

**FACTORS INFLUENCING THE ADOPTION OF SOIL CONSERVATION  
MEASURES: A CASE STUDY IN GAIRO, KILOSA DISTRICT**

**BY**

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## **ABSTRACT**

Gairo division is a semi-arid area and like other semi-arid areas it faces the problem of land degradation. Because of this, Gairo Agroforestry and Land Use Project (GALUP) has been carrying out activities that aim at reversing the trend through recommending various soil conservation measures. The overall objective of the study was to examine factors that influence adoption of the recommended soil conservation measures in the division. The specific objectives were: (i) To determine the extent to which the smallholder farmers are aware of the problem of land degradation; (ii) To determine the extent to which smallholder farmers have adopted the different soil conservation measures; and (iii) To identify factors that influence the adoption of the soil conservation measures. Data were collected from 114 randomly selected households in purposively selected villages using a structured questionnaire. Descriptive and logistic regression analyses using Statistical Package for Social Sciences were employed as major tools of analysis to determine the major factors influencing adoption of soil conservation practices.


Results of the descriptive analysis suggest that adoption of the recommended soil conservation practices is influenced by education level, awareness of the land degradation problem, ownership of livestock, ownership of land, farm size and gender of the household head. Results of the logistic regression model show that adoption of the recommended

practices is influenced by awareness of the land degradation problems implying that extension education has an important role in this regard. The logistic regression model also show that ownership of land is an important factor influencing the adoption of contour ridges and farm yard manure. Existence of by-laws that restrict activities that degrade the environment and to have clear land use plans appear to be issues to be considered in enhancing the adoption of soil conservation practices.

It is recommended that efforts be increased in the area of extension education about soil conservation practices to both women and men. Also, there be emphasis on soil conservation practices that have broader benefits to the smallholder farmers to enhance widespread adoption.

**DECLARATION**

I, Haruni M. M. Kalineza, do hereby declare to the Senate of Sokoine University of Agriculture that the work presented here is my own creation, and has not been submitted for a degree award in any other university.

Signature.....

Date.....13/10/2000.....

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## **DEDICATION**

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## CHAPTER ONE

### 1.0 INTRODUCTION

#### 1.1 Background

There has been increasing awareness of the problem of land degradation during recent decades. Soil erosion now is considered to be widespread, causing substantial losses of the productivity and soil loss especially in the sub Saharan Africa. In these countries, the major cause of land degradation include population pressure, inappropriate farming practices, rampant deforestation and overgrazing of common land. There are many forms of land degradation, however, accelerated soil erosion by water and wind are the major degradation processes in Africa (Lundgren *et al.*, 1993). The degraded land in Tanzania is estimated by the United Nations to be 33-45 percent of the total area (United Republic of Tanzania, 1991 cited by Liwenga, 1995).

Since colonial period, a number of attempts by the government and farmers have been made to control soil erosion in rural areas. One account by Kauzeni *et al.* (1987) notes of the existence of traditional agricultural practices in the farming sytem of the Fipa, Kerewe, Matengo and Iraqw tribes that conserved the soil. These tribes developed soil conservation techniques as coping mechanisms against limited possibility of expanding their farms and grazing land due to various reasons like warfare (the

Matengo and Iraqw) and population pressure (the Kerewe). This was indeed the case for many other cultivators across Africa. Reij (1991) has documented more than 50 permanent farming systems with soil conserving practices in the African tropics.

The colonial rulers effort to conserve the soil started in 1909 when the government declared about 277 square kilometres on the Uluguru Mountains as a reserve forest (Temple, 1977a cited by Magayane, 1994). In the 1930s, the problem of soil erosion was not an issue limited to Uluguru mountains only, but to the entire territory of Tanganyika (Kauzeni *et al.*, 1987). Among the areas noted to have problems were also the drier parts of Ugogo, Unyaturu and South Eastern Usukuma (Gillman, 1930, cited by Kauzeni *et.al.*, 1987). In 1931, a committee on soil erosion under the chairmanship of the director of Amani Research Station estimated that about one thirtieth of the area of Tanganyika Territory was being threatened by soil erosion (Jacks and Whyte, 1939). Due to inadequate funds for large scale soil conservation work, the committee recommended the use of coercive measures and demonstration of methods and approaches of arresting soil erosion and increasing awareness among smallholder farmers.

The major soil conservation measures applied in the 1940s were ridges, contours, banking of cultivated land, gully control, rotational grazing and reforestation. During this period, several reasons contributed to the failure of

soil conservation measures. Firstly, the authorities capitalized on using rules towards them. Secondly, soil conservation activities were sometimes carried out as punishment for disobeying local chiefs or poll tax evasion. Thirdly, the colonial administrators did not appreciate the fact that some groups had adapted their own agricultural systems which controlled soil erosion (Mbegu and Mlenge, 1983 cited by Lundgren *et al.*, 1993; Reij, 1991). After independence, many soil conservation measures were abandoned. This led to serious land degradation processes reaching advanced stage in the first decade after independence (Kauzeni *et al.*, 1987). In the 1970s soil conservation resumed under the auspices of the government and international aid agencies (Lundgren *et al.*, 1993). Notable examples of these projects include Hifadhi Ardhi Dodoma (HADO) in Kondoa, Soil Erosion Control and Agroforestry Project (SECAP) in Lushoto, Hifadhi Mazingira (HIMA) in Iringa, Njombe and Makete districts, Hifadhi Ardhi Shinyanga (HASHI) in Shinyanga, Soil Conservation and Agroforestry Project Arusha (SCAPA) in Arusha, and Gairo Agroforestry and Land Use Project (GALUP) in Gairo.

This study is about the adoption of soil conservation measures in Gairo division. Expanding human and livestock populations in the division has led to needing more land for crop cultivation and animal grazing. The pressure on the land resource has resulted into land degradation, particularly soil erosion. Over the years there has been several attempts by the government

and other agencies to arrest the process of land degradation mainly through tree planting activities. However, experience gained with tree planting activities in the area over the years and from elsewhere, for example, Forest Trees and People Programme in Babati district, show that planting of trees alone is not effective in controlling land degradation (Lohay, 1998). It was in this line that the Gairo Agroforestry and Land Use Project (GALUP) undertook the approach of combining planting trees with other land resource management practices of conserving the soil. GALUP became operational in 1991 with funding from the Irish Government and operated under the Kilosa District Council. It was phased out in 1996 and its activities taken over by the Kilosa Environmental Project (KEP) which covers the entire district.

The adoption of soil conservation measures is seen as critical to the future of development of Gairo which is a semi arid area. Given the seriousness of soil erosion in the area and elsewhere in Tanzania, soil conservation strategies should aim at achieving widespread acceptance by the smallholder farmers. In this regard, there is an obvious need to understand the relative importance of factors which may influence an individual farmer's adoption of the conservation measures being promoted. The extent to which smallholder farmers in Gairo have adopted these conservation measures introduced by GALUP since 1991 is not known.

Although, some studies have been done on the issue of land degradation in

this area (Chamshama *et al.*, 1991; Kaihura, 1993), no comprehensive study has been done on factors that influence the adoption of soil conservation measures in the division. This study, therefore, aims at determining the extent to which farmers have adopted recommended conservation measures and identifying factors that influence the adoption of the soil conservation measures.

### **1.2 Significance of the Study**

Given the seriousness of soil erosion problems in Gairo and elsewhere in Tanzania, there is an obvious need of understanding the relative importance of factors that influence the adoption of soil conservation measures by smallholder farmers. Understanding these factors will contribute towards efforts directed at the twin goal of reversing the trend of land degradation and reducing poverty through increasing farm productivity among smallholder farmers.

### **1.3 Objectives of the Study**

#### **1.3 1 General objectives**

The overall objective of this study is to examine factors that influence the adoption of soil conservation measures in Gairo division.

### **1.3.2 Specific objectives**

The specific objectives of the study are:

- i) To determine the extent to which smallholder farmers are aware of the problems of land degradation.
- ii) To determine the extent to which smallholder farmers have adopted different soil conservation measures.
- iii) To identify factors that influence the adoption of the soil conservation measures.

## CHAPTER TWO

### 2.0 LITERATURE REVIEW

#### 2.1 Introduction

This chapter reviews literature concerning soil conservation. It has two main sections. The first section covers concepts of land degradation, soil erosion and soil conservation. The second section covers adoption and factors influencing adoption of soil conservation measures.

#### 2.2 The Concepts of Land Degradation, Soil Erosion and Soil Conservation

##### 2.2.1 Land degradation

Land degradation refers to all processes which ultimately lead to impoverishment of the production potential of the land. It is also regarded as a process which is a consequence of combined pressure of adverse, fluctuating climate and excessive over-exploitation by human beings (Lundgren, 1993). Of the two however, over-exploitation by human beings seem to be the main cause. The relative importance of causal factors and form of land degradation vary with the physical conditions, rainfall patterns, land use practices and place (Blackwell *et al.*, 1991).

Land degradation may take many forms. These include progressive decline in production, soil erosion, deforestation, increased runoff, reduced

percolation and less biological diversity through loss of species. In Tanzania, the degraded land is estimated by the United Nations to be 33–45 percent of the total area (United Republic of Tanzania, 1991 cited by Liwenga, 1995).

### **2.2.2 Soil erosion**

Soil erosion occurs when soil particles are detached from the ground and transported by water, wind and other forces. The eroded and transported material is deposited when flow of water diminishes or when wind speed is reduced. Although soil erosion is a natural process, it is greatly accelerated by human activities. On the other hand, nearly all agricultural operations tend to encourage soil erosion through vegetation clearing which exposes the soil, ploughing and tilling which disturb the soil (Hudson, 1981). Soil erosion reduces agricultural productivity of the soil through the removal of fertile top soil horizons in which crops obtain their nutrients. Also, it indirectly affects productivity through siltation and pollution of water resources useful for irrigation and other agriculture uses (Thadei *et al.*, 1998). In Tanzania, two agro-ecological zones are seriously affected by soil erosion. The first is steep cultivated mountain slopes with perennial streams and the second is the semi-arid savannah plains with long dry season, severe shortage of water and seasonal streams (Kayombo, 1992). Gairo division falls within the later agro-ecological zone.

### **2.2.3 Soil conservation**

Hudson (1981) defines soil conservation as all measures, practices, amendments and treatments involved in the use, development, reclamation, maintenance, improvement and productivity of the land resources. Soil conservation which pays attention to control soil erosion generally employs three major approaches: vegetative, mechanical and biophysical which is a combination of the two measures (Jasmin and Martin, 1984). Vegetative measures refers to the use of vegetation to provide cover to minimize acceleration of erosion. Mechanical measures are ground works and structures which include terraces, contour bunds, check dams, gabions that are intended to divert or reduce water flow. According to Kayombo (1992), the best way to control erosion is to keep land covered with vegetation. This is because, vegetation protects the soil from erosion by both rainfall and wind.

### **2.3 Factors Influencing Adoption of Soil Conservation Measures**

Feder *et al.* (1985) categorize four types of adoption. They first define adoption as the degree of use of a new technology in a long run equilibrium when the farmer has full information about the new technology. They make a distinction between this and aggregate adoption which is a process of spread or diffusion of a new technology within a region. They also define incidence adoption as the percentage of farmers using a specific technology at a specific point in time. They further define intensity of adoption as the

level of adoption of a given technology (for example, hectares of land applied with fertilizer) while the rate of adoption being the proportion of farmers who have adopted a new technology over time. This study considers adoption as the proportion of farmers who have adopted a new technology over time.

Many attempts to control land degradation in the past have been directed mainly at preventing soil loss by employing physical measures. These did not take into consideration the social, cultural and economic processes which are important to understand the peoples' behaviour towards change. According to Kelly (1982), what really gets in the way of effective soil conservation are the human institutions. The following section reviews literature about different factors that are important in influencing adoption of soil conservation measures.

### **2.3.1 Personal characteristics**

#### **2.3.1.1 Age**

Age and experience of the farmer is likely to have a range of influences on the household decisions in adoption. Old age may for example, influence the farmer in the direction of not adopting (Amir and Pannel, 1999). With regard to experience, Adesina and Baidu-Forson (1995) argue that older farmers may have more experience in cultivation and more able to assess the characteristics of a modern technology than young farmers, therefore they

will be in a better position of adopting. In their study Senkondo *et al.* (1998) found that farmers with more experience in farming were able to adopt rain water harvesting technologies compared to those with less experience. With regard to soil conservation practices whose benefits are accrued after a long period, Robberstad (1997) argues that old farmers are less likely to invest in soil conservation activities which are beyond their reasonable life expectancy. However, this can also be due to the fact that old people are generally conservative in character and can not be expected to match with young people in the process of agricultural transformation. Due to inconsistency of findings about the relationship between age and innovativeness, Adesina and Baidu-Forson (1995), concluded that there is no agreement in the adoption literature concerning the effect of age on adoption as of the effect of age on adoption tended to be location and technology specific.

