growth rate of young goats increases if they are feed up on *Acacia tortilis* pods. Furthermore, the trees are used to hang beehives, which provide honey to the people. In some areas local people as well as the government earn a lot of money from selling of honey.

In many areas trees are protected for different uses and purposes. As observed in Same district people in the highlands have protected indigenous trees in their traditional forests

(the *mshhitu* and *mmbughi*) for worshipping purposes (TIP reports). Also they retain they retain the trees of *Ficus* species in water source as they know that *Ficus* species have high percent of retain water.

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Description of the study area

This study was carried out in the lowland areas of west Same, in Same District within the Kilimanjaro, Region, Tanzania. Five villages were selected for this study. These includes Same mjini, Kwakoko, Njoro, Mwembe and Bangalala villages. Furthermore, six sub-villages were selected from the selected villages. These were Mahuu, Masandare, Mighara, Njoro stendi, Barazani and Kirinjiko chini. The selection of the sub-villages was based on accessibility.

3.2 Geography and socio-economic description

3.2.1 Geographical location

Same District is one of the six administrative districts of Kilimanjaro region. Other districts are Hai, Moshi Urban, Moshi Rural, Rombo and Mwanga . The district is located in the south east of the region. Administratively, Same district is divided into six divisions, namely Ndungu, Mamba Vunta, Same, Mwembe/Mbaga, Chome/Suji and Gonja (Fig.1).

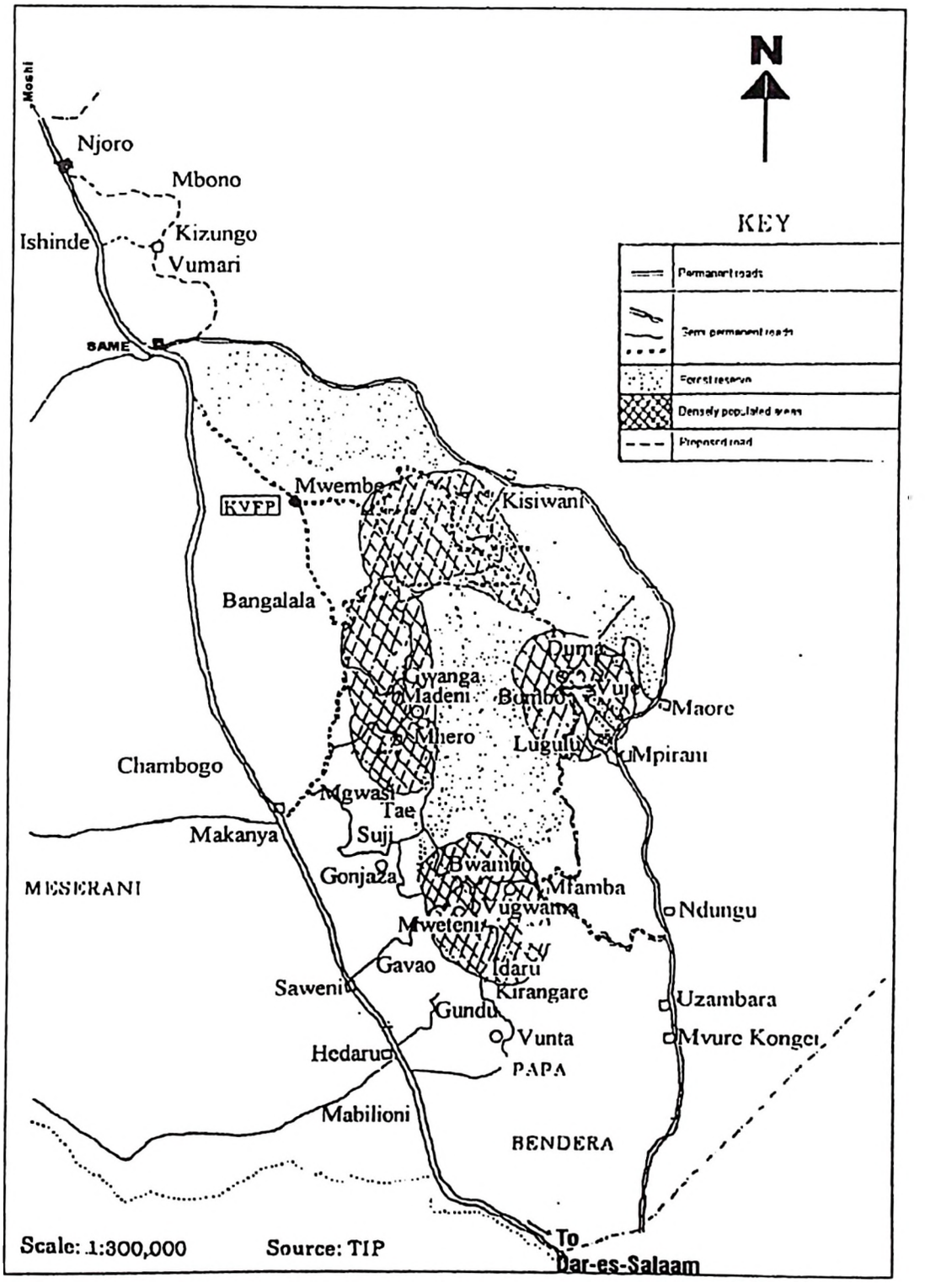

Figure 1: A sketch map of Same showing the district area

The district covers an area of 5 152 km^2 and according to National Population Census (1988) the district had 30 012 households with a total population of 170 000. The District population growth rate was 2.4%. The Pare tribe dominates the rural population. Incomers include Wasambaa, Wachagga, and Wamaasai. The lowland Pare people are pastoralists or semi-pastoralists. They live in a harsh environment marked by erratic and unevenly distributed rainfall, recurrent droughts, floods and famines.

3.2.2 Physical features

Characteristically the district is subdivided into two topographical features; namely the highlands and the lowlands.

The highland areas occupy the central mountain range which include Chome Forest Reserve of South Pare, lying between 900 m and 1 300 m a.s.l. The forest covers 40% of the highlands. The remaining area has a big potential for agricultural production and zero grazing.

These highland areas have similar conditions and characteristics with other highlands of the region, such as the highlands in the south Pare mountains which is densely populated. The low-lying areas are sparsely populated except town centres.

The lowland areas cover much of the western corridor of the district. This part is

characterised as semi-arid. These areas are loosely populated. The eastern lowlands that are humid are where agricultural activities undertaken but sometimes are supported by irrigation systems. The Mkomazi Game Reserve is situated in the north and eastern part of the district.

3.2.3 Climate

The lowland part of the Same district is categorised as semi-arid. The amount of rainfall, its pattern and variation, play a major role in the functioning of the ecosystem in this area. Elevation determines very strongly the amount of rainfall received per annum. Whereas the highlands receive an average annual rainfall ranging from 600 to 1 200 mm, the lowlands receive between 350 - 600 mm (Minako, 1996). The rainfall distribution has conditioned the land utilisation pattern in the district. Cultivation is mostly practised in the highlands while livestock grazing is common in the lowlands. The short rain *vuli* occur from November to January while the long rain season *masika* stretches from February to May. The rainfall distribution in the area is variable. Rainfall occurring in the western lowlands is strongly influenced by the Pare mountain ranges.

Temperatures are influenced by altitude of the areas. The minimum and maximum temperatures in the highlands range between 18°C and 28°C, while in the lowlands they range from 24°C to 34°C. This indicates that the highlands are cool, with more reliable rainfall while the lowlands are dry with scanty rainfall.

3.2.4 Communication

An all weather tarmac road serves Same district from Dar es Salaam to Nairobi via Arusha. There is a railway line from Dar es Salaam to Moshi. The road network which links various villages in the lowlands is generally passable the year round, however, during the heavy rains some of the roads in the lowlands are not passable, for example the road from Same town to Ruvu mferejini.

3.2.5 Social services

West Same lowlands have many educational institutions. There are many pre-nursery, primary and secondary schools. Both private and public health centres and hospitals out of which Same district hospital is the biggest offer health services. Off-farm employment opportunities are limited due to the climate of the area.

3.2.6 Economic activities

Economically, the district depends mainly on subsistence agriculture and livestock keeping. About 43 000 ha are under cultivation. About 10% of the cultivated area, most of which located in the eastern lowlands, are under irrigation. The remaining 90% of the land are under grazing. Statistics show that by June 1995 there were 100 060 cattle, 100 010 goats, 72 000 sheep and 6 500 donkeys (Minako, 1996).

The main subsistence crops are maize (*Zea mays*), rice (*Oryza sativa*), beans (*Phaseolus vulgaris*), cassava (*Manihot esculentum*), banana (*Mussa* species), and a variety of fruits and vegetables. The cash crops are grown in the highlands. They include coffee (*Coffea arabica*), sugar cane and cardamom. Other cash crops such as rice (*Oryza sativa*) ,cotton, sisal (*Agave sisalana*), and beans (*Phaseolus vulgaris*) are grown in the lowlands. Rice (*Oryza sativa*) cultivation is mainly practised under irrigation schemes.

Industrial sector is not well developed in the district. The cotton ginning and oil milling factories are not working efficiently. Ceramic industry is now closed. Generally, the district is not economically developed compared to other districts in the region.

3.2.7 Land tenure system

In Pare society, land ownership is both private and communal. Traditionally the village leaders locally known as M*chili* allocated land. *The Mchili* was working in close collaboration with the chief of the area locally known as *Mfumwa*. All applications for the land were directed to the *Mfumwa*. Land ownership rights were based on the right of occupancy with customary land tenure without any legal rights documented. All members of the community had full rights to use the land, as long as the utilisation was effective and did not contravene with communal rules.