### **2.3.1.2 Education**

Education is a tool that can make people manage resources properly including land. Through education, farmers may know the rationale for taking care of their environment from the point of view of their farming practices and other socioeconomic factors (Rutatora, 1993). The technical proficiency of the client and their perceived ability to undertake a change can define the extent to which various kinds of innovations can be considered for introduction (Croxtton and Appleton, 1984 cited by Steel, 1995). The

relationship between education level and attitude towards land degradation is an empirical question as it provides farmers with the necessary skills to establish and maintain investments in soil conservation. Some skills adoption however, are not necessarily perfectly correlated with years of schooling (Machumu, 1995). For example, Senkondo *et al.* (1998) found that adoption of rain water harvesting technologies in western Pare was not significantly explained by education but rather by other factors such as experience in farming and perceived technology characteristics.

#### **2.3.1.3 Awareness of the problem of soil degradation**

Farmers are not likely to engage in improved land management practices unless they become aware of the land degradation problem (Senkondo and Mwaseba, 1993; Kangalawe, 1995; Robberstad, 1997; Anim, 1999). Recognition of the existence of the soil erosion problem in itself however, does not guarantee the adoption of a particular technology but the technology advocated should be seen by the farmer to be economically profitable and also feasible in order for it to be adopted (Anim, 1999). According to Anim (1999), awareness of the land degradation and perception of the profits to be accrued out of the soil conservation practices are crucial factors for investments and adoption. This means that for soil conservation to be effective, efforts must be made to develop practices that not only conserve the soil but also provide short term, tangible benefits to the farmers (Sanders, 1990). That is introduced technologies should aim at

increasing yield, reduce risks and provide other direct benefits such as taking drudgery out of the farm. Feasibility of the technology relates to the technology to match with the farmers interests and priorities. In the semi-arid areas, for example, peak labour periods usually coincide with the time when soil conservation activities are required to be undertaken. In these situations soil erosion can not to be controlled because farmers at this time will be busy maximizing use of the rains for food production (Kajembe, 1994; Kangalawe, 1995).

Soil degradation in the farm is best indicated by decline in crop productivity and the appearance of rills which later develop into gullies in advanced stage (Kikula *et al.*, 1991). Assessment of these require good base line information which is lacking in most cases. This presents an obstacle to soil conservation work particularly in bringing out awareness about land degradation. Kikula *et al.* (1991) argue that presenting the problem of land degradation in a generalized way may have a negative implication when it comes to adoption of soil conservation measures. This is because farmers will not necessarily see erosion as pressing problem because they are normally not impressed by statistics about tons of soil being lost from the land as presented by scientists (Sanders, 1990). The author argues that based on local peoples' perception and knowledge it is possible to develop methods where farmers can identify symptoms of the problem of degradation and provide solution.

## **2.3.2 Socioeconomic characteristics**

### **2.3.2.1 Income**

Problems of poverty and environmental degradation in developing countries are closely linked. The majority of the poor live in rural areas and derive most of their income from soil and forest resources (Holden *et al.*, 1996). A farmer living in poverty can easily let the immediate need to produce food outweigh the long-term benefits of conserving his land (Livernash and Rodernburg, 1998). This means that poverty does not only cause land degradation but also land degradation results into poverty because farmers will progressively get less out of a degraded land.

Farmers with high income are more likely to be adopters of new practices than farmers with low income. This is because income increases the farmers ability to hire labour and meet costs associated with soil conservation work (Ryoba, 1996). High income also has a positive influence on the initial stages of trial of innovations as wealth allows the farmers to invest a relatively small proportion of their income to venture into an uncertain enterprise (Amir and Pannel, 1999). In his study, Gill (1995) reported that wealthier farmers adopted tree planting than poorer farmers because they could withstand the long term investment needed (in most cases 5-7 years) before one could start reaping the benefits associated with tree planting. In another study, Shivley (1999) found that high income was positively

correlated with adoption of hedgerows in the Philippines.

### **2.3.2.2 Population**

There are competing theories about the relationship between increasing population and pressure on natural resource, particularly land (Robberstad, 1997). According to Robberstad (1997), the most important ones are those by Malthus and Boserup. The view according to Malthus was that, land will deteriorate in quality as population expanded. He theorized that population growth would be ultimately constrained by amount of land available for production. According to this line of thinking high population growth exerts pressure on natural resources. This makes fallow periods reduced, traditional grazing systems meet with difficulties due to increasing livestock and competing with arable land thus affecting the availability of range land. In this way agricultural development is constrained by decreasing soil fertility and limited access to productivity enhancing technologies (Baidu-Forson, 1999). This scenario attests to most of the degradation processes that is observed today. Boserup (1966), on the other hand has argued that population pressure induces agriculture intensification, development of infrastructure and markets and technologies and/or institutional innovation. That is, continued population growth does not always lead into environmental degradation, instead it stimulates adoption of intensification technologies that meet the increased demands. The most cited example in this regard is Machakos district, a semi arid area in Kenya. In this district it

was found that despite the fact that the population had multiplied by five times over a period of over 60 years, agriculture productivity was sustained or in some case even increased due to intensification through improved land husbandry that incorporated soil conservation (Ekbon, 1991 cited in Lundgren, 1993).

#### **2.3.2.3 Land tenure**

Security of land tenure is often cited as a necessity for stimulating on farm investments and resource conservation. Security of land tenure affects farmers' planning horizons and confidence with which they can capture the long term benefits of investments in soil conservation (Cramb and Nelson, 1998; Shivley, 1999). Research has also shown that availability of security of tenure tend to increase adoption of land improvement technologies (Anim, 1999). Studies done in India by Kerr (1992) and Tanzania by Stahl (1991) and Loiske (1991) cited by Lundgren *et al.*, (1993) show that farmers cultivating on owned land were characterized by high investment in various aspects of soil conservation. Although investment in soil conservation has been found to be lower on rented land than on owned land, ambiguity can sometimes arise regarding the role of land tenure in influencing adoption. Shivley (1999), contends that while land security may be a precondition for investment in maintaining land productivity, in some settings, investments on land may actually help farmers to obtain *de facto* right over land. That is, agricultural investment such as soil conservation may be used as a way to

legitimize claim to land since local authorities tend to recognize traditional forms of land tenure when good land use practices are observed. However, Holden *et al.* (1996) argue that security of tenure is only a necessary but not sufficient condition for poor peasants to undertake conservation investments. Poverty and high rates of time preference may induce the farmers to degrade the environment even under conditions of secure rights to land.

In Tanzania, all land belong to the state under three main forms namely the right of occupancy, customary tenure and communal land tenure (Kauzeni *et al.*, 1993). The common practice, however, has been for a farmer to have the right to land that he has actively been cultivating. By tradition, grazing land and water holes have also been free for all to use (Christiansson *et al.*, 1993). In this case, if the community of users does not work out arrangements to respond to appropriate changes, destructive competition caused by free rider tendencies or conflicts may result into resource degradation what Hardin (1968) calls "tragedy of the commons".

#### **2.3.2.4 Size of the farm**

Land as a factor and store of wealth is the most important asset influencing adoption (Shivley, 1999). The farm size can have different effect on the rate of adoption depending on the characteristics of technology and situational setting. The relationship of farm size to adoption depends on such factors as fixed adoption costs, risk preferences, human capital, credit constraints,

labour requirements and tenure arrangements (Feder *et al.*, 1985). Larger farms are more likely to adopt new technologies because they can spread the costs over a wide range of outputs than it is possible for small farms (Hussain *et al.*, 1994 ; Shivley, 1999). Senkondo *et al.* (1998) found that farmers with large farms were able to adopt rain water harvesting technologies in their farms than those with small farms This was possible because the farmers were able to take risks of and experiment with the new technology. Shiferaw and Holden (1996) in their study in the Ethiopian highland found that farmers tended to keep in place soil conservation structures located in large farms than on small ones. Small farms typically rely on a single parcel of land to meet food and cash demands while large farms spread production over several parcels. In this regard, Shivley (1999) found that the opportunity cost of adopting hedgerows on any single parcel tended to be higher on small farms than on large ones. However, in other situations households with small farms may adopt soil conservation practices to prevent soil erosion from reducing the farm under demand for increased subsistence production (Anim, 1999).

#### **2.3.2.5 Labour for soil conservation work**

Labour requirements are widely regarded as critical element in influencing adoption of soil conservation measures because their applications are sometimes labour intensive. A farm with larger number of workers per hectare is more likely to be in a position to try and continue using a

potentially profitable innovations (Grepperud, 1995). In the Phillipine uplands, Cramb and Nelson (1998) found that farmers preferred hedgerow intercropping which required a relatively low labour input compared to structural soil conservation technologies such as terraces. In some instances, a system of food for work and use of machinery have been used to overcome the problem of labour shortage in soil conservation work. Mkunduge (1976) reported of the system of food for work to have been used in Gairo to plant trees, a move that aimed at conserving the environment during famine periods. Reij (1991), however, criticizes this system pointing out that it has been used indiscriminately and as a result it has contributed to the failure of many soil conservation works in Africa.

#### **2.3.2.6 Division of labour according to gender**

The importance of women in agriculture in developing countries is widely acknowledged. Women provide a significance labour (both family and hired) for farm activities (Adesina and Djato, 1997). In Tanzania, it is estimated that about 70% of the food is produced by women (URT, 1997). This is in addition to domestic works which are generally considered to be women's tasks. Implication for this is that where soil conservation involve a lot of work, women may fail to find the extra labour needed to do such activities. Women also play a major role in farm level decision making either as farm managers managing their own fields or as 'effective decision makers' even in households in which the household head is a male, either because of the

specific skills or when the husband is absent for longer periods (Adesina and Djato, 1997). Despite their importance, women farmers face constraints to their productivity arising from limited access to extension services, capital markets and decisions to adopt new technologies. In the conditions of subsistence agricultural production, household decision making is probably authoritarian (Pareena *et al.*, 1999). This implies that decisions that are made within the households and other settings may be by-passing the interests and priorities of women. In the Hifadhi Ardhi Dodoma (HADO) project, Tibaijuka (1987) noted that the decision of closing of large tracts of land to allow vegetation to regenerate had to force women to walk greater distances to get firewood. She, therefore, underscored the need for a closer look at intra household variables such as gender for soil conservation activities.

#### **2.3.2.7 Culture**

Peoples' knowledge and understanding of things are influenced by their culture (Steel, 1995). That is cultural rules and norms are important as part of the institutions which are frameworks essential for a society to function well (Holden, 1996). This is important when it comes to teaching of agricultural practices, particularly soil conservation. This implies that social values and beliefs have to be taken into consideration for any soil conservation measures to be introduced. In Sukumaland, Kikula *et al.* (1991) reported that tree and grass planting was rejected because it was thought

that they would bring back tsetse flies and ticks. He also reported of destocking being rejected because it was against the Sukuma's high regard placed on large herds of cattle. The other example is the rejection of bench terraces in favour of the local practice of making ladder terraces by the Lugurus in 1950s (Reij, 1991). It is also important to note that household decisions concerning various aspects of culture and behaviour are not static but they are expected to evolve with technological change and changing opportunity and social norms (Pareena *et al.*, 1999).

### **2.3.3 Institutional factors**

These are derived from those publicly operated systems for providing services to the farmers. These include institutions such as research and extension and those dealing with credit and marketing (Machumu, 1995). Rejection or acceptance of a new idea largely depend on how the information is relayed from the source which is mainly the extension service. However, the process of transmitting technology has tended to be bureaucratic, hierarchical and communication is always downwards thus hampering upward feedback from the farmers (Mlozi and Mvena, 1990). Agricultural production is carried out by smallholder farmers who are in most cases resource poor. In this situation they will tend to avoid risks associated with credits which could otherwise improve their investments to produce more (Holden *et al.*, 1996). Minde (1990) writing on credit commented that the perpetual low marginal and the inability to qualify for credit by the lending

institutions lead to a cyclic problem of lack of capital for farm investment by the smallholder farmers. On part of the markets, many of the markets in the third world countries tend to be missing and imperfect. This cause price distortions which make farmers misuse or degrade land resources through improper farming practices (Holden and Sankhayan, 1997).

#### 2.3.4 Policy factors

Poorly conceived national policies may contribute to environmental problems (Mwalyosi and Mohamed, 1996). Majority of countries have little in the way of soil conservation policy and strategies and instead rely on short term programmes and projects to deal with land degradation problems when they occur and when funds permit (Sanders, 1990). In Tanzania, different sector policies on natural resources have resulted into sectoral biases leading into contradictions among policies (Christiansson *et al.*, 1995; De Pauw, 1995). The most notable policy was the Arusha Declaration of 1967 which was regarded as the beginning of radical departure of land use policy in Tanzania (Warner, 1993). In the years which followed the Arusha Declaration, for example, villagisation was heralded as one of the means to transform the nation to development. However, the sites of these villages were based on being near to the roads and the existence of sufficient land for 300 or more families. The criteria for number of families was not based on environmental or agricultural land but on the number of children needed to maintain an elementary school. Christiansson *et al.* (1995) argue for a natural resource

policy that will minimize conflicts and overlap of activities. The challenge however, is that it is not easy to find the right mix of policies to sustain agricultural development (Robberstad, 1997).

### **2.3.5 Technology characteristics**

A given agricultural technology embodies a number of important characteristics that may influence adoption decision. The observed adoption choice on agricultural technology is hypothesized to be the end result of a complex set of inter technology preference comparison made by the farmers (Adesina and Baidu-Forson, 1995). Farmers therefore make decisions to adopt technologies based upon utility consideration. They will adopt new technology if the utility exceeds utility of the old one. Adesina and Baidu-Forson (1995) found that varietal characteristics of rice and sorghum were important to influence their adoption in west Africa. Senkondo *et al.* (1998) reported that perceived technology characteristics of rain water harvesting technologies in increasing yield positively influenced their adoption in western Pare, Tanzania. Batz *et al.* (1999) and Kaliba *et al.* (1997) have underscored the need of considering the technology characteristics influencing adoption in a situation where the sample is relatively homogeneous with respect to farm characteristics and if the farmers are also working under comparable farming circumstances. According to Batz *et al.* (1999), five major types of technology characteristics that influence adoption are relative profitability, relative risk initial cost, relative investment index and

relative complexity.

#### **2.3.5.1 Relative profitability**

This is the partial effect of the technology on the farm profitability. Farmers will adopt technologies that give high returns to investment relative to the current technology in use. Relative profitability may be reflected in reduced labour costs or increased productivity caused by the new technology.

#### **2.3.5.2 Relative risk**

This is the partial effect of the technology on the farm profitability. Some technology can be assumed to have high risk reduction effect in a high risk environment whereas other technologies may have no effect or even increase it. Technologies with a high risk reducing effect will be adopted faster than low risk reduction technologies.

#### **2.3.5.3 Initial cost**

This refers to the initial cost of buying the smallest unit of the technology. Initial cost determines the decision to adopt a technology especially to resource poor smallholder farmers. This means that, if the farmers are resource poor and access to capital is limited, profitable technologies might not be adopted if they require a big capital outlay.

#### **2.3.5.4 Relative investment index**

This refers to cost of purchase of the smallest unit of technology divided by its partial effect on the farm profitability. An initial high relative investment index means that initial costs are high compared to the additional profits that can be obtained and vice versa. A technology with high relative investment index will be adopted slowly than a technology with a low relative investment index.

#### **2.3.5.5 Relative complexity**

This is the number of activities needed to be done to adopt and use the new technology compared to the old technology. Complexity is high when the farmer has to carry out many activities to establish and run a technology. A technology with high relative complexity is adopted and/or diffuses slowly than that with low complexity.

## CHAPTER THREE

### 3.0 METHODOLOGY

#### 3.1 Introduction

This chapter covers methodology used in this research and has five sections. The first section offers description of the study area with regard to location and population of both humans and livestock. The second section covers the research design used while the third section is about sampling procedure used. Section four covers methods of data collection and sources. The last section is about the type of analyses done on the collected data.

#### 3.2 The Study Area

The study was conducted in Gairo division. Gairo division is one of the nine divisions in Kilosa district. Other divisions in the district are Kimamba, Magole, Nongwe, Mikumi, Masanze, Ulaya, Kidete and Kilosa. Administratively, Gairo division consists of four wards, namely Gairo, Rubeho, Chakwale and Iyogwe. The division is situated in the north of Kilosa district, Morogoro region. It lies between latitudes of 6°-6°3'S and longitudes of 36°-37°8'E. The altitude of the division ranges from 1076 to 1631 metres above sea level.

The division experiences a unimodal type of rainfall characterized by unreliable and varying distribution pattern. The mean annual rainfall ranges

between 600 to 800 mm with an average of 700 mm. It has an area of about 517 square kilometres and according to KDC (1997) the human population was estimated to be 92 541 in 1997. The division is said to be the most populous within the district. The main activities within the division are crop cultivation and livestock keeping. In 1997, livestock population was about 187 051 cattle, 72 263 goats, 8 652 sheep, 1 848 pigs and 710 donkeys, and is said to be the highest in the district (KDC, 1997).

Gairo division was chosen for this study because of the following reasons:

- i) The division is facing a threat of land degradation caused by intense land use competition between crop cultivation and livestock grazing.
- ii) There has been efforts of trying to arrest the problem of land degradation.

### **3.3 Research Design**

Cross sectional research design employing a survey was used. The survey was conducted from March to May, 1999. This type of research design involves data collection at one point in time from the sample to describe the population at that particular time. The population of the study consisted of all farmers in Gairo division who were involved with GALUP activities. Further information was collected from leaders at the division/ward headquarters and respective villages.

### **3.4 Sampling Procedure**

Purposive sampling was used to select four villages out of 27 villages in the division. The villages selected were, Msingisi, Kwipipa, Rubeho, and Kisitwi. Selection took into consideration the fact that GALUP has carried out substantial work on soil conservation in these villages. A total of 30 heads of households per village were randomly selected using a table of random numbers. Thirty heads of households for each village was considered enough for the planned analysis of the data to be collected. Separate lists of men and women were used in order to get adequate number of both sex categories (15 heads of households for each sex category). The procedure used was such that a list of names of the farmers were obtained from the village register. Respondents were selected by matching their numbers in the register with the first three numbers in the table of random numbers. The lists of names of male and female household heads in respective villages constituted the sampling frame while the unit of analysis was the individual household.

### **3.5 Data Collection**

Data were collected through personal interviews using a structured questionnaire (Appendix 1). The questionnaire was written in English and administered to the respondents in Kiswahili. The interviews were conducted at the respondents' residences after making prior arrangements through village leadership, a day before the interview date. Despite of the efforts

made in making prior arrangements to meet the farmers, only 114 respondents turned out to be interviewed out of the total planned sample of 120 respondents (i.e. 30 respondents per village). This was a response rate of 95 percent. Semi structured interviews with key informants at the village, ward and division level were used to get information related with soil conservation activities (Appendix 2). Other primary data were collected through field observations in the study villages.

### **3.6 Data Analysis**

Both descriptive and regression analyses were carried out using the Statistical Package for Social Science (SPSS/PC +) to find out positive relationship between the factors and the recommended practices. The descriptive analyses were done as a first step towards determining individual factors that influence the adoption of soil conservation practices. Further analysis was carried out using a logistic regression model, to see the influence of several factors on the adoption of soil conservation practices.

#### **3.6.1 Descriptive analysis**

Descriptive statistics were used to get frequency counts of various coded qualitative responses and to compare means of quantitative responses. Crosstabs were used to get joint frequency distribution of cases as defined by categories of variables. Chi-square tests were carried out to test the influence of individual factors on adoption of the different soil conservation

practices. The factors investigated were age, education level, availability of labour for soil conservation work (number of adults able to work), awareness of land degradation problem (extension education), ownership of livestock, ownership of land, farm size and gender.

### 3.6.2 Regression analysis

After the descriptive analysis it was decided to run the logistic regression model in order to determine the combined effect of the factors on adoption of soil conservation practices. The factors investigated included age, level of education, availability of labour for soil conservation work (number of adults able to work), farm size, awareness of land degradation problem (extension education), ownership of land, and number of cattle owned. The estimated logistic regression model is expressed as follows:

$$\ln (P/(1-P)) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + e$$

Where:

$X_1$  = Age of household head (years)

$X_2$  = Level of formal education of household head (years)

$X_3$  = Number of adults in the household available for farm work

$X_4$  = Farm size (acres)

$X_5$  = Extension education, dummy variable

$X_6$  = Ownership of land, dummy variable

$X_7$  = Number of cattle owned

$e$  = Disturbance term

$\beta_i$  = Coefficients of the independent variables in the adoption equation.

The dependent variable is the natural log of the probability of adopting a soil conservation measure (P) divided by the probability of not adopting (1-P). The dependent variable takes the value 1 for adopting and 0 for not adopting. The model was estimated for three most common soil conservation practices recommended by GALUP: contour ridges, tree planting and use of farm yard manure. These three soil conservation practices were separately used as dependent variables. The first seven independent variables were included in all three adoption equations but the eighth variable, number of cattle owned was only included in the use of manure adoption equation.

## CHAPTER FOUR

### 4.0 RESULTS AND DISCUSSION

#### 4.1 Introduction

This chapter is divided into eight sections. The first section discusses general characteristics of the sampled households such as age, education, household size and structure. The second section deals with issues of land availability, land use, land ownership, farm size, crops grown and cropping patterns, method of land preparation, topography, livestock production and sources of income of the respondents. Issues about the awareness of the land degradation problems by the respondents are discussed in the third section. The fourth section discusses the extent of adoption of soil conservation measures while the fifth section looks at the sources of knowledge on soil conservation practices. By-laws concerning land degradation are discussed in section six. Section seven discusses investment priorities of the sampled farmers. The chapter winds up on the discussion of results of descriptive and logistic regression models.

#### 4.2 Household Characteristics

The following section discusses the household characteristics of the sampled farmers. It is important to understand these characteristics because they may influence adoption of soil conservation practices. The characteristics which were examined in the study were age, education and

household size as described below.

#### 4.2.1 Age

Results show that age of the household heads ranged from 18 to 76 years with a mean of 41.5 years. Male headed households had a mean of 42.6 years while that for female headed households was 39.5 years. The mean ages were not significant different (at  $p < 0.05$ ). Table 1 shows that over half of the respondents (66 or 57.8%), were adults, that is in the age category of 36 to 64 years followed by youth (41 or 36.0%) in the age range of 18 to 35 years. The rest (7 or 6.1%) were elders in the age range of 65 to 76 years.

Table: 1 Age of the household heads (N=114)

Age (years)	Male headed households (n=71)		Female headed households (n=43)		Total (n=114)	
	n	%	n	%	n	%
Below 35	26	36.6	15	34.8	41	36.0
Between 35-65	40	56.3	26	60.5	66	57.8
Above 65	5	7.0	2	4.6	7	6.1

#### 4.2.2 Education

Table 2 shows that most respondents (89 or 78.1%) were literate with four to 12 years of schooling. The mean year of formal schooling for the sample was 4.3 years. Male respondents had an average of 4.6 years of formal schooling while female respondents had an average of 3.8 years formal of schooling. The mean years of schooling for male and female headed households were not statistically significant at  $p < 0.05$ . Female respondents

with no formal education were 13 or 30.2% while male respondents were 12 or 16.9%. Few respondents (25 or 21.9%) had not attended formal education. Only one female respondent reported to have reached post primary education. It can be said that most of the sampled farmers (89 or 78.1%) were able to read and write which was good for adoption of improved agricultural practices.

**Table: 2 Education level of the household heads (N=114)**

Level of education	Male headed households (n=71)		Female headed households (n=43)		Total (N=114)	
	n	%	n	%	n	%
No formal education	12	16.9	13	30.2	25	21.9
Primary education	59	83.1	29	67.4	88	77.2
Secondary education	0	0.0	1	2.3	1	0.9

#### 4.2.3 Household size and structure

The sampled households had a mean size of 6.4 persons. This family size is relatively higher compared to the national household size which stands at 5.1 in rural areas (National Bureau of Statistics, 1997). The mean number of family members for male headed households was significantly bigger than that for female headed households ( $t=2.9$ ,  $p<0.05$ ). Also, male headed households had significant bigger mean number of family members who were able to work than female headed households ( $t=2.92$ ,  $p<0.05$ ). Less than half (53 or 46.6%) of the household members in the sample were able to work. Table 3 shows the household size and structure.

**Table: 3 Household size and structure (N=114)**

Household size	Male headed households (n=71)	Female headed households (n=43)	Total (N=114)
Mean size of the households	7.0	5.4	6.4
Standard deviation	3.1	2.3	2.9
Minimum	1	1	1
Maximum	17	13	17
Mean number of members able to work	3.3	2.4	3.0

### 4.3 Land Ownership, Availability and Use

#### 4.3.1 Land ownership

Table 4 shows that 71 or 64.0% of respondents cultivated owned land acquired through various means such as buying and inheriting. Thirty seven or 32.5% of the respondents cultivated land which was rented from others or obtained it through other means such as being given on trust by relatives or friends. Only four or 3.5% cultivated land which they rented. In many countries customary practices do not allow women to own land. Results in Table 4 show that a higher percentage of women (29 or 67.4%) were found to own land compared to men (44 or 61.9%). The reason could be that the sampled population was a matrilineal society in which case kinship inheritance could have favoured women. The other reason is that the sampled women were all household heads, a situation which made them stand a good chance of owning land, particularly those who were widowed. Bruce (1989), noted that widowhood is probably the most significant life cycle event in terms of security of property rights.

**Table: 4 Respondents' type of land ownership (N=114)**

Type of ownership	Male headed households (n=71)		Female headed households (n=43)		Total (N=114)	
	n	%	n	%	n	%
Owned	44	61.9	29	67.4	73	64.0
Rented	2	2.8	2	4.6	4	3.5
Other	25	35.2	12	27.9	27	23.6
<b>Total</b>	<b>71</b>	<b>100.0</b>	<b>43</b>	<b>100.0</b>	<b>114</b>	<b>100.0</b>

#### 4.3.2 Farm size

Farm size is important as it may dictate the type of soil conservation and the extent of implementation. Table 5 shows that average farm size per households ranged from 0.5 to 17.5 hectares. The average land holding per person was found to be 3.0 hectares, but half of the respondents owned less than this. On average, male headed households owned significant bigger farms than female headed households ( $t=4.3$ ,  $p<0.05$ ). This average of 3.0 hectares owned by the respondents in the study area was slightly higher than the national average of 2.0 hectares owned by 93 percent of smallholder farmers in Tanzania (Ministry of Agriculture and Food and Agriculture Organization, 1995). However, this amount was said to be insufficient to meet cash and food production for most farmers. Discussions with some farmers revealed that production per hectare for maize stood at 1.2 tons. Because of this low production level, most respondents (110 or 96.5%) expressed the desire to expand their farms in order to make up for the production deficit. Most farmers said that they usually went out to neighbouring villages in Kiteto and Mpwapwa districts to rent land. In these areas land was said to be relatively abundant and fertile.