Traditional forest reserves were highly respected by all members of the community. Customary forests were mostly used for ancestral worship and were known as *Mshitu*

and *Mmbughi*. Customary rules were followed until recently when the system started to break apart.

3.3 Source of data and information

The data and information for this study were collected from both primary and secondary sources.

3.3.1 Primary data collection

Primary data were obtained from four sources: reconnaissance survey, questionnaire survey, informal discussions and group interviews.

3.3.1.1 Reconnaissance survey

The reconnaissance survey was made to get the ground information such as the vegetation cover, species composition, existence and development of any conservation measure. This was done purposely to verify and crosscheck physical and socio-economic variables of the required data in the field conditions.

3.3.1.2 Questionnaire survey

Before the actual survey took place, a questionnaire was designed, pre-tested and modified. This was done in order to improve the accuracy and relevance of the information being sought. Two households in each sub-village were visited during the

preliminary surveys. There were administered a structured and semi-structured questionnaire (Appendix 1).

The questions concerned various aspects of the household and their surrounding were used. There were questions related to household particulars, income and expenditure, land use and tenure, production activities, forest and tree issues and *mlimbiko* ownership, management and improvement. Farmers were visited individually at their homes, following prior arrangement made by sub-village chairpersons. The questionnaire was administered with the help of three staff from KVFP.

3.3.1.3 Informal discussion

Informal discussions were held in order to obtain general information on the activities related to forestry and trees. Some informal surveys were carried out involving sub-village leaders, field forest officers, extension officers, and women.

3.3.1.4 Group interviews

Group interviews are useful for tapping the collective wisdom of a community. One group interview was made for this study. This was done purposely for clarification of information obtained from household surveys.

3.3.2 Secondary data collection

Secondary data were obtained from documentary search and records from similar studies. Published and unpublished documents were used. Organisation or project operating in the area such as KVFP provided useful information.

3.4 Sampling procedure

The parliamentary constituency in Same district forms the sampling frame, that is, the study was conducted in the western part of Same district. A multistage random sampling from division to households was adopted. The selection criteria was based on:

(i) the lowland areas only;

(ii) sub-villages covered by KVFP in its participatory extension programme;

(iii) the pastoralists or semi-pastoralists sub-villages.

Basing on the mentioned criteria, two administrative divisions were identified namely Same and Mwembe/Mbaga. Three administrative wards namely, Same, Njoro and Mwembe were selected. In the two wards, two villages were selected. In the other ward one village was selected (only this village fulfilled the set criteria). Among the villages selected, one sub-village from each of four villages was selected while in the fifth village, two sub-villages were selected (Table 1). This was done differently from other villages in order to have a wide coverage of Njoro village as well as Njoro ward.

The sub-villages formed the sampling areas. This was taken in order to simplify

communication among the researchers and the villagers because the sub-villages were well organised and known. The households were selected as the sampling units. A household is defined as a group of people who share the same leadership and the same pot. They share dwelling houses and may cultivate the same land. They household members recognise the authority of one person (Poate and Daplyn, 1988 cited by Kajembe, 1994).

The scattered nature of households as found in pastoralists area combined with the lack of comprehensive sampling frame for rural land users or systematic numbering of compound farm houses lead to the use of stratified or cluster sampling of households. A total sample size of 90 households was fixed such that 15 households from each sub-village were sampled.

Table 1: Sampling procedure:

Divisions	Wards	Villages	Sub-village
Same	Same	Same mjini	1. Mhuu
		Kwakoko	2. Masandare
	Njoro	Njoro	3. Mighara
			4. Njoro stendi-
Mwembe/ Mbaga	Mwembe	Mwembe	5. Barazani
		Bangalala	6. Kirinjiko chini

3.5 Data analysis

Data analysis was based on the fact that the study was exploratory and descriptive in nature, with both qualitative and quantitative information. The data were analysed using Statistical Packages for Social Science (SPSS). Descriptive statistics such as measures of central tendency (means, modes); statistical measures of dispersion (ranges, standard deviation); frequencies and cross tabulation were employed to summarise the data.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Sample attributes

The key population attributes commonly assessed in social sciences were taken into consideration. These are gender, age, education and marital status (Table 2).

4.1.1 Gender

While equal chances were given to both men and women female respondents were only 23.8% of the total and males were 76.2% (Table 2). There were two main reasons for this disparity. (i) Most females were busy with farming at the time of interview. (ii) Males tended to dominate the discussion since females in most cases were not open to explain important issues such as those pertaining to the wealth of the family.

4.1.2 Age

To capture the wealth of knowledge various age groups were involved in the survey. Indigenous knowledge generally accumulates with the age. Aged people were considered to be important since they know a lot of information based on traditional land use. They also know much on traditional land management, changes occurring overtime

and many other modifications. The age of the respondents ranged from 18 to 55 years, the majority of respondents being between 32 and 55 years. Young people were included to get their perception on important issues affecting the natural resources.

4.1.3 Education

Most of the respondents (77.8%) had at least primary education (Table 2). This is due to the large distribution of primary schools throughout the study area. In all villages surveyed there is a primary school. Primary shools located in the study area include Same, Masandare, Njoro Mwembe and Bangalala.

The level of education is known to influence the level of adoption of innovation (Kajembe, 1988). A study on village afforestation in Tanzania indicated that tree planting in rural areas was positively correlated with the level of education (Kajembe, 1988). As the level of education today increases in the study area it is therefore possible that traditional systems will change as new options will be made available.

4.1.4 Marital status of the respondents

The marital status of the respondents was important with respect to identifying the head of the household. This helped in knowing who is the decision-maker in the *mlimbiko* system. From table 2, it is clearly shown that many of the respondents were married (89.9%) The married group is the one which determines the fate of woodland and other

resources. Unmarried female in the Pare culture, unlike their adult brothers, is not counted as a sub-village member who can be given a piece of land and can decide on the major issues affecting natural resources.

Table2: Respondents in percentage with respect to gender, education and marital status

Attributes	Mahuu	Masandare	Mighara	Njoro Stendi	Barazani	Kirinjiko chini	Mean
a)Gender:Female	46.7	26.7	13.3	10.0	33.3	13.3	23.8
Male	53.3	73.3	86.7	90.0	66.7	86.7	76.2
b)Level of edu							
Noformal edu.	26.7	13.3	6.7	6.7	20.0	13.3	14.5
Primary edu.	66.7	73.3	86.7	80.0	73.3	86.7	77.8
Secondary edu.	6.7	13.3	6.7	13.3	6.7	0.0	7.8
c) Marital status							
Married	93.3	80.0	93.3	93.3	86.7	93.3	89.9
Unmarried	6.7	6.7	6.7	0.0	0.0	0.0	3.5
Divorced	0.0	6.7	0.0	0.0	0.0	0.0	1.2
Widowed	0.0	6.7	0.0	6.7	6.7	6.7	4.5

Source: Own field data (1998) n =15 @ N =90

4.2 Income and expenditure

4.2.1 Household economic activities

The main economic activities of the people in the study area are agricultural production and livestock keeping. These activities represent 73.6% of the total sampled households (Table 3). The agricultural activities are mostly carried out in the highland areas where climatically conditions are relatively favourable.In the lowland areas where the climate is hostile farmers practice mainly livestock keeping.

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Further strategies adopted by farmers involve the diversification or combination of various activities. Some farmers combines agriculture and business (4.3%) in order to meet their basic needs. The people of Masandare and Barazani sub-villages were engaged in both agriculture and business activities (6.7%). The Barazani sub-village attracted business because it is the centre of different roads, which include old Dar es Salaam to Arusha road and the road from the highland areas. However, in the Bazarani sub-village peoples depended mainly on agriculture activities (46.7%) as compared with other sub-villages. The main reason is the favourable environment of this area, as it received relatively higher amount of rainfall (more than 600 mm per annum) as compared with other sub-villages (Minako, 1996).

It is very interesting to note the influence of climate on agro-pastoral activities. For example, Kirinjiko chini has the lowest population of the people who were engaged in agricultural activities, that is, 3.1% (Table 3). This was Contributed mainly by the drier climate found in this sub-Village. On the other hand Barazani sub-village has the highest population of farmers. This sub-village, being just on the foot of the mountain, enjoys a better climate. As indicated in table 3 Kirinjiko chini depends mainly on livestock keeping.

Table 3: Household main economic activities

	% of the sampled respondents						
Activities	Mahuu	Masandare	Mighara	Njoro stendi	Barazani	Kirinjiko chini	Mean
Agriculture	12.2	6.7	10.0	15.0	46.7	3.1	15.6
Agriculture and Livestock	81.1	80.0	76.6	77.0	40.0	87.0	73.6
Agriculture and Business	4.4	6.7	3.3	2.7	6.7	2.1	4.3
Agriculture, Livestock, and Business	2.2	6.7	10.0	5.3	6.7	7.8	6.5

Source: Own field data (1998) n =15 @ N = 90

4.2.2 Household sources of income

Most households derived their income from the sale of animals and their products (hides, milk and ghee) and surplus of crops (Table 4). The percentage of respondents depending on this combination was 53.5%. The combination livestock, crop and business ranked second. Since the main source of income for the people in the study area is agriculture and livestock keeping, this means that the development interventions geared towards improving these activities have more chances of being adopted.

Table 4: Household sources of cash income

	% of the sampled respondents						
Source	Mahuu	Masandare	Mighara	Njoro. stendi	Barazani	Kirinjiko chini	Mean
Animal, crops and animal products	61.1	46.6	71.1	68.9	20.1	53.4	53.5
Animal, crop and business	35.5	46.7	25.6	31.1	79.9	39.9	43.2
Crops and remittances	3.3	6.7	3.3	0.0	0.0	6.7	3.3

Source: Own field data (1998) n = 15@ N = 90

4.2.3 Household expenditures

About 69.9% of the respondents spent their income on food and farm inputs (Table 5). Many people buy food because the food obtained from agricultural activities does not meet the household requirements. As observed the main causes of food insufficient are the unfavourable climatic conditions.

Another sink of income was health services (Table 5). About 16% of the respondents spent their income mainly on food and human health. This is far lower than the real figure. The reason is that most of the interviewers were men, who spent most of their time away from their families due to grazing. They therefore might not know the actual health situation of their family. Also traditional medicines are widely used in rural areas whereby the cost of this is often overlooked.

Few farmers spent their income on animal care and children education. The reason for this includes the scarcity of veterinary officers in the study area and income limitation in the rural areas. The number of children attending school was relatively low despite a fair distribution of primary schools in the surveyed villages. The reason given was that some parents felt that boys should be trained in grazing animals while girls should be educated at homes as future mothers. Furthermore, it was noted that some children refused to go to school due to the long distances to be covered. This was caused by the scantiness of the area since some villagers are living very far from school facilities. For example it involves many kilometres for a child to move from Kirinjiko chini to Mwembe or Masandare primary schools.

Table 5: Household expenditures

	% of the sampled respondents						
Area of Expenditure	Mahuu	Masandare	Mighara	Njoro stendi	Barazani	Kirinjiko chini	Mean
Food&human health	17.8	13.3	24.4	14.8	13.3	11.7	15.9
Food&farm inputs	63.3	66.7	68.9	73.1	73.3	74.3	69.9
Food animal care, fee and farm input	1.9	20.0	6.7	12.1	13.3	14.0	14.2

Source: Own field data (1998) n = 15 @ N = 90

4.3 Land use and tenure system

All farmers in the study area own land. The land is acquired through one or a combination of ways namely, inheritance, purchase, through the village government and own selection. Table 6 gives more details on land acquisitions as observed in differentsub-villages.

Table 6: Means of land acquisition:

Means	% of the sampled respondents						
	Mahuu	Masandare	Mighaa	Njoro stendi	Barazai	Kirinjiko chini	Mean
Inheritance	41.1	46.7	46.7	45.2	33.3	16.7	38.3
Purchase	0.0	0.0	13.3	18.9	20.0	0.0	8.7
Given by village govt.	24.4	20.0	33.3	31.1	20.0	12.3	23.5
Own selection	15.6	13.3	0.0	0.0	0.0	56.1	14.2
Inheritance & own selection	7.8	6.7	0.0	0.0	0.0	12.7	4.5
Inheritance & by village govt.	10.0	13.4	6.7	3.7	26.7	2.2	10.5
Inheritance & purchase	1.1	0.0	0.0	1.1	0.0	0.0	0.2

Source: Own field data (1998) n = 15 @ N = 90

As the table clearly shows the major ways of land acquisition are through inheritance and village government. It was noted that all farmers who owned land had no title deeds but user rights. The lack of title deeds in many parts of Africa especially in semi-arid areas is mainly caused by either the existing legislation and the old tradition

which does not consider aspects of crop farming and livestock keeping as main and long term economic activities. The number of land parcels owned by individual farmers ranged from one to seven parcels. A land parcel as described in the study area is a piece of land with an average size of half a hectare to three hectares. Most households have an average of three parcels of land ranging from 1.5 ha to 7.5 ha. The variations may be explained in terms of land holding re-allocation from the time the livestock keepers decided to adopt a permanent or semi-permanent settlement. Farmers, who were forced to move from an area, retained the traditional ownership rights of the land they owned. Some people migrated from the highland areas to the lowland areas to look for pastures for their livestock. The size of land around homestead is small (less than one hectare) because of land fragmentation, which is caused by the current inheritance system. A person with many sons will have his land divided to all of them when they get married. Having many sons will lead to serious land fragmentation. Eventually, the sons may have to move from their fathers' home to look for another area.

Many farms were found located far away from homes at distances ranging from one kilometre to 13 km, but in average farmers move four kilometres to the crop fields. Increased distance from the homestead to the farm reflects increased settlement areas and the proportional contraction of woodland resources. This is a reflection of the situation in Tanzania where deforestation rates are high (Monela and Solberg, 1998).

Demarcation of land in Kilimanjaro Region is very important especially in areas that are densely populated. As indicated in table 7, people in the study area (35.6%) demarcate

their pieces of land mainly by planting sisal (*Agave sisalana*). Tree survival is hampered by long drought encountered in the area. Trees which were found in the farm boundaries were those which grow naturally. Indigenous trees and shrubs of dry areas developed a set of ecological strategies (Munyanziza and Oldeman, 1995, 1996). Sisal was common on boundaries because it is more tolerant to drought and is not eaten by animals or termites. Drought resistant native trees should be incorporated in the system in greater proportions. Nineteen percent of the respondents did not demarcate their areas because they believe that there is no intruder who can take their land, which, to their view is not productive.

Table 7: Demarcation of cropping land

	% of the sampled respondents						
Types	Mahuu	Masandare	Mighara	Njoro stendi	Barazani	Kirinjiko chini	Mean
Tree	20.0	26.7	12.0	50.0	54.8	11.2	29.2
Sisal	51.2	53.3	48.0	13.9	28.2	18.7	35.6
Contour/ridge	13.3	6.7	7.9	20.0	4.5	2.3	9.2
No demarcation	13.3	6.7	31.0	13.0	11.5	38.7	19.0
Using debris	2.2	6.7	1.1	3.1	1.0	29.1	7.0

Source: Own field data (1998) n = 15 @ N = 90

Large proportions of land holdings are allocated to crop farming and/or grazing and to a growing extent to human settlement. According to this study 64.8% of the respondents indicates that there was no problem associated with farming. The rest, however, listed a number of problems. These were overgrazing and prolonged and severe droughts. (Fig

2).Overgrazing and droughts according to respondents, decreases soil fertility through the removal of organic matter and accelerates soil erosion. This is scientifically true (Nair, 1987). Efforts undertaken to increase crop production have been mainly to expand the area rather than to improve the soil productivity. New options are now needed since land expansion is no longer possible.

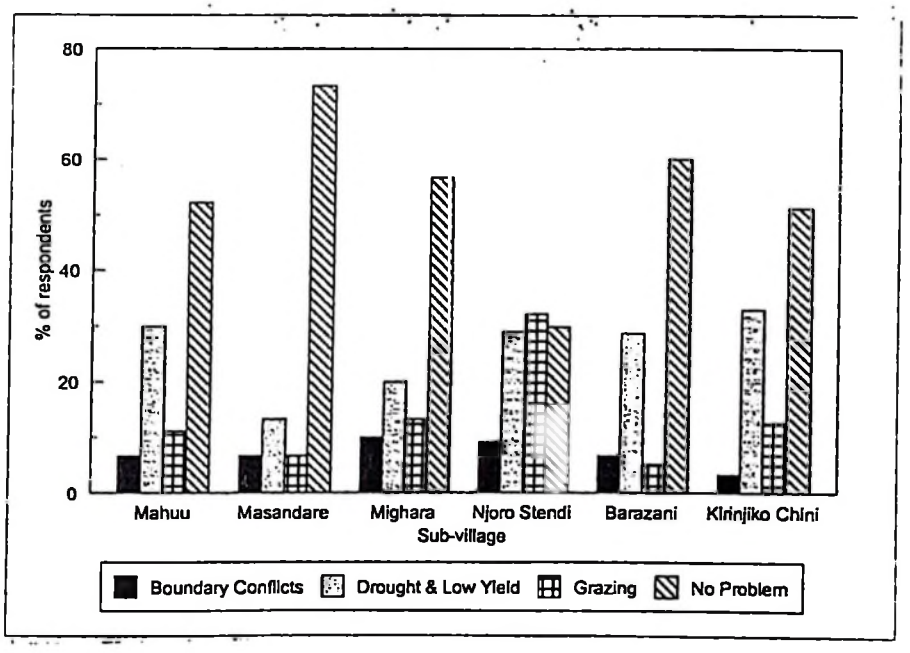

Figure 2: Problems reported to be associated with farm land

4.4.1 Crop production

Cultivation is mainly manual. The use of animal power in the study area for ploughing is not practised due to traditional and/or religious beliefs. The use of animal manure is not common even though almost every household have livestock. The respondents, however, are aware of the steady decline in soil productivity. The author also made a similar observation. The key contributing factors were unreliable rainfall and poor crop management. Many farmers cultivate the same field for years without crop rotation and without adding fertilisers or manure to the soil.

4.4.2 Livestock production

Nearly all farmers (90%) keep livestock. The types of livestock kept include cattle, goats, sheep, donkey and poultry. Cattle are preferably kept as compared to small ruminants. A herd of cattle ranged from one to 210 with the mean of 24± 6 cattle per household. Many people acquire cattle through inheritance and few are bought. Livestock are kept as a major source of income. Animal sale, milk, ghee and hides secured income to the owner. In the past, people in the lowland depended mostly on livestock keeping but due to climatic changes they started to practice agriculture. During that time, if some one cultivates the area he/she was supposed to protect the area himself/herself because all the land was considered to be a grazing land. However, since they started to include crop production as one of their activities, they separated the crop fields from grazing area. Such a shift is a step towards agricultural intensification. In areas called *Ngusero* where the main crop fields are found, animals are not allowed to

graze even after harvesting the crops although some broke the laws.

Livestock management is extensive. Almost all people (94.5%) use free grazing as a major means of feeding their livestock (Fig. 3). These people have developed various grazing systems to ensure sustainability of pasture. The main sources of livestock feeding were identified as individual *mlimbiko*, croplands after crop harvest, communal *mlimbiko*, and any other remaining areas with pasture. The *mlimbiko*, as will be discussed later (4.6), is an indigenous woodland or grassland management system that seeks to supply fodder on a permanent basis and especially during the dry season.