Because of the increased human and livestock populations, more land has been put under cultivation and livestock grazing. The result is that areas under fallow have been reduced. Table 5 shows that the total area under fallow for the sampled farmers was 57.9 hectares only. The fallows had an average size of 0.5 ha and a mean duration of 0.5 years. Based on this, it seemed that the possible option to increase production per hectare would be to improve the existing land holdings through carrying out soil conservation measures.

**Table: 5 Respondents' farm size per household (N=114)**

Farm size(ha)	Male headed households (n=71)	Female headed households (n=43)	Total (N=114)
Mean	3.7	1.8	3.0
Minimum	0.8	0.4	0.4
Maximum	17.5	5.8	17.5
Std deviation	6.5	2.4	5.8
Area under fallow(ha)			
Maximum	10.8	1.3	10.8
Mean ✓	2.2	0.8	1.2
Std deviation	4.2	0.8	3.4
Duration of fallows (yrs)			
Maximum	10	5	10
Mean	0.6	0.3	0.5
Std deviation	0.6	0.3	1.3

#### 4.3.3 Crops grown and cropping patterns

Most respondents (82 or 71.9%) monocropped in their farms, while 26 or 22.8% of them intercropped and only 6 or 5.3% relay cropped. Those who did not intercrop cited lack of appropriate seed as the reason for not intercropping. Major crops grown were maize, sorghum, millet, sunflower, ground nuts, sweet potatoes, bambara nuts and sweet potatoes (Table 6).

Table: 6 Distribution of respondents by cropping pattern (N=114)

Cropping pattern	Male headed		Female headed		Total	
	households (n=71)		households (n=43)		(N=114)	
	n	%	n	%	n	%
Monocropping	48	67.6	34	79.1	82	71.9
Intercropping	19	26.8	7	16.3	26	22.8
Relay cropping	4	5.6	2	4.6	6	5.3
Total	71	100.0	43	100.0	114	100.0

#### 4.3.4 Methods of land preparation

Less than half of the respondents (52 or 45.6%) reported using the hand hoe as a tool to prepare their land. Others, 42 or 36.8% reported using the hand hoe/ox-plough, 12 or 10.5% reported using ox-plough to prepare their land. The use of tractor was reported by only two or 7% of the respondents. This implied that there was low <sup>improved</sup> use of equipment in land preparation (Table 7).

Table: 7 Respondents' methods of land preparation (N=114)

Land preparation	Male headed		Female headed		Total	
	households (n=71)		households (n=43)		(N=114)	
	n	%	n	%	n	%
Hand hoe	29	40.8	23	53.4	52	45.6
Oxen	8	11.3	4	9.3	12	10.5
Tractor	2	2.8	0	0.0	2	1.7
Hand hoe/tractor	1	1.4	1	2.3	2	1.7
Hand hoe/oxen	27	38.0	15	34.8	42	36.8
Tractor/oxen	1	1.4	0	0.0	1	0.9
Tractor/hand hoe/oxen	3	4.2	0	0.0	3	2.6
Total	71	100.0	43	100.0	114	100.0

#### 4.3.5 Topography

Table 8 shows the location of the respondents' farms with regard to topography. Most respondents (85 or 74.5%) had their farms located on a

flat land. Those who had their farms located on medium hilly and flat land constituted 25 or 21.9% of the interviewees. Four or 3.5% respondents had their farms located on medium hilly areas.

Table: 8 Distribution of respondents' farms by topography (N=114)

Topography	Male headed households (n=71)		Female headed households (n=43)		Total N=114	
	n	%	n	%	n	%
Flat land	50	70.4	35	81.4	85	74.5
Medium hilly	3	4.2	1	2.3	4	3.5
Flat and medium hilly	18	25	7	16.3	25	21.9
Total	71	100.0	43	100.0	114	100.0

#### 4.3.6 Livestock production

Livestock keeping is an important activity in Gairo. Forty one or 36% of the respondents kept some livestock (cattle, sheep and goats) while 30 or 26.3% kept cattle only. Of the 30 respondents who kept cattle, only 5 were female headed households. The mean number of cattle and small stock (sheep and goats ) per households for the sample was 2.3 and 1.9 respectively (Table 9). The mean number of cattle owned by male headed households was significantly higher than those owned by female headed households ( $t=2.7$ ,  $p<0.05$ ). Livestock was culturally mens' property and partly explained the situation of few females owning livestock. Findings show that, herd size for cattle ranged from 1 to 40 animals with a mean of 8.9 animals per household. An earlier survey done by Sokoine University of Agriculture and Ministry of Agriculture in 1998 found that the herd size ranged from 3 to 100 animals at Msingisi village. Livestock were mostly kept

on free range system.

**Table: 9 Respondents' cattle herd size per household (N=114)**

Herd size	Male headed households (n=71)	Female headed households (n=43)	Total N=114
Mean	3.4	0.5	2.3
Minimum	1	1	1
Maximum	40	10	40
Std deviation	6.8	1.8	5.6
Percent keeping cattle	35.2	11.6	26.3

Of the thirty the respondents who kept cattle, thirteen or 43.3% of them said that they kept cattle to meet cash and food demands, while two or 6.7% said that they kept them for traction purposes. These were all male headed households. Fifteen or 50.0% said that they kept cattle for mixed purposes that is to get food, earn cash and for traction (Table 10). Other mentioned uses included to pay dowry and for security. Regardless of the purposes for which cattle were kept, most of the interviewees who kept cattle (26 or 87.8%) showed the desire to increase their herd sizes.

**Table: 10 Distribution of cattle keepers by purpose (N=30)**

Purpose	Male headed households (n=25)		Female headed households (n=5)		Total (N=30)	
	n	%	n	%	n	%
Cash/food	10	40	3	60.0	13	43.3
Traction	2	8	0	0.0	2	6.7
Cash/food/traction	13	52	2	40.0	15	50.0
Total	25	100.0	5	100.0	30	100.0

#### 4.3.7 Village sources of income for the 1997/98 season

Table 11 shows various on-farm and off-farm sources of income for the study area. Sixty four or 56.1% of the interviewees got income from petty trading with a mean of Tsh 101 573.7 (mainly trading grains, shop keeping, food vending, selling vegetables and local brews), followed by 54 or 47.4% who got income from selling crops, with a mean of Tsh 31 295.2 (mainly maize, sunflower and beans). Male headed households obtained significant higher mean income from sale of crops than female headed households ( $t=2.5$ ,  $p<0.05$ ), possibly because they had bigger farm plots in which they got higher yields and a portion was sold. Others, 30 or 22.8% got income from selling livestock (mainly cattle, sheep and goats).and the mean was Tsh 19 864.0. Other sources of income for the interviewees were employment (11 or 9.9%) with a mean of Tsh 9 182.8 and selling of forest mainly honey, fuelwood and building poles. (4 or 3.5%) with a mean of Tsh 989.5. A small proportion of the respondents to get little income from selling crops could be due to most farmers harvesting little crops in the 1997/98 season because of too much rains.

**Table: 11 Respondents' sources of income for the year 1997/1998**

Sources of income	Petty Trading	Sale of crops	Sale of livestock	Employed	Forestry products
Percent of females*(n=43)	65.1	27.9	18.6	9.3	0.0
Minimum (Tsh)	8 000	6 000	4 000	2 000	-
Maximum (Tsh)	741 000	9 000	480 000	120 000	-
Mean (Tsh)	64 606.9	10,327.9	18 953.4	5 348.8	-
Percent of males*(n=71)	50.7	57.7	25.4	9.8	5.6
Minimum (Tsh)	2 800	3 000	1 000	15 000	1 200
Maximum (Tsh)	355 2500	522 500	560 000	240 000	57 600
Mean(Tsh)	123 961.9	43 935.9	20 415.4	11 504.7	1 588.7
Percent total*(N=114)	56.1	47.4	22.8	9.6	3.5
Minimum (Tsh)	2 800	3 000	1 000	15000	1 200
Maximum (Tsh)	3 552 500	522 500	560 000	240 000	57 600
Mean (Tsh)	101 573.7	31 259.2	19 864.0	9 182.8	989.5

\*Households had more than one source of income.

#### **4.4 Awareness of the Cropping and Livestock Keeping Systems that Caused Land Degradation**

##### **4.4.1 Cropping system and land degradation**

Most respondents, (92 or 80.7%) were able to associate the type of cropping system they used with the observed land degradation in their farms (Table 12). This was the case because of the continuous cropping without leaving the farms on fallow and without replenishing nutrients to the soil. Farmers awareness of the problem of land degradation has been reported elsewhere by other researchers (Senkondo and Mwaseba, 1993; Kangalawe, 1995) as it influences decisions related to investments in soil conservation practices.

##### **4.4.2 Livestock keeping and land degradation**

The system of keeping livestock in Gairo is by using extensive system. This involves livestock grazing on natural pastures and on crop residues in-situ

when crops have been harvested. When these feed sources are finished, particularly during the dry season, the land becomes bare. During this time, land compaction and soil erosion through wind and water sets in resulting into land degradation. Land degradation through improper livestock keeping system is of importance in Gairo due to the large number of livestock found in the division. Of the 41 interviewees with livestock, 34 or 82.9% of them were able to associate their livestock keeping system with the observed land degradation in their farms and in grazing fields (Table 12).

Table: 12 Respondents' opinions whether crop/livestock production systems degraded the environment

Cause land degradation	Livestock (n=41)		Cropping system (n=114)	
	n	%	n	%
Yes	34	82.9	92	80.7
No	7	17.1	22	19.2
Total	41	100.0	114	100.0

#### 4.5 Adoption of Soil Conservation Measures

##### 4.5.1 Farmers practising soil conservation practices

Important practices that were recommended by GALUP included tree planting, contour ridges on steep slopes, use of farmyard manure (FYM), and demarcating areas for village forest reserves. Results in Table 13 show that Ninety three or 81.6% of the sampled farmers reported to conserve their land holding using one of the practices recommended by GALUP. The remaining 21 or 18.4% interviewees mentioned to use no soil conservation measures in their land holdings. Higher proportions of male headed households (65 or 91.5%) practised soil conservation practices in their farms than female

headed households.

**Table: 13 Respondents' opinions about practising soil conservation (N=114)**

Practice soil conservation	Male headed household (n=71)		Female headed households (n=43)		Total (N=114)	
	n	%	n	%	n	%
Yes	65	91.5	28	65.1	93	81.6
No	6	8.5	15	34.9	21	18.4
Total	71	100.0	43	100.0	114	100.0

Where technically possible, farmers will make investment in soil conservation in a stepwise manner in order to reduce the initial investment and at the same time postpone the cost to the future (Kerr and Sanghi, 1992). This implies that farmers will apply soil conservation measures to only part of their farm plots or few of the several farm plots they owned. Results show that of the 93 respondents who practised soil conservation measures, only 12 or 12.9% of them applied soil conservation practices in all of their farm plots while the remaining 81 or 87.1% applied to a few farm plots. Farmers gave the reasons for doing this as follows. Firstly, 32 or 39.5% of farmers practising soil conservation practices said that it was due to the fear of livestock damaging the constructed soil conservation structures which would make their effort useless. Secondly, 19 or 23.4% of those farmers said that they had little time, labour and money to make soil conservation structures. Thirdly, 25 or 30.8% of those farmers said that soils were of poor quality to warrant the cost of making soil conservation measures and that they rented the land to others. Fourthly, 5 or 6.2% of those farmers said that they did not carry out soil conservation measures because they did not own the land (Table 14).

Table: 14 Respondents' reasons for conserving few of their farm plots (N=81)

Reason	Male headed Households (n=49)		Female headed households (n=32)		Total (N=81)	
	N	%	n	%	n	%
Limited time and labour	10	20.4	9	28.1	19	23.4
Land not mine	3	6.1	2	6.2	5	6.2
Can't safeguard livestock	22	44.9	10	31.5	32	39.5
Other reasons	14	28.5	11	34.3	25	30.8
Total	49	100.0	32	100.0	81	100.0

#### 4.5.1.1 Tree planting

Tree planting was the most popular soil conservation practice adopted by farmers in the study area. Farmers planted trees in different agroforestry practices and as woodlots. With regard to type of trees planted, 79 or 84.9% of the respondents said that they planted exotic trees and only four or 2.1% had planted indigenous trees. Observations showed that most the indigenous trees were planted near homesteads and in fields surrounding homes (Table 15). A mixture of exotic and indigenous trees were planted by 12 or 12.9% respondents. Exotic tree species were preferred because of their rapid growth rate and easy availability of seeds and seedlings.