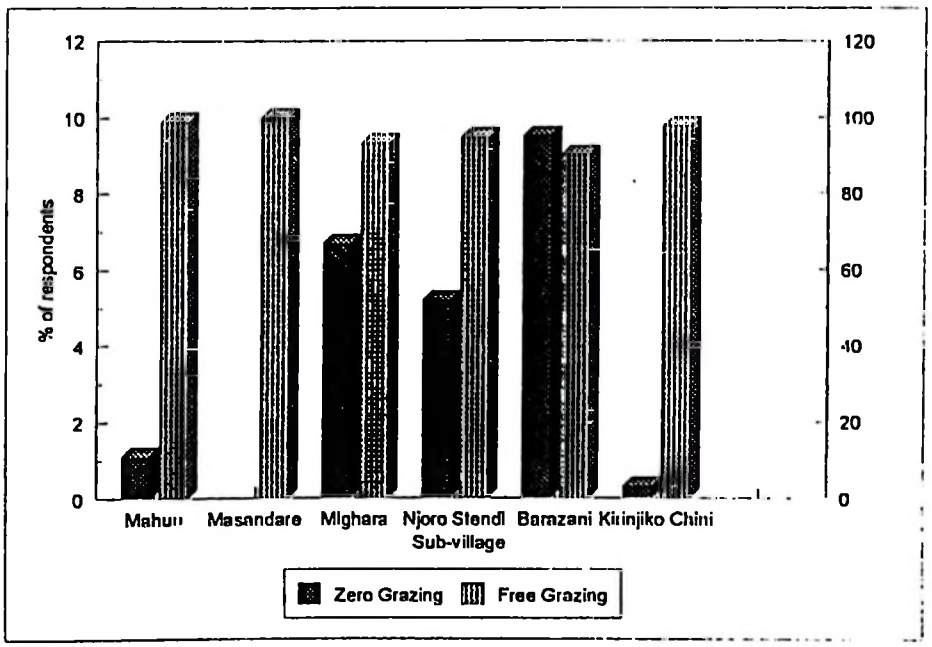

Figure 3: Methods of feeding livestock in the study area

Contrary to free grazing, zero grazing consist in tethering the animal in tree or shrub and allowing the animal to graze within the threads radius. It is a sort of intensification in the use of resources. Adoption of zero grazing reflects the shortages of pasture resources and people awareness of the effect of overgrazing on land resources. As observed from Fig. 3 people in Masandare sub-village do not practice zero grazing because the sub-village has a vast area of grazing, extending as far as to Ruvu village. As it was observed zero grazing is environmentally friendly. More tree flowers and other vegetation cover were observed around homesteads where zero grazing was practised. Free grazing was associated with much disturbed environment.

The *mlimbiko* systems, both individual and communal were identified to be more important in livestock feeding than other sources (Fig. 4). Normally, natural rangelands provide fodder/pasture during wet season, while individual and communal *mlimbiko*, reserved trees, croplands and sometimes natural rangelands where available, formed important sources of livestock fodder/pasture in the dry season. The discussion with key respondents revealed that large areas in this district are under cultivation, game reserve (Mkomazi) and NGOs activities leaving relatively small portions as open land available for establishment of communal *mlimbiko*.

From Fig. 4 it is clearly shown that in Mahuu sub-village, people prefer to use both communal *mlimbiko* and reserved indigenous tree (78.2%) because of the nature of their area which does not favour other activities apart from grazing. Also there are many Acacia species which provide fodder during the dry seasons. This is a good

example where people take private initiatives to conserve species. Species conservation reflects the need and priority of stakeholders. In Njoro stendi and Barazani sub-villages people don't consider reserved trees as a dry fodder. In Njoro stendi most of the trees found there are exotic species mainly *Azadirachta indica* and *Senna* species which are not eaten by animals. Professionals who did not take into account local needs have introduced these species. Also in Barazani there are many fruit trees i.e. *Mangifera indica* and *Ficus* species together with other exotic species. The respondents reported that indigenous dry fodder trees were very common before the government took party of their area and being allocated to KVFP.

In the lowland areas of Same District, livestock have proved a great barrier to planners and environmentalists since people emphasised to have large number of animals rather than productive herds. This has been explained in the literature that livestock keeping especially cattle is associated with many things of cultural, social or economic value (Maro, 1995).

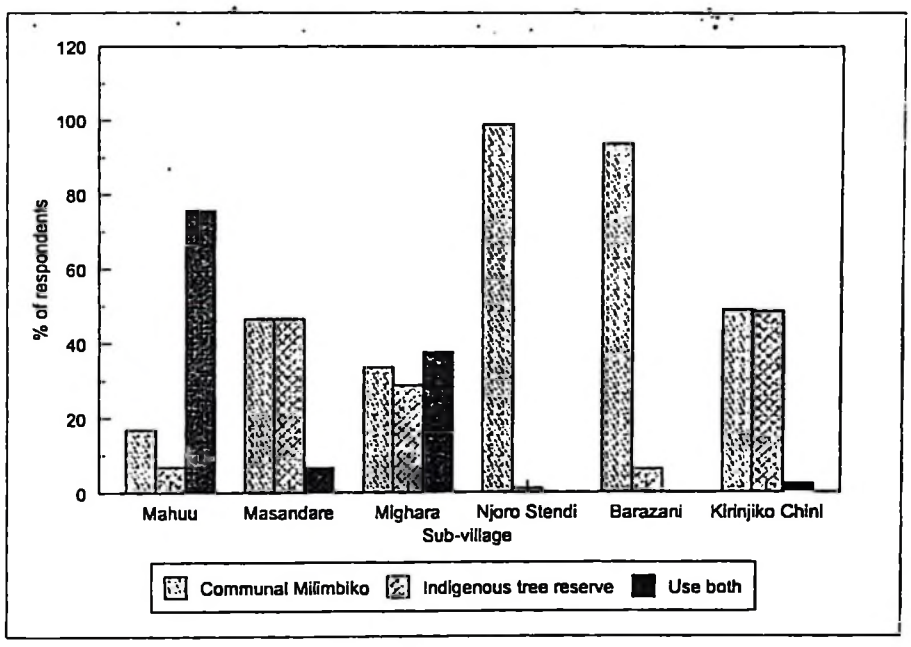

Figure 4: Means of solving fodder problem

4.4.2.1 Constraints limiting livestock production

Livestock production is constrained by the shortages of pasture/fodder. About 64% of the respondents declared that there is a problem of obtaining livestock feed. Lack of veterinary services, drugs and dipping areas were also mentioned as factors limiting livestock production. Shortage and lack of water was identified as the main problem for

the human beings and animals. In one sub-village (Kirinjiko chini) there was no single source of water in the vicinity. Women travelled more than seven kilometres to Same town to fetch water. The livestock from this sub-village were used to get water from a water point (Loresho) constructed by KVFP but the source is out of use due to the breakdown of the pumping machine at KVFP. Due to shortage of pasture and lack of water during the dry season, some farmers move their stock to distant pastures in Hedaru and near river Ruvu. Young men and heads of the family move from their settlement and make temporary camps in grazing areas where they stay during the whole period of pasture shortage while women and children remain back. This has a multiplier effect to other areas of development. As observed during this study it was not uncommon to find that almost all members of sub-village environmental conservation committee were away during the dry seasons. This causes interruption in the implementation of the planned activities.

The traditional mobility patterns of pastoralists have long history in other parts of Tanzania such as in Shinyanga region, but the practice varies considerably from one area to another (Brandstrom 1985, 1990). This mobility also might have an effect on food and health security of women and children who remain behind thus deprived of food commonly derived from livestock keeping.

The use of individual and communal *mlimbiko's* which was observed in 56.5% of respondents was identified as the major means of solving fodder/pasture problem in this area. In Barazani sub-village, people were not using the word *mlimbiko*, instead they

said "set aside a big area". Destocking was not viewed as an acceptable option in the study area. Instead people were ready to move to the southern parts of Tanzania. This attitude was earlier observed in Shinyanga (Brandstrom, 1985; Barrow *et al.* 1988; Jerve, 1990; Shao *et al.*, 1992). The Pare people keep large herds of cattle purposely. They fear that during the dry periods many animals may die and some will remain. For that reason destocking was strongly resisted.

Other suggestions made were the expansion of the reserved area to the areas where land is not used for other activities. People also suggested that the KVFP should allow small ruminants to use the project site which formally was used by these animals. The KVFP sites used to be dominated by the fodder native trees *Acacia tortilis*

4.5 Forest resources

Almost all people (94.4%) have planted trees, at least for the period stretching from 1945. However, 80.2% of the respondents planted trees between 1990 - 97 (Table 8). This is the impact of the KVFP, a project dealing with social forestry in the district. The project distributed free of charge all planting materials. The main customers includes individuals, village community groups, schools and religious organisations.

Forest resources in semi-arid areas provide important benefits in terms of forest products and environmental services that are often necessary for sustainable economic development. The replacement costs of lost services due to deforestation or

inappropriate management of forest resources in this area is very high.

Table 8: Time during which the tree planting was started in the study area

Year	% of the sampled respondents						
	Mahuu	Masandare	Mighara	Njoro stendi	Barazani	Kirinjiko chini	Mean
1945	1.1	-	-	1.1	6.7	-	1.5
1960	1.1	-	-	1.1	6.7	-	1.5
1970-75	5.6	-	6.7	0.8	20.0	-	5.5
1983-85	2.2	-	3.3	2.7	6.7	-	2.5
1986-89	6.7	6.7	3.3	3.3	33.3	-	8.9
1990-93	13.0	26.7	10.0	11.3	20.0	1.1	13.7
1994-97	70.0	66.7	76.7	79.7	6.7	98.9	66.5

Source: Own field data.(1998). n = 15 @ N = 90

The lowland area is highly affected by stong wind and long period of dry seasons. People in this area have noted this as a major problem facing their area and declared that this was due to lack of trees. Therefore, they started to plant treea for shade, windbreak, firewood, fruits and environmental conservation (Fig. 5). Useful tree species identified in the study area includea Albezia species, Leucaena leucocephala, Senna siamea, Senna spectabilis, Azadirachta indica, Mangifera indica, Tamarindus indica, Trichilia emetica, Croton megalocarpus, Acacia species and others. It was noted that most of these species are exotic. The wide distribution of exotic species in Tanzania has been observed by Munyanziza (1999). Projects dealing with afforestation are short-lived. They usually promote trees already known or those with high growth rate and often overlook the priority of needs as identified by the stakeholders. This is also reflected in species

introduced in the study are.

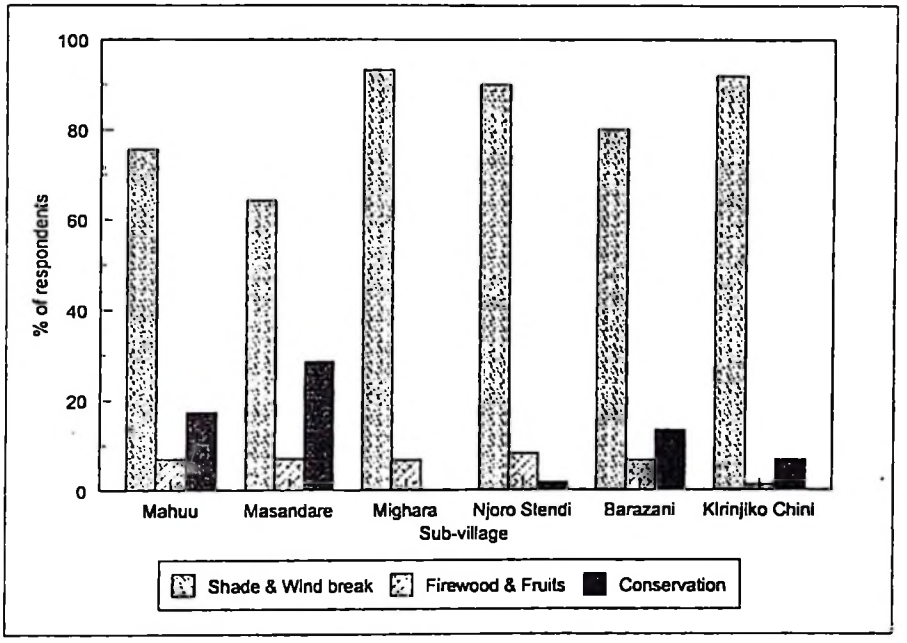

Figure 5: Reasons for planting trees as given by the respondents

From (Fig. 5) it can be observed that only 6.2% of the respondents plant trees for firewood and fruits. It was noted that many people collect firewood from the forests or woodlands. The planted trees do not meet the required need for the family. Firstly, the planted trees have a low survival rate. Secondly, most of the trees planted so far are still young. Thirdly, the calorific values of most of the planted trees are low and have higher amount of smoke according to respondents. The indigenous trees mostly

preferred for firewood includes *Acacia* species. These species are also a good supply of fodder for animals. Farmers plant few fruit trees as found in the study area due to the lack of planting materials. Also most of the fruit trees such as *Mangifera indica, Persia americana, Psidium guajava, Citrus sinensis, Carica papaya*, and others do not tolerate the harsh climatic conditions found in the study area.

Trees provide shade to people and animals and protect chickens from being preyed upon by dangerous birds. The site mainly planted with trees was around the homestead as observed in 73.0% of the respondents. Some farmers retain a few trees around their farm boundaries (15.7%) as a boundary demarcation. This is an area where intervention can increase tree population by planting just on the boundary.

Trees were not grown in the farm. The main reason given for not growing trees in farm is drought that causes high mortality (Table 9). Some of the trees that are planted need to be watered. It is difficult to plant trees in the farm because of water scarcity. Another reason advanced by the people is the damage by animals. The last reason was land tenure system. Land security was low and hence hinders tree planting initiatives.

Table 9: Reasons for not planting trees in the farm

Reasons	% of the sampled respondents						
	Mahuu	Masandare	Mighara	Njoro stendi	Barazani	Kirinjiko chini	Mean
Drought	43.3	40.1	45.2	58.7	29.2	55.7	45.4
Grazing land	32.2	26.6	31.5	31.9	18.9	42.2	30.6
Not mine	18.9	20.0	20.0	7.2	7.80	2.1	12.7
No reason	5.6	13.3	3.3	2.2	44.1	0.0	11.5

Source: Own field data (1998) n = 15 @ N = 90

According to respondents the management of trees planted far from homestead is a very difficult venture. Farmers prefer to plant trees near their houses where they can use waste water to irrigate them. Also the protection of such trees from animals will be easier. In the past, an attempt was made by KVFP to plant trees in the farm fields *ngusero* but none of them survived.

Sources of tree seedling

As observed from (Fig.6) it is clearly indicated that most of the planting materials weresupplied by KVFP. About 86% of the respondents appreciated this. In some other areas people use wildlings (6.5%) of *Senna siamea* and *Azadirachta indica* which were reported to perform better than the potted seedlings. Wildlings are often better equiped interms of mother symbiotic micro-organisms (Munyanziza and Oldeman, 1996). These increase seedling survival.

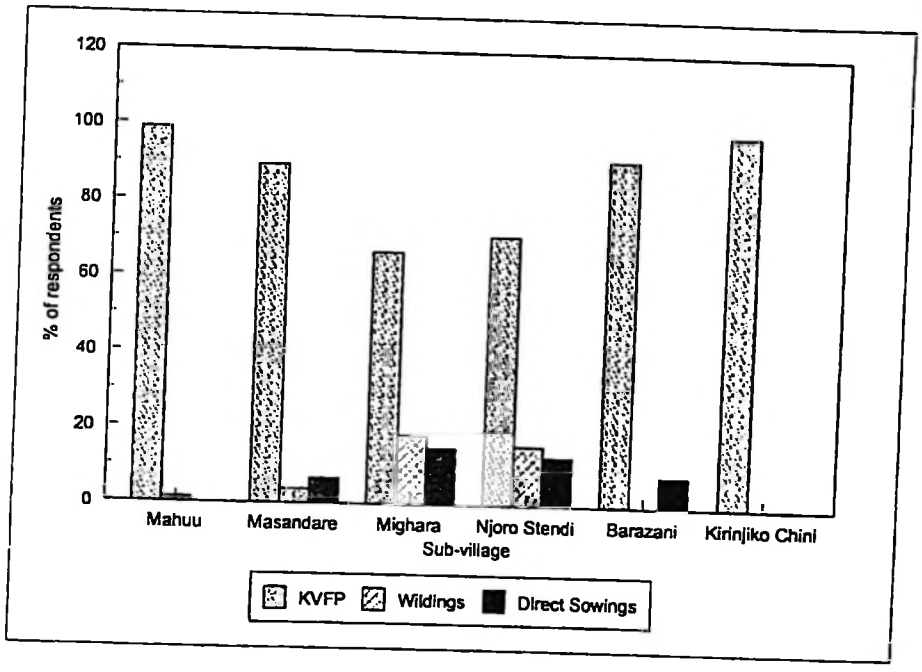

Figure 6: Sources of tree seedlings

Many trees growing in Njoro village (Mighara and Njoro stendi sub-villages) regenerate naturally. This constitutes the source of wildlings. According to the present study there was no farmer who purchased seedlings despite that the KVFP has been selling some of its seedlings since 1995. Low income and limited tree survival contributed the main causes of this.

4.6 The indigenous *mlimbiko* silvo-pastoral system

This section is divided into four sub-sections, which are the historical background of the indigenous silvo-pastoral system, its type, the role of the *mlimbiko* system and a thorough description of *mlimbiko*.

4.6.1 Historical background of the *mlimbiko* indigenous silvo-pastoral system

Mlimbiko is an indigenous management system observed in Pare. The *mlimbiko* is locally applied in the conservation of threatened tree species, grasses, and water reservoirs.

The term *mlimbiko* comes from the Swahili word *Limbika* that means, "accumulate". It involves the conservation of fallow and rangelands for certain purposes and for a specified period of time. During the rain season, the vegetation is left to regenerate and accumulate the biomass. During the dry season the area is open for grazing. The concept of dry season fodder conservation in Pare areas was developed purposely to ensure sustainable pasture production. Pasture shortage was caused by long and frequent droughts, shortages of herding labour, diminishing grazing land due to increased agricultural area and human settlement.

Traditionally, *mlimbiko* had been developed to protect individual rights since each family in pastoralists' area had its own area reserved. However, due to high population

pressure, government regulations (i.e. lack of land tittle), villagelization and expansion for agricultural land, among other factors, there has been a shift from individual *mlimbiko* to the communal *mlimbikos*. Ownership, management and land tenure rights of *mlimbiko* under the traditional system were governed by local norms.

Mlimbiko has undergone many changes since its emergence. These changes have been brought by the changes in the government policy and in the population size and related land degradation. Fire burning for example, used to be one of the management tools. Nowadays no fire burning is practised partly because of restrictions by the government and shortage of pastures.

4.6.2 Types of *mlimbiko*

4.6.2.1 Individual/private *mlimbiko*

Individual *mlimbiko* comprises of a small area around the homestead. The size of the area depends on the number of animals owned and on the ways the land unit was acquired. The area is under use immediately when all animals have been moved far from the homestead. The owner is not allowed to use the area before that time nor to graze other animals apart from the stated ones, failure to follow the regulation all members of the area will bring their animals to the *mlimbiko* of the breaker of the rules.