Table: 15 Respondents' opinions by type of tree planted (N=93)

Type of tree	Male headed households (n=63)		Female headed households (n=30)		Total (N=93)	
	n	%	n	%	n	%
Exotic	54	85.7	25	83.3	79	84.9
Indigenous	1	1.6	1	3.3	2	2.1
Indigenous/exotic	8	12.7	4	13.3	12	12.9
Total	63	100.0	30	100.0	93	100.0

Reasons for planting trees varied among the respondents. However, it was

noted that for the most part, trees were planted to meet multiple purposes of conserving the soil, making boundaries of their land, getting firewood and to get building poles. Over half of the respondents, (55 or 59.1%) said that they planted trees to get woodfuel and building poles, and 29 or 31.2% of them said that they planted trees to conserve the soil. Only 9 or 9.7% of the interviewees said that they planted trees for shade and aesthetic purposes (Table 16).

**Table: 16 Respondents' opinions about purposes of planting trees (N=93)**

Purpose	Male headed Household (n=63)		Female headed household (n=30)		Total (N=93)	
	N	%	n	%	n	%
	Woodfuel/building poles	31	50.8	24	80.0	55
Conserve soil/delineate land	25	39.6	4	13.3	29	31.2
Shade/ornamental	7	11.1	2	6.7	9	9.7
Total	63	100.0	30	100.0	93	100.0

During the Gairo Agroforestry and Land Use Project (GALUP), villagers obtained tree seedlings from its central and community nurseries. The community nurseries were managed by groups, schools and individuals. Seedlings were bought back by GALUP at ten shillings per potted seedling and then distributed free of charge to the villagers to plant. However, after the pull out of GALUP, the study found that farmers in Rubeho and Msingisi villages complained of not having a buyer of their seedlings and hence sustaining a loss during the 1998/99 season. Substantial number of over grown tree seedlings were also observed in Kwipipa village. In 1998/99 season, each multipurpose tree seedling and fruit tree was selling at twenty

and fifty Tanzanian shillings respectively. Discussion with some farmers revealed that they failed to buy the seedlings because they were expensive.

#### a) Agroforestry practices

GALUP recommended simple practices such as planting of trees to mark farm boundaries, on field crops, as live fences around farms and around homesteads, Table 17 summarises adoption rates for the different agroforestry practices.

Table: 17. Respondents' opinions about practising agroforestry practices (N=114)

Agroforestry practice	Male headed households (n=71)		Female headed households (n=43)		Total (N=114)	
	n	%	n	%	n	%
Trees on cropland	4	5.6	2	4.6	6	5.3
Trees as live fence	15	21.1	5	11.6	20	17.5
Trees on boundaries	24	33.8	4	9.3	28	24.6
Home gardens	42	59.1	21	48.8	63	55.3

Trees on cropland serve the purpose of providing valuable tree products and improving soil and water retention. Table 17 shows that only few respondents (six or 5.3 %) planted trees on crop fields. The small percentage of farmers planting trees on cropland under semi-arid condition is similar to the results reported by Budelman (1994). Budelman (1994) observed that under semi-arid conditions, competition between trees and crops for water and nutrients is too strong to go beyond a light presence of trees in a cropped field. Table 17 shows that 28 or 24.6% of the respondents planted trees to mark farm boundaries. Planting trees on farm boundaries did not require much labour.

However, some respondents pointed out that conflicts arose as to where the trees should be planted in areas where boundaries were shared with other farmers. This was so because planting of trees on improperly agreed borderline was seen as proving ownership of a piece of land or proof of an intention to assert a right over a piece of land.

GALUP also recommended planting of trees as live fences and shelter belts. Twenty or 17.5% of the respondents said that they planted trees to serve as live fences. Observations show that the preferred trees and shrubs for live fences were *Euphorbia* sp locally known as *minyaa* and *Agave* sp (sisal) due to their drought resistance and easy establishment (Table 17). Trees planted around homesteads was popular in the study area as 63 or 55.3% of the respondents practised it. This could be explained by two reasons. Firstly, it was easier to manage trees planted near the homesteads than if planted far away. Secondly, the farmers feared livestock damage and sabotage by livestock herders for plots located far away. Informal discussions with some farmers revealed that livestock herders damaged the trees planted in the fields because they feared that the trees could form a basis for excluding them from grazing the areas during the off seasons.

#### **b) Small woodlots.**

With regard to planting trees as woodlots, only 17 or 15.0% of the respondents reported having established woodlots (Table 18). Comparison

also show that female headed households owned less woodlots (3 out of 43 or 6.9%) compared to male headed households (14 out of 71 or 19.7%). Livestock damage and sabotage by livestock herders (who are mostly men) was partly cited to be the reason which discouraged females from owning woodlots.

**Table: 18 Respondents' opinions about owning woodlots (N=114)**

Owning a woodlot	Male headed households (n=71)		Female headed households (n=43)		Total (N=114)	
	n	%	n	%	n	%
Yes	14	19.7	3	6.9	17	15.0
No	57	80.3	40	93.1	97	85.0
Total	71	100.0	43	100.0	114	100.0

#### 4.5.1.2 Contour ridges

Contour ridges are placed across a slope of land to control run off and soil erosion. In the process they prevent further loss of soil fertility through nutrient washed away in the eroded soil material. Contours are important in Gairo where deep erosion gullies and huge sand fans are a common feature in the fields. Results in Table 19 show that only 14 or 12.3% of the respondents used contour ridges (locally known as *makinga maji*). Those who did not use contour ridges on hilly land indicated that the practice was relatively labour demanding. Field observations showed that ridges (locally known as *matuta*) were used as conservation measures on cases where respondents grew sweet potatoes commonly found near homesteads. Respondents also pointed out that they faced problems in making contours ridges due to lack of co-

operation with owners of other fields located upstream. This implied that erosion problems that cut across boundaries were likely to be left unattended.

**Table: 19 Respondents' opinions about using contours ridges (N=114)**

Use contours	Male headed households (n=71)		Female headed households (n=43)		Total (N=114)	
	n	%	n	%	n	%
Yes	10	14.1	4	9.3	14	12.3
No	61	85.9	39	90.7	100	87.7
<b>Total</b>	<b>71</b>	<b>100.0</b>	<b>43</b>	<b>100.0</b>	<b>114</b>	<b>100.0</b>

#### 4.5.1.3 Use of farmyard manure (FYM)

Most farmers in Gairo are faced with declining fertility in their farms and limited access and means to purchase inorganic fertilisers. GALUP recommended the use of farmyard manure as one approach to overcome this. Table 20 shows that only 27 or 23.7% of the respondents used FYM in their farms.

**Table: 20 Distribution of respondents by use farmyard manure (N=114)**

Use of FYM	Male headed households (n=71)		Female headed households (n=43)		Total (N=114)	
	n	%	n	%	n	%
Yes	20	28.2	7	16.3	27	23.7
No	51	71.8	36	83.7	87	76.3
<b>Total</b>	<b>71</b>	<b>100.0</b>	<b>43</b>	<b>100.0</b>	<b>114</b>	<b>100.0</b>

Farmers who did not use FYM in their farms mentioned two major reasons. Firstly, that their farms were too far away and that they were not able to hire or did not own ox-carts to ferry it to their farms. This was a common problem associated with the use of FYM because of its bulkiness as reported by other researchers (Senkondo and Mwaseba, 1993; Kaliba *et al.*, 1998). Secondly,

that the use of FYM increased weed infestation and incidences of cut worms (*Agrostis* sp). Cut worms destroyed roots of cereal crops while weed infestation increased labour demand through frequent weeding. Both situations appeared to discourage farmers from using FYM. Table 21 shows that Rubeho village had the highest percentage of respondents using FYM compared to other villages. This village had the highest number of respondents keeping livestock compared to others suggesting that FYM was easily available. Results shows that most respondents got FYM from their own animals, few others from neighbours free of charge. However, due to low nutrient content of FYM, high application rates were required and most farmers appeared not to meet this. For Gairo, the application rate was reported to be 10-15 tons per ha (Kaliba *et al.*, 1998).

Table: 21 Respondents' opinions about using farmyard manure by source and availability (N=114)

Village	Rubeho n=28	Kwipipa n=31	Msingisi n=28	Kisitwi n=27	Total N=114
<b>Adoption</b>					
Adopters	39.3	29.0	14.3	11.1	23.7
Non adopters	60.7	71.0	85.7	88.9	76.3
<b>Source</b>					
Own kraal	17.9	12.9	3.9	11.1	11.4
Given free	17.9	16.1	7.1	0.0	10.5
Purchased	3.6	0.0	3.6	0.0	1.8
<b>Availability</b>					
Easy	35.7	22.6	10.7	11.1	20.2
Not easy	3.6	3.2	3.6	0.0	2.6
Difficult	0.0	3.2	0.0	0.0	0.9

#### 4.6 Source of Knowledge on Soil Conservation Practices.

Sixty or 64.5% of the interviewees acknowledged to have got advice on soil conservation from GALUP while 27 or 29.0% got it from other sources. The other sources of knowledge were agencies such as the Anglican Church, Sokoine University of Agriculture and predecessor programmes to GALUP at Msingisi, especially information on planting trees. Only 16 or 14.0% respondents reported to have attended seminars or went on a study tour on soil conservation practices (Table 22).

Table: 22 Respondents' sources of knowledge about soil conservation (N=93).

Source of knowledge	Male headed Households (n=63)		Female headed households (n=30)		Total (N=93)	
	n	%	n	%	n	%
GALUP Extension staff	38	60.3	22	73.3	60	64.5
Other agencies	22	34.9	5	16.7	27	29.0
Own/Indigenous practice	2	3.2	2	6.7	4	4.3
Neighbour	1	1.5	1	3.3	2	2.2
<b>Total</b>	<b>63</b>	<b>100</b>	<b>30</b>	<b>100</b>	<b>93</b>	<b>100.0</b>

#### 4.7 By-laws Enforcing Soil Conservation Practices in the Study Area

The study villages were found to have laid down by-laws that restricted villagers from doing activities that destroyed the environment. These by-laws restricted villagers in five important areas. These included free grazing of livestock in the crop fields, starting up unprescribed fires, cultivating and grazing on degraded areas, cutting public trees and entering into the reserved areas without official permission.

Table 23 shows that most respondents (98 or 86.2%) were aware of these by-laws. Awareness of the by-laws varied between villages with all respondents in Kisitwi showing that they were aware, followed by those in Rubeho (85.7%), Kwipipa (83.9%) and Msingisi (75.0%). Evidence showed that according to village officials, individuals found to contravene the by-laws were brought before the village authorities and punished accordingly. Cases not resolved at the village were sent to higher authorities outside the village.

Table: 23 Respondents' awareness of the by-laws (N=114)

Awareness	Msingisi n=28	Kwipipa n=31	Rubeho n=28	Kisitwi n=27	Total N=114
Yes	75.0	83.9	85.7	100.0	86.2
No	25.0	16.1	14.3	0.0	13.8
Total	100	100	100	100	100

Respondents were also asked to show if the by-laws were effective in controlling villagers' activities that degraded the environment. Less than half of the respondents, (53 or 46.8%) were of the opinion that village by-laws were ineffective (Table 24). This appeared to apply to the by-law restricting livestock to graze on crop fields. According to most respondents, this was the most offended by-law because in Gairo grazing livestock on communal or individual harvested fields was a normal practice. Farmers therefore found it improper to sue defaulters on such cases. The study found that the villagers were hesitant to sue defaulters because they feared to jeopardise the good relationship that existed amongst themselves especially, if the other party in the conflict did not possess livestock.

**Table: 24 Respondents' opinions about the effectiveness of the by-laws (N=114)**

<b>Effectiveness/Village</b>	<b>Msingisi n=28</b>	<b>Kwipipa n=31</b>	<b>Rubeho n=28</b>	<b>Kisitwi n=27</b>	<b>Total N=114</b>
Very effective	17.9	6.5	26.6	51.9	25.7
Slight effective	32.1	64.5	46.4	44.4	46.8
Effective	7.1	3.2	0.0	3.7	3.5
Ineffective	14.3	6.5	7.1	0.0	6.9
Very ineffective	28.6	19.3	19.9	0.0	16.9
<b>Total</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>

Individuals convicted for destroying the environment were fined at the village court. At Msingisi village, the maximum fine was five thousands shillings (Tsh 5 000) for a single offence. Out of this amount, two thousands shillings (Tsh 2 000) went to the village government fund, two thousands (Tsh 2 000) shillings remained with the environment committee, while the remaining one thousand shillings (Tsh 1 000) were given to the person who apprehended the culprit as a motivation for the good job done.

Informal discussions with some villagers revealed that there were problems of inconsistency in administering the fines paid by the convicted individuals. Inconsistency involved the culprits not paying the fines or paying short of the specified amount. It appeared that there were also no proper accountability on the use of the accumulated money from the paid fines in three of the four villages that is, Rubeho, Msingisi and Kwipipa. Observations also showed that these villages' fields were more degraded than Kisitwi, a village in which respondents were more aware of the laid down by-laws concerning environmental conservation.

#### 4.8 Investment priorities

Table 25 shows investment priorities of the farmers in the study area. Thirty-three 33 or 28.9% of the interviewees preferred to invest in household improvement and, 30 or 26.3% preferred buying livestock. Others, 26 or 22.8% said that they would start or expand their businesses while 12 or 10.5% said that they would invest in crop cultivation. Still 6 or 5.3% of the interviewees said that they would construct soil conservation measures in their farms. Lastly, it was only one respondent or 1.8% who opted for paying schools fees for the children. Constructing soil conservation measures did not receive priority as an area for investment by the farmers although most of them acknowledged that land degradation was a problem in their farms. This supports the views expressed by Senkondo and Mwaseba (1993), Kerr and Sanghi (1992) that soil conservation is like any other investment and farmers undertook it if it was profitable.

Table: 25 Respondents' opinions about investment priorities (n=114)

Investment category	Number	Percent
Household improvement	33	28.9
Livestock keeping	30	26.3
Start/expand business	26	22.8
Crop production	12	10.5
Soil conservation	6	5.3
Education for the children	2	1.8
Other	5	4.4
Total	114	100.0

## **4.9 Factors Influencing Adoption of Soil Conservation Measures**

### **4.9.1 Results of the descriptive analyses**

This section presents results of cross tabulation using chi-square test carried out to determine how the individual factors influenced adoption of soil conservation practices. Factors investigated included age, education, availability of labour, awareness of the land degradation problems, ownership of cattle and land, farm size and gender.

#### **4.9.1.1 Age and soil conservation practices**

The results presented in Table 26 show that with the exception of establishing woodlots, most of the soil conservation practices were carried out by those who were in the age category between 35 and 64 years. Three or 2.6% out of the total six or 5.3% who planted trees on crop fields were from this age category. Similarly, 14 or 12.3% out of the total 20 or 17.5%, planted trees as live fences, 31 or 27.2% out of the total 63 or 55.3% planted trees around their homesteads and 18 or 15.8% out of the 27 or 23.7% used farmyard manure. However, respondents within this age category (35-64 years) were also many compared to those who were in the age range of 18 to 34 years and those above 64 years. A chi-square test on this variable was found to be significant ( $\chi^2=11.5$ ,  $p<0.05$ ) for trees planted around homesteads.

**Table: 26 Age and use of soil conservation practices (N=114)**

Soil conservation practice	Age group (years)						Total	
	16-35		36-64		65-76			
	n	%	n	%	N	%	n	%
Trees on cropland	2	1.7	3	2.6	1	0.9	6	5.3
Trees as living fences	4	3.5	14	12.3	2	1.8	20	17.5
Trees on farm boundaries	10	8.7	16	14.0	2	1.8	28	24.5
Woodlots	8	7.0	6	5.3	3	2.6	17	15.5
Trees around homesteads	26	22.8	31	27.2	6	5.3	63	55.3
Farmyard manure	6	5.3	18	15.8	3	2.6	27	23.7
Contour ridges	6	5.3	6	5.3	2	1.7	14	12.3

#### 4.9.1.2 Education and soil conservation practices

Table 27 shows the relationship between the level of formal schooling and use of soil conservation practices. Respondents with formal education tended to use more soil conservation practices than their counterparts with no formal education. Results show that of the six or 5.3% respondents who planted trees on crop fields all had four to seven years of formal schooling, again those who planted trees as live fences, 17 or 14.9% out of 20 or 17.5% had this level of formal education. Similarly, for the other practices such as trees around homesteads (41.2 % out of 55.3 %), contour ridges (11.4% out of 12.3 %) and farmyard manure (22.9 % out 23.7%) were practised by respondents who had four to seven years of formal education. A significant relationship was found between education and the use of farm yard manure ( $\chi^2 = 10.7$ ,  $p < 0.05$ ), meaning that farmers with formal education recognised the importance of farmyard manure in restoring soil fertility and hence used it in their farms.

**Table: 27 Education and use of soil conservation practices (N=114)**

Soil conserving practice	Years of schooling								Total	
	0		4		7		12		n	%
	n	%	n	%	n	%	N	%		
Trees on cropland	0	0.0	4	3.5	2	1.8	0	0.0	6	5.3
Trees as live fences	3	2.6	11	9.6	6	5.3	0	0.0	20	17.5
Trees on boundary	6	5.3	11	9.6	11	9.6	0	0.0	28	24.6
Small woodlots	2	1.8	4	3.5	11	9.6	0	0.0	17	15.0
Homegardens	15	13.1	24	21.0	23	20.2	1	0.9	63	55.3
Farmyard manure	1	0.9	17	15.0	9	7.9	0	0.0	27	23.6
Contour ridges	1	0.9	5	4.4	8	7.0	0	0.0	14	12.3

#### 4.9.1.3 Availability of labour and soil conservation practices

Availability of labour within the household appears to determine the households' members capacity to engage in soil conservation activities. Results presented in Table 28 show that labour for soil conservation practices was reported to be adequate by 87 or 93.5% of the respondents. Most respondents (89 or 95.7%) said that they used family labour and relatives in carrying out the soil conservation activities and in few instances they hired labour (4 or 4.3%). Respondents gave reasons for not hiring labour in carrying out soil conservation activities. Firstly, the soil conservation practices popular in the area involved planting trees which required little labour. Soil conservation practices which required more labour were making contours and using farmyard manure. Secondly, farmers were not willing to hire labour because the returns on soil conservation practices were low compared to wages paid. This confirms findings by Ryoba (1995) in Mwangi district who found that farmers were willing to employ labour if the returns were higher than the wage to be paid.

Table: 28 Availability of labour for soil conservation work (N=93)

Labour sufficient	Male headed households (n=63)		Female headed Households (n=30)		Total (N=93)	
	n	%	N	%	n	%
Yes	60	95.2	27	90.0	87	93.5
No	3	4.8	3	10.0	6	6.5
Total	63	100.0	30	100.0	93	100.0

#### 4.9.1.4 Awareness of causes of land degradation and soil conservation practices

Results in Table 30 show that most of the respondents were aware of the problem of land degradation. Findings further show that, respondents who were aware of land degradation problem planted trees as live fences (14% of out of the total 17.5%), they planted trees on farm boundaries (18.4 % out of 24.5 %), they established woodlots (11.4 % out of the total 15%), planted trees around homesteads (40.4% out of the total 55.3%). They also used farmyard manure in their farms (18.4% out of the total 23.7%) and made contour ridges in their farms to reduce run off (10.5% out of the total 12.3%).

Table: 29 Awareness of land degradation and use of soil conservation practices (N=114)

Soil conservation practice	Awareness				Total	
	Yes		No		n	%
	n	%	n	%		
Trees on cropland	6	5.3	0	0.0	6	5.3
Trees as live fences	16	14.0	4	3.5	20	17.5
Trees on farm boundaries	21	18.4	7	6.1	28	24.5
Woodlots	13	11.4	4	3.5	17	15.0
Trees around homes	46	40.4	17	15.0	63	55.3
Farmyard manure	21	18.4	6	5.3	27	23.6
Contour ridges	12	10.5	2	1.7	14	12.3

A chi-square test on this variable yielded significant results ( $p < 0.05$ ) for all soil conserving practices except the use of farmyard manure. This implies that there is a strong relationship between awareness of the land degradation problems and individuals' decision to use the soil conservation practices (Table 30).

Table: 30 Chi-square values between awareness of land degradation and soil conservation practices

Soil conservation practice	Degree of freedom	Chi square Value	Significance Level
Trees on cropland	2	9.4232**	0.0089
Trees as live fences	2	7.8211**	0.0200
Trees on farm boundaries	2	7.4375**	0.0242
Woodlots	2	7.4758**	0.0238
Trees around homesteads	2	6.2824**	0.0432
Farmyard manure	1	1.1956	0.2741
Contour ridges	2	8.4412**	0.0146

Note \*\* = significant at  $p < 0.05$

#### 4.9.1.5 Ownership of livestock and soil conservation practices

Livestock is an important resource which may influence the adoption of new innovations. A relationship was thus sought to see how many of the livestock keepers practised soil conservation practices in their farms. There was a significant relationship ( $\chi^2 = 3.8$ ,  $p < 0.05$ ) between owning livestock and using farmyard manure (Table 31).

**Table: 31 Chi-square values between owning livestock and use of soil conservation practices**

Soil conserving practice	Degree of freedom	Chi-square value	Significance level
Trees on crop land	2	0.4122	0.8137
Trees as live fence	2	3.8725	0.1442
Trees on farm boundaries	2	0.4060	0.8162
Woodlots	2	1.2578	0.5331
Trees around homestead	2	5.0143	0.0815
Farmyard manure	1	3.8773**	0.0489
Contour ridges	2	3.2226	0.1996

Note\*\*= significant at  $p < 0.05$

This was so because it was easy for the farmers to get farmyard manure from their animals and possibly easier to transport it to the farms using their ox-carts. With regard to the other soil conservation practices such as planting trees, livestock keepers planted less trees in their homesteads (15.8% out of 39.4%), on farm boundaries (8.8% out of 24.5%), on crop fields (1.8% out of 5.3%) and also established less woodlots (7.0% out of 15.0%). The reason for this could be that they avoided incurring loss through damage by livestock which they owned. However, a slightly higher percent of the livestock keepers (9.6% out of 17.5%) planted trees as live fences possibly for the reason of guarding their crop land against damage by livestock. Table 32 summarizes this.

**Table: 32 Ownership of livestock and use of soil conservation practices (N=114)**

Soil conserving practices	Keep livestock				Total	
	Yes		No		n	%
	n	%	n	%		
Trees on cropland	2	1.8	4	3.5	6	5.3
Trees as live fences	11	9.6	9	7.9	20	17.5
Trees on farm boundaries	10	8.8	18	15.8	28	24.5
Woodlots	8	7.0	9	7.9	17	15.0
Trees around homesteads	18	15.8	45	39.4	63	55.3
Farmyard manure	14	12.3	13	11.4	27	23.6
Contour ridges	8	7.0	6	5.3	14	12.3

#### **4.9.1.6 Ownership of land and soil conservation practices**

Table 33 presents the relationship between ownership of land and the different soil conservation practices that were adopted by the respondents. Most of the interviewees who had adopted soil conservation practices were those who owned land. For example, trees on crop fields were planted by half (2.6 % out of 5.3 %) of those who owned land. With regard to the other practices, trees as live fences were planted by 13 or 11.4% out of the total 20 or 17.5% respondents , woodlots were established by 13 or 11.4% interviewees out of the total 17 or 15.0%. Trees on farm boundaries were planted by 18 or 15.7% respondents out of the total 28 or 24.5%, farmyard manure was used by 21 or 18.4% out of the total 27 or 23.7% and homegardens were established by 35 or 30.7% out of the total 63 or 55.3% interviewees. These results are similar to findings by Kerr (1993), Stahl (1991) and Loiske (1991) cited by Lundgren (1993) who argued that farmers with secure land ownership were more likely to adopt soil conservation practices than those with insecure land tenure.

**Table: 33 Ownership of land and use of soil conservation practices (N=114)**

Soil conservation practice	Land tenure						Total	
	Owned		Rented		Other		n	%
	n	%	n	%	n	%		
Contour ridges	8	7.0	1	0.9	5	4.3	14	12.3
Woodlots	13	11.4	1	0.9	3	2.6	17	15.0
Tree on cropland	3	2.6	1	0.9	2	1.7	6	5.3
Tree as live fences	13	11.4	0	0.0	7	6.1	20	17.5
Tree on farm boundaries	18	15.7	1	0.9	9	7.8	28	24.5
Trees on around homes	35	30.7	3	2.6	25	21.9	63	55.3
Farmyard manure	21	18.4	1	0.9	5	4.3	27	23.7

#### 4.9.1.7 Farm size and soil conservation practices

Findings in Table 34 shows that respondents who had large farm plots (three hectares and above) planted trees on crop fields (3.5% out of 5.3%), planted trees on farm boundaries (13.1% out of the total 24.5%). More than half of the respondents (13.15% out of the total 23.7%) of those who used farmyard manure had large farm plots. The relationship between farm size and use of farmyard manure was significant ( $\chi^2=6.5$ ,  $p<0.05$ ), implying that an individual with large farm plots were more likely to have more resources (money and livestock) to enable them use farmyard manure. On the other hand, results show that respondents who had small farm plots tended to plant trees around homesteads (37.7% out of the total 55.3%) than those with large farm plots. With regard to using contour ridges and planting trees as live fences, equal number of respondents (those with small farms and large farms) were found to practice them (Table 34).

Table: 34 Farm size and use of soil conservation practices (N=114)

Soil conservation practice	Farm size				Total	
	3 ha and less		3 ha and above		n	%
	n	%	n	%		
Trees on cropland	2	1.7	4	3.5	6	5.3
Trees as live fence	10	8.7	10	8.7	20	17.5
Trees on boundaries	13	11.4	15	13.1	28	24.5
Woodlots	10	8.7	7	6.1	17	15.0
Trees around home	43	37.7	20	17.5	63	55.3
Farmyard manure	12	10.5	15	13.1	27	23.7
Contour ridges	7	6.1	7	6.1	14	12.3

#### 4.9.1.8 Gender and soil conservation practices

Results in Table 35 show that more male headed households significantly practised soil conservation involving tree planting and contour ridges than female headed households.

Table: 35 Chi square values between gender and soil conservation practices

Soil conservation practice	Degree of freedom	Chi-square value	Significance level
Trees on cropland	2	9.1934**	0.1008
Trees as live fences	2	9.7076**	0.0078
Trees on farm boundaries	2	14.4217**	0.0007
Woodlots	2	10.9855**	0.0041
Trees around homesteads	2	7.7090**	0.0211
Farmyard manure	1	2.0946	0.1478
Contour ridges	2	9.2682**	0.0097

Note \*\* = significant at  $p < 0.05$ .