The main purposes of individual *mlimbiko* are two fold:

(i) First is used to supply fodder during the dry season to milking cows, sick

animals and calves;

(ii) Second acts as a protection of ownership rights.

4.6.2.2 Communal *mlimbiko*

Communal reserves are established with mutual consent of village members. Since the main activity of the people in the lowland is livestock husbandry, all members of the communities living in the lowland are members of *mlimbiko* of their own sub-villages and/or near-by sub-villages. In some areas, communal *mlimbiko* are further divided into the following:

(i) *Mlimbiko* for small and young animals

The pastoralists do separate young cattle, goats and sheep from adult ones to ensure smooth feeding. The areas with characteristics of producing nutritious and edible grasses, twigs and pods are more suitable for small and young animals.

(ii) *Mlimbiko* for mature animals

The areas that have the characteristics of having high grass and shrub regeneration set-aside for mature animals.

4.6.3 The importance and role of *mlimbiko* conservation

In general, *mlimbiko* conservation is applied in conservation of endangered and threatened ecosystems, tree species, grasses, and water reservoir.

4.6.3.1 M*limbiko* conservation of ecosystem and threatened plant species

The threatened plants include tree and grass species. The conservation of plant species can be achieved by protecting their habitat through control of land use and ecosystem alteration. Indigenous techniques play a vital role in conserving plant species in many areas. A study from Sudan shows that people on lower slopes and highlands use traditional agroforestry systems based on the Acacia species (*Faidherbia albida*) over centuries (Miehe, 1986). This species sustained a densely settled population and was protected at the same time.

In the lowland areas of Pare, people use traditional technique *(mlimbiko)* to protect tree species which are useful to people and animals. The most preferred tree species is *Acacia tortilis*. Under *mlimbiko* rules people are not allowed to cut these trees. They retain the species for different roles mainly for small ruminants' fodder. The *Acacia tortilis* pods are very nutritious for goats and sheep (Maenda, *et al.*, 1996). These species are also used to hang beehives. The country earns a lot of money from exports of honey and bee wax. *Acacia tortilis* is a drought tolerant tree probably due to its association with microbes (Munyanziza and Oldeman, 1996). Seeds are dispersed and germinate under natural conditions. *Acacia tortilis* is a multipurpose species. Pods

provide fodder, flowers provide nectar and nesting place for bees, it acts as a good windbreak, provide shade and has medicinal values as reported by local people. Despite the *mlimbiko* conservation technique, this species is facing extinction. It is highly required for firewood and for charcoal making. The prison has a greater threat on this tree species because firewood requirements are on the large scale as compared to the households. The village *mlimbiko* committee fails to overcome this problem because the prison is a government institution.

4.6.3.2 Mlimbiko conservation of water reservoir

Water is the most important and highly needed resource for both people and animals since it affects food availability. In semi-arid areas water is the most critical resource. The retention of water in the soil in semi-arid area is limited due to the type of soil found there and the bare land which has been contributed mainly by inappropriate land management techniques. In the semi-arid lands of Pare, farmers and herders have developed indigenous techniques for water conservation and supply. People, individually or collectively have developed local water reservoir systems known as *malambo*. The *malambos* are constructed for harvesting water during the rain seasons. The water harvested under the *malambo* system is supplied during the dry season to humans and livestock. The *malambo* rules and regulations are similar to those applied to the *mlimbiko* system as earlier discussed.

The most salient feature of the rules used on *mlimbiko* conservation for pasture and

water is that all newcomers are allowed to graze on the communal *mlimbiko* free of charge. Newcomer, however, have to pay for drinking water. The fee collected ranges from Tanzanian shilling 500.00 to 1 000.00 for the whole period the animals will be there. This fee is used for maintaining of the *malambo*.

This indigenous technique on water conservation has been used for some decades and sustained people to some extent. It can be effectively used to preserve or manage on a sustainable basis the protected areas of semi-arid zones. It should be noted that most of the protected forests of Tanzania are currently undergoing a high rate of encroachment (Nsolomo and Chamshama, 1996).

4.6.4 Description of the *mlimbiko* system

In order to get comprehensive information on the *mlimbiko* system, farmers were asked to describe the *mlimbiko* system, types of *mlimbiko* system and their importance. This information was supplemented by the researcher's experience in the area, field observations and literature study on the system.

Under the *Mlimbiko* system the area designated is granted the conservation status as soon as the long rain starts, that is from March. Prior to this a survey, is made to assess the suitability of the area. Once the area is qualified, demarcation of boundaries is made and the area is ready for reservation. The area is under reserve from March to August and is used for grazing thereafter for the period expected to

have shortage of pasture. Sometimes the specified period may not be reached, sometimes it may be extended. This depends on the rainfall quantity and distribution. The problem is that rainfall in semi-arid zone of Tanzania is irregular (Mwaseba et al.; 1994).

4.6.4.1 Selection of *mlimbiko* area

Farmers through practical experience have acquired m*limbiko* management practices for many decades. Using *mlimbiko* systems, farmers acquire relevant knowledge on identification of suitable areas, management techniques required and are able to distinguish different grass types depending on the quality and quantity of grasses found on their area.

As it emerged from the group discussion, site selection takes into account ecological conditions and the relative distance from the village to the area for mlimbiko conservation. The choice of an area is made in the sub-village meeting whereby all community members including village leaders (under the council of male elders) agree on where communal *mlimbiko* should be located.

4.6.4.2 Characteristics of the selected *mlimbiko* area

Mlimbiko sites are selected from areas that have not been used for other activities rather than grazing. Virgin land, where available, is preferred by herders. The best site is that

with soil with high water holding capacity. Such soils sustain green vegetation for a longer period. This criterion reflects farmers' ecological knowledge.

The distance from human settlement is another factor, which have to be taken into consideration. Farmers prefer sites, which are close to their settlements to facilitate management and control measures. Furthermore, it assures the herders to come back to their households after grazing. However, selection of an area for communal *mlimbiko* cannot fulfil the needs for every individual member of the community, instead they select suitable sites available within the communal land.

Through years of experience, farmers know how to determine the quality of grass by observing its physical conditions and appearance. Sometimes, animals' preference on certain grass species is used as an indicator to determine the site for *mlimbiko*. During grazing, the herders also study their animals. This helps them to determine future sites for *mlimbiko*. The quality of grasses is assessed basing on palatability (edibility), nutritive contents, greenish and roughage (Kilahama, 1994). Animals' weight gain and increase in milk production observed by the farmers also assist in detecting the suitable site for *mlimbiko*. According to farmers experience in livestock keeping they said that, soon after rains and grass seed germination, there has been an increase in both milk production and animal weight for good pastures.

Another factor that is considered in selecting *mlimbiko* sites is the quantity of grass available. According to farmers' experience, soon after first rain and once the grasses

start to sprout they are able to determine if the selection of certain site will meet the required amount of grass required during the dry season. It is clearly known that, the growth rate of grasses and hence their quantity are affected by rainfall amount and pattern, the duration of sunshine, wind, tree density, human activities and number of animals grazing in a specified area (Kilahama, 1994).

Farmers in the semi-arid areas and particularly in developing countries including Tanzania practice rainfed agro - pastoral activities. This indicates that climate has a great influence on grass quantity. The quantity of grass in a specified site depends on the amount of rainfall during the wet seasons and on its distribution. Low rainfall causes poor grass performance and substantially reduces grass quality. Sunshine is important in grass growth, but strong sunshine results in low quality and quantity of grasses (Kilahama, 1994). Strong wind also affects grass growth because they increase evapotranspiration and blow away some grass flowers that would supply seeds for increased regeneration. Tree density also affects grass growth, the effect varying from species to species farmers reported this. In areas where tree canopy is dense and closed, poor grass performance or no grass at all is observed (Kilahama, 1994). Also some trees have allelopathetic effect which hinders underneath growth. Farmers in this area know the indigenous tree species that favour grass growth and these are left untouched in *mlimbiko* sites.

Human activities carried out in the *mlimbiko* areas influence grass growth rate. For instance, extensive charcoal burning leads to reduction in grass growth rate. Areas that

formally used as agricultural land are not suitable for *mlimbiko* site because the land has been disturbed to the extent that grass seeds have died. This leads to germination of unknown grasses, which may not be palatable to animals.

The areas selected in the previous year may not be necessarily selected this year, because the grass quantity may be poor probably due to the number of animals using that area. According to farmers' experience there is a general decline in growth rate of grass after using the area for one year due to the number of animals using the area. Farmers would like to fallow the area for one year or more to encourage adequate grass regeneration and site recolonization. However, due to lack of enough areas, they continue using *mlimbiko* area without fallowing. It could be interesting to make trials of totally new grass and shrub species in the area. Those herbs with nitrogen fixation might be of great potential.

4.6.4.3 Communal *mlimbiko* membership

Since livestock husbandry is one of the economic activities, all community living in the lowland areas are members of *mlimbiko* in their own sub-villages and also in the adjacent areas. After a sub-village or village has demarcated an area for *mlimbiko*, information is disseminated all over the surrounding areas so as to alert the community that the site is under reserve till further information on the opening time. In areas where cattle trespass, the animals are considered as temporary grazers and the owners are considered as members of *mlimbiko*. However, they are supposed to pay the water reservoir *malambo* fee. All issues concerning *mlimbiko* are discussed in

the sub-village/village meetings whereby farmers and livestock keepers participate in planning, implementing and utilising the *mlimbiko* areas. These meetings are good bodies for promotion of development.