Results in Table 36 show that few female headed households practised farmyard manure and contour ridges than male headed households. Few women practising the recommended soil conservation practices could be explained by the following reasons. Firstly, women in the sample comprised of household heads who may have been overwhelmed by other farming activities and other household chores. Secondly, it was only about 17 or

39.5% of sampled female headed households who acknowledged to have got extension advice on using the soil conservation practices compared to 42 or 59.1% of the males headed households. These findings confirm those by other researchers on less accessibility of extension service by women (Mwaseba *et al.*, 1991).

**Table: 36 Gender and use of soil conservation practices (N=114)**

Soil conserving practices	Gender				Total	
	Female		Male		n	%
	n	%	n	%		
Trees on cropland	2	1.8	4	3.5	6	5.3
Trees as live fences	5	4.4	15	13.2	20	17.5
Trees on boundary	4	3.5	24	21.0	28	24.5
Woodlot	3	2.6	14	12.3	17	15.0
Trees around homes	21	18.4	42	36.8	63	55.3
Farmyard manure	7	6.1	20	17.5	27	23.6
Contour ridges	4	3.5	10	8.8	14	12.3

#### 4.9.2 Results of the logistic regression models

The results of the three logistic regression models of the decision to practice the three soil conservation practices are presented in Table 37. In each case the goodness-of-fit statistics for the models with all the independent variables were adequate. The high likelihood of the observed results indicated that the models were reliable and the classification results shows that overall, 87.72 percent, 81.40 percent and 86.32 percent of cases were correctly classified in the contour ridges, tree planting and farmyard manure adoption models respectively, suggesting that the models fitted the data well.

Table: 37 Parameter estimates of logistic models of factors influencing the decision to adopt soil conservation practices

Explanatory variable	Contour ridges	Tree planting	Farmyard manure
	Parameter estimate $\beta$ (Wald-statistic)	Parameter estimate $\beta$ (Wald-statistic)	Parameter estimate $\beta$ (Wald-statistic)
Constant	-6.29 (4.62)**	-1.02 (0.45)	-1.95 (0.75)
Age of household head (years)	0.06 (2.48)	0.01 (0.46)	0.01 (0.12)
Education of household head (years)	0.28 (2.33)	0.07 (0.65)	0.24 (1.57)
Number of adults able to work	0.23 (0.88)	0.22 (2.10)	0.23 (1.8)
Farm size (acres)	0.04 (0.51)	0.02 (0.14)	0.05 (1.51)
Ownership of land	0.81 (3.87)***	0.12 (0.68)	0.33 (3.06)***
Awareness of soil degradation and conservation measures	1.50 (5.16)**	1.26 (4.25)**	1.15 (3.57)***
Livestock ownership	-	-	0.53 (1.02)
-2 log likelihood	70.99	143.11	104.81
Model Chi-square	13.94***	14.05***	20.00*
Overall cases correctly predicted	87.72	81.40	86.32
Sample size (n)	114	114	114

Note \*\*\* = significant at  $p < 0.01$  \*\* = significant at  $p < 0.05$  \* = significant at  $p < 0.1$

Two out of the nine variables included in the model were found to influence adoption of soil conservation practices recommended by GALUP. The variables were awareness of land degradation problem and ownership of land. Awareness of land degradation problem was found to have significant coefficients in all the three adoption models whereas land ownership has significant coefficients in only two models (Table 37). The results are similar to those obtained in the descriptive analysis when the factors were considered

individually and they suggest that extension education had significant effect on the adoption of soil conservation practices in the study area. This finding is similar to the finding in western Pare lowlands of Tanzania that the extent of knowledge in rain water harvesting had a positive significant effect on the probability of adoption of rain water harvesting technologies (Senkondo *et al.*, 1998). Other researchers elsewhere in the developing countries have also provided evidence on the significance of extension education on the probability of adoption of improved agricultural technologies (Jaminson and Moock, 1984; Baidu-Forson, 1999 ; Mwaseba *et al.*, 1991). This evidence supports the innovation diffusion model as pointed out in earlier works of Rodgers (1995) that information about the technology is the key factor in determining adoption.

Land ownership had a significant influence on the probability of adoption of contour ridges and use of farmyard manure but had no significant influence on the probability of adoption of tree planting. In using chi-square, ownership of land had no significant influence in the adoption of any of the recommended soil conservation practices, although it had positive relationship with land ownership. Implication of the findings in the logistic model could be that land tenure was less important to smallholder farmers in Gairo in their decision to plant trees for soil conservation ~~soil~~. This may be partly due to the fact that trees planted for conservation purposes could be cut for fuelwood and building poles.

Using chi-square analysis, farm size was found to be significant in the adoption of farmyard manure, but did not appear to be a significant determinant in the adoption of any of the recommended practices in the logistic models. With regard to the other recommended practices, the descriptive analysis showed that farm size had a positive relationship. That is households with big farm sizes tended to use the recommended practices than those with small farms. Ownership of cattle, which was only included in the farmyard manure adoption model, had no significance in explaining variation in use of farmyard manure. In the descriptive analysis however, ownership of livestock was found to have significant influence in the adoption of farmyard manure. Implication of this is that owning livestock as an individual factor was important for the farmers' decision to use farmyard manure. Although the sign of coefficients of these variables are as expected, the fact that they are insignificant seem to suggest that age, formal education, availability of labour (number of adults able to work), ownership of livestock and farm size had little effect on farmers decision to adopt soil conservation practices.

## **CHAPTER FIVE**

### **5.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS**

#### **5.1 Introduction**

This chapter summarises major findings, conclusions and provides recommendations derived from the study. The overall objective of this study was to examine factors that influence adoption of soil conservation measures. The specific objectives were (i) To determine the extent to which the farmers are aware of the problem of land degradation (ii) To determine the extent to which farmers have adopted different soil conservation measures (iii) To identify factors that influence the adoption of soil conservation measures.

#### **5.2 Summary of Major Findings**

##### **1. Extent of awareness of the land degradation problem**

Farmers were aware of the land degradation problem and its impact to their crop and livestock production systems. Of the 114 respondents, 92 or 80% were able to associate the type of cropping systems and/or livestock keeping systems with the observed land degradation in their farms and grazing fields. Farmers awareness was important for them to adopt the different interventions on soil conservation recommended by the change agencies.

## **2. Adoption of soil conservation practices**

Gairo Agroforestry and Land Use Project recommended tree planting, contour ridges, farmyard manure and establishment of forest reserves as measures to conserve the soil. Planting of trees was found to be the most popular practice of all the recommended practices. Fifty two or 45.6% respondents planted trees as opposed to 14 or 12.3% and 27 or 23.7% who practised contour ridges and farmyard manure respectively. Trees were planted in various agroforestry practices and as woodlots. Popularity of tree planting practice was due to its low labour demand and that the trees had other uses such as provision of food (fruits), fuelwood and timber.

Wider use of farmyard was limited by problems of handling, transportation and that it caused increased infestation of weeds and cutworms. Contour ridges were the least practised soil conservation measure because most of the respondents' farms were located on flat land. Contours are useful on hilly land to control run off and soil erosion. Those who did not have contour ridges on hilly land indicated that the practice was relatively high labour demanding. They further indicated that making them effective in controlling run off depended on owners of fields which are located upstream also to make them, otherwise their efforts were rendered useless.

### **3. Factors influencing adoption of soil conservation measures**

Results of the descriptive analysis using chi-square have shown that of the three practices, using farmyard manure was positively and significantly influenced by four factors. The factors: education, ownership of livestock, farm size and awareness of the land degradation problem.

Furthermore, using chi-square analysis, the relationship between gender and two practices that is, tree planting and contour ridges yielded significant results. Few female headed households were found practising tree planting and using contour ridges in their farms compared to male headed households. On the other hand, results of the logistic regression model showed that awareness of the land degradation by the farmers was significant to explain the use of all recommended practices. These results suggest that extension education had significant effect on the adoption of soil conservation practices recommended by GALUP. Results of the regression analysis have also shown that land ownership significantly influenced the probability of adoption of contour ridges and farmyard manure. Factors such as ownership of cattle, age, formal education, availability of labour and farm size in the logistic regression model were not significant determinants in the adoption of any of the recommended practices.

### **5.3 Conclusions and Recommendations**

Several recommendations can be drawn on basis of this study to assist change agencies, planners, and other development agencies with regard to soil conservation in Gairo.

1. Results of the study have shown that inspite of the general awareness of the importance and need for soil conservation among smallholder farmers, adoption of some of the recommended practices was found to be low. Awareness of land degradation was a significant factor in explaining the rate of adoption of the recommended soil conservation practices. Implication of this finding is that there is a need for providing more extension education on soil conservation technologies.
2. This study has shown that tree planting was the most popular soil conservation practice not because of its relatively low labour requirement but also trees had other uses. This suggests that soil conservation technologies with observable utility are more likely to be adopted. It is recommended that extension agencies provide extension education on soil conservation practices that demonstrate gains to smallholder farmers to enhance adoption.
3. Results of the descriptive analysis have shown that adoption of soil conservation practices by female headed households was low compared

to male headed households. This was mainly because female headed households were less educated and had less access to extension services. It is recommended that extension services should address this imbalance by providing knowledge and skills regarding soil conservation technologies to both female and male headed households.

4. Results of the logistic analysis suggest that farmers with knowledge through extension education as well as those with secure land tenure were likely to adopt soil conservation technologies. Implication of both of these is that there is a need for clear land policy that provides rights of owning land among smallholder farmers. Secure land rights will promote investments on land such as adoption of soil conservation practices. However, clear land use plans in the villages and strict by-laws to protect the instituted soil conservation measures appeared to be issues to be considered alongside secure land rights. In this regard, it is recommended that smallholder farmers should be facilitated to have secure land rights, strict by-laws and the villages to have land use plans that show clearly areas for cropping, grazing and forest reserves.

**REFERENCES**

- Adesina, A. A. and M. E. Zinnah (1993) Technology Characteristics, Farmers Perceptions and Adoption Decisions: A Tobit Model Application in Sierra Leon. *Agricultural Economics*.9: 297-311.
- Adesina, A. A. and J. Baidu-Forson (1995) Farmers' Perception and Adoption of New Agricultural Technology: Evidence From Analysis in Burkina Faso and Guinea, West Africa. *Agricultural Economics*.13: 1-9.
- Adesina, A. A. and K. Djato (1997) Relative Efficiency of Women as Farm Managers: Profit Function Analysis in Cote di'vore. *Agricultural Economics*. 16: 47-53.
- Amir, K. A. G. and D. J. Pannel (1999) A Conceptual Frame Work of Adoption of Agricultural Innovation. *Agricultural Economics*. 21: 145-154.
- Anim, F. D. K. (1999) A Note on the Adoption of Soil Conservation Measures in the Northern Province of South Africa. *Journal of Agricultural Economics*. 50(2): 336-345.

Batz, F. J., K. J. Peters and W. Janssen (1999) The Influence of Technology Characteristics on the Speed of Adoption. *Agricultural Economics*.21: (2) 121-130.

Baidu-Forson, J. (1999) Factors Influencing Adoption of Land enhancing Technology in the Sahel: Lessons From the a Case Study in Niger. *Agricultural Economics*. 20: 231-239.

Blackwell, J. M., R. N. Goodwilly and R. Well (1991) *Environment and Development in Africa: Selected Case Studies*. EDI Policy Case series. Analytical Case Study No 6 International Bank for Rural Development/The World Bank. pp 145.

Boserup, E. (1966) *The Conditions of Agricultural Growth. The Economics of Agrarian Change Under Population Pressure*. George Allen and Unwin Ltd, London. pp 124.

Bruce, J. W. (1989) *Community Forestry Rapid Appraisal of Tree and Land Tenure*. Food and Agriculture Organization, Rome. pp 90.

Buldeman, A. (1994) The Role and Potential of Agroforestry in Sustaining Land Use In: *Agroforestry and Environment in Tanzania Summary of Proceedings of the First Tanzania National Agroforestry and Environment Workshop* (Edited by E. L. Ngatunga, B. M. Gama and M. Lutkamu). 12-16 October, 1993 Ministry of Agriculture and Ministry of Tourism Natural Resources and Environment. pp 12-16.

Chamshama, S. A. O., L. L. L. Lulandala., G. P. Msumali., Z. S. K. Mvena., M. N. S. Nnyiti., and J. I. B. Rugambisa (1991) Socio-economic Survey of Gairo for an Appropriate Agroforestry System. Final Report Submitted to Ford Foundation, Tanzania. pp 34.

Cramb, R. A. and R. A. Nelson (1998) The Economic Incentives for Farmers in the Phillipines to Adopt Hedgerow Inter-cropping. *Journal of Environmental Management*. 54: 83-100.

Christiansson, C., A. C. Mbegu and A. Yrgard (1993) *The Hand of Man Soil Conservation in Kondoa Eroded Area, Tanzania* Regional Soil Conservation Unit/Swedish International Development Authority, Nairobi. pp 55.

Christiansson, C., I. S. Kikula and W. Osterbag (1995) *Research in Support of Soil Conservation Projects or of Land Users*. Research Report No. 90, Institute of Resource Assessment, University of Dar-Es-Salaam/Working Paper No. 20 Environment and Development Studies Unit School of Geography Stockholm, Sweden. pp 10.