There are elected *mlimbiko* committees that consist of chairperson, secretary and committee members. The committee members are selected based on their interests and generally include young and old people. They include young people because they are strong, hard working and can move fast and far to look for an area suitable for *mlimbiko*. Also young men are strong, therefore they have the power to arrest those people who go against the *mlimbiko* rules. Furthermore, they are used as guards. The old men remain to be members of *mlimbiko* due to their accumulated knowledge and their advisory role.

4.6.4.4 *Mlimbiko* by-laws (rules)

Farmers in the lowland areas of Same District, formulated traditional by-laws that are applied to protect *mlimbiko* areas. The rules used differ between individual and communal *mlimbikos*. This was suggested due to the different type and number of animals using the two types of *mlimbiko*. The rules vary according to the type of mistakes done, who did and how many times. Sometimes the children may not be punished if it is the first time, instead his father will be given a warning.

The punishment for any one who breaks the rules on individual *mlimbiko* is one tin (approximately 20 litres) of local brew known as *mbuta*. Sometimes the offender

may be charged other things including three kilogram of sugar. On the other hand for communal *mlimbiko*, the punishment formally was a cow if cattle found grazing, a goat for goats and a sheep for sheep. But knowing that charging a cow nowadays is very expensive, people decided to charge one goat for any type of animals found using the *mlimbiko* area before time.

The most important thing in the punishment is that, the animal is slaughtered at a gathering of *mlimbiko* committee members including the offender. The meat is roasted or cooked on an open fire and is eaten by all members without carrying any meat back home except the head, legs and the skin. The unfair thing is that most of the members of the family do not have any share specifically the women and children.

4.6.5 *Mlimbiko* management practices

Men with the main purpose of accumulating grass quantity exclusively do management of mlimbiko system. The *mlimbiko* committee members use the following as their guidance to ensure continuity of pasture availability. First of all, they locate a big area as much as available. Secondly, they are supposed to know the time of closure in order to allow optimum grass production. Thirdly, they divide the area into paddocks and graze one at a time in order to ensure systematic grazing as part of grass management strategy. And lastly, they guard the area to make sure that the area remains closed until the need to open it arises.

Another management measure that is necessary for the new *mlimbiko* area is boundary demarcation. This is achieved by placing thorny branches such as those of *Acacia species*. Often Euphorbia species are used for this purpose. In the individual *mlimbikos*, soil heaping and the use of thorny branches as a boundary are common. However, the majority of people prefer thorny branches because they help them not to employ herdsmen if the area is well fenced. Incorporation of fodder trees on the boundary may mean increased woody biomass and fodder in the system.

In the past fire burning was employed as one of the management tool in the study area. Fire was used in order to create new and fresh pasture. Fire burning was possible probably due to small numbers of animals kept during that time as compared to the land available. Therefore, prior to rain season, fire was set in order to allow grass sprouting. But nowadays, fire management on grass is no longer undertaken since all grasses are consumed by animals and leaving bare soils. Another reason that led to the use of fire in the past was to control tsetse flies. According to farmers' experience, the problem of ticks in the area is not existing. However, they have been advised by extension officers to use chemicals rather than fire burning due to its effect on the environment. It is however true that the use of chemicals is expensive and also some of the chemicals are not environmentally friendly.

4.6.6 Farmers attitude towards *mlimbiko* conservation

Both the individual and communal *mlimbiko* systems and the protection of indigenous

tree species were suggested as the key issues needed to be improved for appropriate *mlimbiko* conservation of environment and pasture production. Farmers also suggested that the three techniques should go hand in hand without separating in order to have a wider coverage. However, the success of *mlimbiko* conservation will be depend on government policy regulations on land use. According to the farmers' view, the future destiny of *mlimbiko* management system will depend on the restoration of customary land use system or local by-laws and the change in ownership patterns. The customary land use pattern and local by-laws under *mfumwa* were reported to be more effective in protecting *mlimbiko* than the present government system which is not clearly defined.

To improve *mlimbiko* system, respondents mentioned three issues including property right/ownership, protection period and pasture improvement as a guide for future *mlimbiko* management for environmental conservation and sustainable pasture production. There is a need to clearly define the ownership pattern of any area using *mlimbiko* system for conservation. People in the study area suggested that defining the ownership pattern and ensuring of tenure would encourage *mlimbiko* owners to improve their areas, hence conserving the environment and securing sustainable pasture production.

The protection measures to improve *mlimbiko* were related to ownership pattern. People are more willing to protect individual *mlimbiko* than communal ones. This was emphasised by the already planted trees around their homesteads which is an area set aside for individual *mlimbiko*. The ownership pattern has a great influence on *mlimbiko*

system as observed in KVFP sites whereby the project apply *mlimbiko* rules to protect areas where they plant trees. People surrounding this project claimed that they would not respect the KVFP *mlimbiko* because they do not know who are the owners and beneficiaries. Also they do not know for how long the area is going to be under *mlimbiko*. This has eventually caused conflicts between the villagers and the project staff. As a result the villagers decided to cut down the planted trees and let their animals to graze in the KVFP *mlimbikos* after working hours. Protecting for whom, is an important question.

Other suggestion to improve *mlimbiko* protection was to use government laws. Such laws have to be published and implemented as soon as formulated. The low productivity of pasture in *mlimbiko* area has been recognised as either being caused by overgrazing, diminishing of some important plant species or inappropriate management techniques. As a result, farmers suggested setting aside a bigger area for *mlimbiko*. However, since land is limited there is a need to plan for better *mlimbiko* management. One of the techniques could be the reservation on indigenous trees that are found in the *mlimbiko* areas.

This study revealed that *mlimbiko* system is a culturally well established and well known tradition all over the lowland areas of Same district. This study also found that the system was beneficial to most of agro-pastoralists since it provides pasture/fodder during the dry seasons and conserves the threatened tree species. It therefore contributes in one way or another to food security and biological diversity.

4.6.7 Constraints limiting the *mlimbiko* productivity and sustainability

A participatory approach whereby respondents were asked to mention and/or explain the constraints limiting the *mlimbiko* productivity was adopted. Almost all respondents, about 92%, claimed that the main limiting factor in *mlimbiko* production is the climate. The main climatic factors which hinder production in *mlimbiko* areas, include rain and temperatures. The effect of climate on pasture production was also reported in Shinyanga on *ngitiri* system (Kilahama, 1994). The time of raining, amount and duration determine the time to close or open an area. Years with enough rainfall lead to plenty of grasses and vice versa. In other parts, rainfall has effects on water supply for animals. Farmers construct water reservoirs malambo which are still not sufficient due to the poor tools used for construction and high rate of evaporation. Tree cutting for charcoal making and firewood was also mentioned as one of the constraints in *mlimbiko* production. The respondents claimed that collection of firewood as done by women has no effect on the area because they always collected the dry or dead wood. Institutional firewood collection was reported as having greater impact on *mlimbiko* areas. Overgrazing was pin pointed among major factors limiting the productivity of *mlimbiko* and agricultural areas. Field observation in the *ngusero* area confirmed this. The respondents, however, were not willing to destock; they are willing to move to other parts of the country including the southern lowlands rather than reducing the population of their animals.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The overview of the socio-economic setting of the households in the study area helped to explain the current and future community problems in silvo-pastoral areas. The community derives a great share of her livelihood on woodland resources. By 1988 the Same District had 30 012 households with a total population of 170 000 with growth rate of 2.4%. This indicates that the population is increasing while the district area remains the same. As human population expands the taxation on the woodland resources increases and the chance for environmental breakdown rise. All households depends very much on the existing woodland resources to obtain woodfuel, poles, medicinal plants, fruits and wild animals for food. This indicates that as the human population increases the woodland resources are depleted. This has a direct bearing on human lives since the majority of the people in the area depend on farming and livestock keeping.

This study revealed that about 77.8% of the people in the surveyed area have attained primary education. This means that the transfer of knowledge and experience from old to the young generation is easy. The main economic activities in the study area are agriculture and livestock keeping (73.6%). These activities also form the main sources of cash income to the household members.

All farmers in the study area own land acquired either by inheritance (38.3%), given by village Government (23.5%), or obtained from both inheritance and village Government (10.5%). Farms are allocated some distances from homestead and also far from *mlimbiko* areas. Boundary demarcation especially in the farms is mainly by sisal (35.6%) because sisal is tolerant to drought and not eaten by animals or termites.

Free grazing in this area was found to be practised by 94.5% of the respondents, mainly using individual and communal *mlimbikos*, croplands after harvest, and browsing of indigenous trees. Shortage of animal pasture was the main constraint that hinders livestock production. The lack of water sources was another problem that livestock and human beings faced

Animal husbandry was a common practice in the area. It is characterised by few to many animals per household. The mean number of cattle per household is 26± 6. The other animals include goats, sheep, donkeys and poultry. This study revealed that the animal populations exceed human population. In order to overcome the problems of fodder and water shortage, the Pare people had developed traditional management techniques, the key one being the *mlimbiko*. The *mlimbiko* is used to achieve adequate supply of fodder to livestock during the dry season. It embodies a wealth of indigenous knowledge.

The *Mlimbiko* system seems to be multipurpose. While it is primarily designed to ensure fodder to livestock during the dry season it addresses also the problems of woodland

conservation, protection of endangered plant species, general biodiversity and water resource conservation. The conservation of water resources in the area is vital since the lowlands receive an average annual rainfall of 350-600 mm. This hinders not only agriculture and livestock but also tree planting.

The KVFP is a social forestry project operating in the area since 1990. The presence of this project has significantly increased the rate of tree planting. About 82.5% of the people in the study area have planted trees. The role of the project has been to distribute planting materials. Unlike the KVFP, local people have been experimenting on native trees. They have developed the techniques of tree propagation, including the use of wildlings of native trees such as fodder trees of *Acacia tortilis*.

Through the *mlimbiko* system, people exhibit an extensive knowledge about individual trees at various stages of development. They know enormous details on individual trees/shrubs growing in the area. *Mlimbiko* system is therefore culturally well established and well known all over the lowland areas of West Same as well as Same District as a whole.

Basing on the results obtained in this study it can be concluded that the local knowledge can be successfully incorporated into the development and environmental conservation processes. If the development programmes are taking into consideration the traditional ways of managing the natural resources, then the risk of ecological damage could be

reduced and pastoral areas could improve their productivity and contribution to both the local and national economy while retaining ecological stability.

The present study indicates that the *mlimbiko* system still constitutes a major source of dry season fodder supply for livestock. Inputs in terms of labour, cash and time spent in establishment and management of *mlimbiko* areas are minimal, thus the *mlimbiko* could be a highly economic venture towards environmental conservation. Combining the professional and traditional knowledge to formulate management techniques that will reduce the desertification rate at low costs can achieve a lot.

The traditional *mlimbiko* systems along with their underlying management concepts provide a valuable opportunity and basis for development of sustainable silvo-pastoral agroforestry systems since they combine trees, crops and livestock.

5.2 Recommendations

5.2.1 Land tenure.

The current legislation on land tenure system in the country does not consider crop farming and livestock keeping as main and long-term economic activities. It therefore needs a review. Arrangements for that should be made to grant people title deeds.

5.2.2 Planting activities

As the study revealed, tree planting and survival in the study area are constrained by severe and prolonged droughts. Efforts should be made to invest in tree species native in the area. These have developed ecological strategies. This will certainly need collaboration between local people and scientists.

5.2.3 Livestock keeping

The population of livestock kept per household is quite high. Sometimes people keep livestock as a prestige. There is a need to advise the farmers to keep few livestock for economic production and food security rather than big numbers that are not economically manageable. Livestock owners should be encouraged to keep livestock that they are able to feed adequately using their own land. This will result in reduced migration, increased animal health and higher economic returns.

5.2.4 *Mlimbiko* conservation system

This study focused mainly on fodder supply aspect of *mlimbiko*. There is also a need to find out other economic values of *mlimbiko*. Improved *mlimbiko* system would provide sufficient and nutritious fodder to the animals during dry seasons. Other economic values such as provision of poles, firewood, honey and bee wax could be derived from the *mlimbikos*. Non tangible benefits such as carbon sequestration soil conservation and recreation can be generated from the *mlimbiko* system. Therefore, future agricultural and environmental development programmes should be based on

the traditional *mlimbiko* system, and retain its productivity, social and conservation functions. Integrating new commodities into the system will help improve economic opportunities for the people. However, the effects of *mlimbiko* conservation practices will depend on clearly defined ownership pattern, specification beneficiaries and the time period.

5.2.5 Woodfuel

The main source of woodfuel was from natural woodland areas that are also considered as *mlimbiko* areas. Therefore, it is recommended that the *mlimbiko* techniques be applied in order to ensure that woodfuel supply is available to the community members all over the year. This will reduce the time spent by women and children in collecting firewood, and hence, give them more time for other development activities.

5.3 Areas for further studies

The following areas are recommended for further studies.

(i) Studies on potential uses of tree species mainly found in *mlimbiko* areas;

(ii) Study on nutrient dynamics in *mlimbiko* areas; *mlimbiko* areas;

(iii) Comparative study on the cost of establishing and managing of mlimbiko between KVFP and neighbouring villages.

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APPENDIX 1

QUESTIONNAIRE FOR HOUSEHOLD DATA

This questionnaire is to be completed by the head of the household

A. Structured Questionnaire

1. HOUSEHOLD PARTICULARS

(i) Name of head of household.....

(ii) Sex 1. Male ..... 2. Female .....

(iii) Age ..... years

(iv) Level of education

1.Illiterate ..... 2. Primary school leavers .....

3. Secondary school leaver.....

4. Post Secondary education .....

(v) Marital status

1. Married .....

2. Unmarried .....

3. Separate .....

4. Divorced .....

5. Widowed .....

(vi) Household composition

Appendix 1: (continued)

1 Total number of people in the household.....

2.Children (below) 16 years Male .....

Female .....

3. Dependants: Males ..... Female .....

4. Household members who live outside but seek help .....

2. INCOME AND EXPENDITURE

(i) Household main economic activities

1. Farming only .....

2. Livestock keeping only .....

3. Farming & livestock keeping .....

4. Employment (specify) .....

5. Charcoal burner .....

6. Fuelwood dealers .....

7. Hunter ....

8. Others (specify) .....

(ii) Source of cash income for the household

1. Sale of animals ..... 2. Sale of crops .....

3. Casual employment .....

Appendix 1: (continued)

4. Petty trades (specify) .....

5. Remittances from relatives .....

6. Sale trees .....

7. Sale of seedlings.....

8. Sale of other forest products (specify) .....

9. Others (specify) .....

(iii) Household expenditure

1. Food purchase .....

2. Farm inputs..... 3. Seedlings purchase.....

4. Health services .....

5. Animal care .....

6. Others (specify) .....

3. LAND USE AND TENURE

(i) Do you own land? Yes ..... No .....

(ii) How did you get this land

Inheritance .....

Bought.....

Appendix 1: (continued)

Given by the village government.....

Borrowed.....

Others (specify) .....

(iii) How did you demarcate your land

(a) By planting trees .....

(b) By planting sisal .....

(c) Using debris .....

(d) No demarcation .....

(e) Others (specify) .....

(iv) How much land do you put under

(a) Crop .....

(b) Grazing .....

(c) Forestry .....

(d) Others (specify) .....

(v) Do you have any special problems with this land units Yes ..... No .....

Appendix 1 (continued)

4 PRODUCTION ACTIVITIES

(i) Land allocation for each crop (by season: short and long rain) (ha)

(a) Agricultural crops .....

(b) Fruits .....

(c) Trees .....

(d) Others (specify) .....

(ii) What are the uses of crops raised in the farm?

(iii) What is the average harvest per season for major crops grown in the farm?

Crop	Amount per season per acre

(iv) How many animals do you own?

(a) Cattle .....

(b) Goats .....

(c) Sheep .....

(d) Poultry .....

Appendix 1 (continued)

(e) Pigs .....

(f) Donkeys .....

(e) Others (specify) .....

(v) Methods of feeding livestock Free grazing .....

Zero grazing .....

(vi) Is there any problem of obtaining livestock feed Yes ..... No .....

(vii) List major livestock production problems .....

(viii) How do you solve the fodder/pasture problems .....

5. FOREST AND TREE ISSUES

(i) Have you planted trees? Yes ..... No .....

(a) If yes, since when (year) .....

(b) Why do you plant trees? .....

(ii) Do you plant trees on your farm? Yes ..... No .....

If no, why? .....

Appendix 1 (continued)

If yes, What species is and where is the farm?

(a) Along the farm boarder .....

(b) In specific sites .....

(c) In the reserved area .....

(iii) Where do you get seedlings?

(a) District council .....

(b) Project nursery .....

(c) Buying.....

(d) Wildlings .....

(e) Direct sowing .....

(f) Others (specify) .....

(iv) What are the main difficulties hindering tree planting in your area .....

(v) Do you buy seedlings? Yes ..... No ..... If yes, how much per seedlings per species .....

(vi) Could the benefits obtained from the forest/woodland be improved without destroying trees? Yes ..... No .....

(vii) If yes, in what ways .....

Appendix 1 (continued)

6 *MLIMBIKO* CONSERVATION SYSTEM

(i) Do you own *mlimbiko* Yes ..... No .....

(ii) What type of *mlimbiko* do you own

(a) Individual .....

(b) Member of communal *mlimbiko* .....

(c) Both .....

(d) None .....

(iii) Is there a need to improve the present *mlimbiko* management system

Yes ..... No .....

(iv) Is the *mlimbiko* system beneficial to you

Yes ..... No .....

B. Semi-structured Questionnaire

(i) What are main economic activities of the family?.....

(ii) How many land parcels do you own? .....

(iii) How far are those land parcels from your home ?..... km

Appendix 1 (continued)

(iv) What are the main difficulties hindering tree planting activities in your area .....

(v) What tree species are locally used for any purposes.....

(vi) What property rights do you have on these trees?.....

(vii) Are there any indigenous techniques used in this area to conserve tree/forest/woodlands Yes ..... No .....

If yes, give the name ..... and explain the technique .....

(viii) Give reason why you prefer to use any of the above mentioned technique .....

(ix) What has happened as a result of the forest projects?.....

(x) What has been provided to you by these projects?.....

Appendix 2

This part to completed by village leader

1. Name of the village .....

2. Human population in the village .....

   (a) Total population .....

   (b) Female .....

   (c) Male .....

   (d) Aged people (over 60 years).....

   (e) Children (below 16 years).....

   (f) Disabled people (i) male.....

   (ii) female.....

3. Number of Households in the village.....

4. Average size of household.....

5. Social service and infrastructure in the village

   (a) School .....

   (b) Dispensary/Hospital .....

   (c) Markets .....

   (d) Others .....

6. Source of water for the village .....

7. Main crops grown in the village .....

Appendix 2 (continued)

8 Energy sources for the households in the village

(a) Fuelwood .....

(b) Kerosine .....

(c) Electricity .....

(d) Cow dung .....

(e) Others .....

B. Semi-structured Questionnaire

1. What are the main economic activities of the village? .....

2. Where do the village obtain fuel wood ?.....

3. What type of environment problems are caused by the lack trees .....

4. How do Land management are carried in the village.....

5. Do you have any management techniques to conserve woodlands

Yes ..... No .....

If yes, is the technique traditional or introduced .....

6. What are these techniques

4