De Pauw, (1995) *Development of Land Use Planning and Land in Tanzania, Main Report*. Technical Support Project TTSSI - URT/94/02T Food and Agriculture Organization. pp 124.

Feder, G., R. E. Just and D. Zilberman (1985) Adoption of Agricultural Innovation in Developing Countries: *A Survey Journal of Economic Development and Cultural Change*. 33: 255-297.

Gill, D. S. and M. K. Luckert (1995) Adoption of Agroforestry Practices: A Case Study From Andhra Pradesh. *Agroforestry Systems*. 32: 1-14.

Grepperud, S. (1995) Soil Conservation and Governmental Policies in Tropical Areas Does it Worsen the Incentive for Arresting Erosion. *Agricultural Economics*. 12: 129-140.

Hardin, G. (1968) The Tragedy of the Commons. *Science*. 13: 1243-1248.

Held, B. R. and M. Clawson (1967) *Soil Conservation in Perspective*. The John Pleins Press. Baltimore, Maryland. pp 344.

Holden, S. T. (1996) Farmers Ranking of Goals: Adaptive or Stable Preferences ? A Study of the Javanese Transmigrants in Summatra. Discussion Paper No. D-28/1996 Department of Economics and Social Sciences, Agricultural University of Norway. pp 25.

Holden, S. T., B. Shiferaw and M. Wik (1996) Poverty, Credit Constraints and Time Preferences: Of Relevance for Environmental Policy. Discussion Paper No D-26/1996. Department of Economics and Social Sciences, Agricultural University of Norway. pp 23.

Holden, S. T. (1997) Environmental Problems and Agricultural Development in the Least Developed Countries. Paper written for United Nations Co operation for Trade and Development (UNCTAD). Discussion Paper No D-2/1997, Department of Economics and Social Sciences, Agricultural University of Norway.

Holden, S. T. and P. Sankhayan (1997) *Population Pressure, Agricultural Change and Environmental Degradation in the Himalayan Region: A Conceptual, Historical and Methodological Basis Discussion Paper No D-05/1997*, Department of Agricultural Economics and Social Sciences, Agricultural University of Norway.

Hudson, N. (1981) *Soil Conservation*. English Language Book Society, London. pp 324.

Hussain, S. S., D. Byerlee and P. W. Hesley (1994) *Impact of Training and Visit System on Farmers' Knowledge and Adoption of Technology: Evidence From Pakistan*. *Agricultural Economics*. 10: 39-47.

Jacks, G.V. and R. O. Whyte (1939) *The Rape of the Earth*. Faber and Faber Ltd. London. pp 312.

Jaminson, D. and P. R. Mook (1984) *Farmer Education and Fertilizer Use Efficiency in Nepal: The Role of Schooling, Extension Services and Cognitive Skills*. *World Development*. 12: 67-86.

Jasmin, B. B. and C. R. Martin (1984) Mechanical Structures for Soil Erosion Control. In: *Proceedings of a Workshop on Soil Management*. (Edited by Craswell, E.T., J.V. Remenyi and L. G. Nallana). 3-5 December, 1984 held at PCARRD, Los Banos, Phillipines. pp 213.

Kaihura, F. B. S. (1993) Preliminary Survey Report on Farmer Oriented Soil and Water Management Research in Gairo In: *Proceedings of Research Planning Workshop* (Edited by Hatibu, N. and T. E. Simalenga). 13-15 January, 1993 held at Dodoma, Tanzania. pp 85.

Kaliba, A. R. M., A. M. Featherstone and D. W. Norman (1997) A Stall Feeding Management for Improved Cattle in Semi Arid Centra Tanzania: Factors Influencing Adoption. *Agricultural Economics* 17: 133-146.

Kajembe, G. C. (1994). Indigenous Management systems as a Basis for Community Forestry in Tanzania: A Case study of Dodoma Urban and Lushoto Districts. PhD Thesis, Wageningen Agricultural University. pp 194.

Kangalawe, R. (1995) Fighting Soil Degradation in the KEA, Kondoa District, Tanzania: Socio-economic Attributes, Farmer Perception and Nutrient Balance Assessment. MSc Thesis, Agricultural University of Norway. pp 128.

Kauzeni, A. S., I. S. Kikula., S. A. Mohamed., J. G. Lyimo and D. B. Dalal-Clayton (1993) *Land Use Planning and Resource Assessment in Tanzania: A Case Study*. Institute of Resource Assessment Research Paper No. 35 University of Dar Es Salaam/International Institute of Environment and Development Environmental Planning Issue No. 3. pp 128.

Kauzeni, A. S., I. S. Kikula and E. K. Shishira (1987) Developments in Soil Conservation in Tanzania, In: *History of Soil Conservation in the SADCC Region*. Soil and Water Conservation and Land Utilization Programme Report No. 8 March, 1987. Maseru, Lesotho. pp 22.

Kayombo, B. (1992) Soil Conservation in Tanzania. Paper Presented to the First NALERP Quarterly Workshop 1992/93 held in Morogoro, Tanzania. pp 19.

Kelly, H. W. (1982) *Keeping the Land Alive-Soil Erosion Its Causes and Cures*. Food and Agriculture Organization, Rome. pp 78.

Kerr, J. and N. K. Sanghi (1992) *Indigenous Soil and Water Conservation in India's Semi-Arid Tropics*. Gate Keepers Series No. 34. International Institute for Environment and Development, London. pp 30.

Kilosa District Council (1997) District Development Plan 1998-2000. pp 142.

Livernash, R. and E. Rodenburg (1998) Population Change, Resources and the Environment *Population Bulletin*. 53: (1) Washington, D.C. Population Reference Bureau, March 1998. pp 40.

Liwenga, E. T. (1995) *The Impact of Land Conservation Measures on Household Food Security in Kondoa Eroded Area, Tanzania*. MSc Thesis, Agricultural University of Norway. pp 109.

Lohay, J. A. (1998) *Participation of Women in Tree Planting in Babati District, Tanzania*. Msc Thesis, Department of Agricultural Education and Extension, Sokoine University of Agriculture. pp 123.

Lundgren, L. (1993) *Twenty Years of Soil Conservation in Eastern Africa*. Regional Soil Conservation Unit/Swedish International Development Authority, Nairobi. pp 50.

Lundgren, L., G. Taylor and A. Ingevall (1993) *From Soil Conservation to Land Husbandry*. Guidelines Based on SIDA's Experience. Swedish International Development Authority, Nairobi. pp 58.

Machumu, F. B. N. (1995) *Factors Associated with the Adoption of Agricultural Technologies: A Case of Sasakawa Global 2000 Project in Dodoma Rural District, Tanzania*. MSc Thesis, Department of Agricultural Education and Extension, Sokoine University of Agriculture. pp 116.

Magayane, F. T. (1995) *Farmers' Adaptive Efforts to Soil Erosion and Land Productivity Decline: The Case of Uluguru Mountains Tanzania*, PhD Thesis, University of Illinois at Urbana-Champaign, United States of America. pp 139.

Mbegu, A. C. (1988) *The HADO Project: What, Where, Why, How* Ministry of Natural Resources and Tourism, Forestry and Beekeeping Division, Dar-Es-Salaam, Tanzania. pp 37.

Minde, I. J. (1990) Factors Affecting Marketing of Agricultural Surplus in Tanzania: The Case of Maize In: *African Rural Social Sciences Research Network; Issues in Africa Rural Development* (Edited by Cheryl, R. D. and C. Alson) Winrock International Institute for Agricultural Development. pp 508-525.

Mkunduge, G. L. M. (1976) Aspects of Famine Relief in Gairo Division Kilosa District. MA Thesis, Department of Geography, University of Dar-Es-Salaam. pp 81.

Mlozi, M. R. S. and Z. S. K. Mvena (1990) Advancement of Small Farmers Through the Transmission of Agricultural Innovations: The Case of Sokoine University of Agriculture In: *The Role of Agricultural Institutions in Advancement of Small Farmers in Developing Countries* (Edited by Mattee A. Z., E. Evers and N. M. Mollel) Sokoine University of Agriculture, Morogoro. pp 35-40.

Mndeme, A. H. (1997) A Multidisciplinary Approach to Extension Services: The GALUP Experience. In: *Proceedings of a Workshop for Extension Officers* (Edited by Isinika, A.C., Kawa, I.H. and Neke, S.M.). 14-15 August, 1997 Morogoro, Tanzania. pp 82-86.

Mwalyosi, R. B. B. and S. Mohamed (1996) *A survey of Expertise on Natural Resources Management and Environment Conservation in Tanzania*. Research Paper No. 38 Institute of Resource Assessment, University of Dar-Es-Salaam. pp 38.

Mwaseba, D., E. G. Rwambali and R. T. Mulimira (1991) *Womens Lack of Accessibility to Agricultural Extension Services: A Social-cultural Explanation* In: *Proceeding of Tanzania Society of Agricultural Education and Extension Workshop* (Edited by Mattee A. Z., I. J. Lupanga., N. M. Mollél and S. C. Lugeye) 25-27 November, 1991 held in Dodoma, Tanzania. pp 103

National Bureau of Statistics and Macro International Incorporation (1997) *Tanzania Demographic and Health Survey, 1996*. Claverton, Maryland, United States of America. pp 312.

Pareena, G. L., J. H. Sanders and S. Ramaswamy (1999) *Impact of Technologies on Women: A Conceptual and Quantitative Analysis in Burkina Faso*. *Agricultural Economics* 20: 203-214.

Reij, C. (1991) *Indigenous Soil and Water Conservation in Africa*. Gate Keepers Series No. 27 International Institute for Environment and Development, London. pp 35.

Robberstad, B. (1997) *Time, Toil and Soil: A Study of Time Preferences and Soil Conservation in Karatu, North Tanzania*. MSc Thesis, Agricultural University of Norway. pp 215.

Rogers, E. M. (1995) *Diffusion of Innovations* 4th Edition, Free Press, New York. pp 518.

Rutatora, D. F. (1993) *Agricultural and the Environment: The Need for Continuous Farmer Education* In: *Proceedings of Tanzania Society of Agricultural Education and Extension Workshop* (Edited by Rutachokoziwa, V., D.F Rutatora, S. C Lugeye and N. M. Molel), 22-24 November, 1993 held in Dodoma. pp 53.

Ryoba, Z. M. (1996) *An Assessment on the Use of Indigenous Soil and Water Management Technologies in Semi-Arid Areas: The Case of Mwanga District in Tanzania*. MSc Thesis, Department of Agricultural Education and Extension, Sokoine University of Agriculture. pp 174.

Sanders D. W. (1990) New Strategies for Soil Conservation *Journal of Soil and Water Conservation*. 45: (5) 511-515.

Senkondo, E. M. M. and D. Mwaseba (1993) Socio-economic Aspects of Soil-Water Management in Semi-Arid Areas of Tanzania In: *Proceedings of a Workshop Research Planning Sokoine University Research Programme in Soil Water Management in Semi-Arid Areas of Tanzania* (Edited by Hatibu, N. and N. E. Simalenga), 13-15 January, 1993 held in Dodoma, Tanzania. pp 85.

Senkondo, E. M. M., N. S. Y. Mdoe., N. Hatibu., H. Mahoo and J. Gowing (1998) Factors Influencing Adoption of Rain Water Harvesting Technologies in Western Pare Low Lands of Tanzania. *Tanzania Journal of Agricultural Sciences*. 1 (1): 81-89.

Shiferaw, B. and S. T. Holden (1996) Resource Degradation and Adoption of Land Conservation Technologies by Smallholders in Ethiopian Highlands: A Study in Andit Tid, North Shewa. Discussion Paper No - 31/1996, Department of Economics and Social Sciences, Agricultural University of Norway.

- Shiferaw, B. (1996) Economic Analysis of Land Degradation and Incentives for Soil Conservation in Smallholder Farming: A Theoretical Development. Discussion Paper No-30/1996, Department of Economics and Social Sciences, Agricultural University of Norway. pp 37.
- Shivley, G. E. (1999) Consumption Risk, Farm Characteristics, and Soil Conservation Among Low Income Farmers in the Phillipines. *Agricultural Economics* 17: 165-177.
- Siden, J. and D. A. King, (1990) Adoption of Soil Conservation Measures in Manila Shire, New South Wales. *Agricultural Economics* 58: 179-192.
- Sokoine University of Agriculture and Ministry of Agriculture and Cooperatives (1998) Identifying Farmers' Needs in Gairo Mlali-Area. Participatory Rural Appraisal Report, Tanzania. pp 26.
- Steel, A. C. (1995) Social Factors Constraining the Uptake of Technology in Agriculture. PhD Thesis, University of Newcastle, United Kingdom. pp 340.

Thadei, S.Y., S. Kobayashi, and A. J. P. Tarimo (1998) Evaluation of Soil Conservation Measures: In: *Proceedings of Second Faculty of Agriculture Annual Research Conference; Towards the 21st century the Research and Technological Thrust in Development of Agriculture in Tanzania* (Edited by Dihenga, H. O., A. E. Kimambo., A. J. P. Tarimo, and A. E. Temu) held at Sokoine University of Agriculture, 25-27 September, 1996. pp 384.

Tibaijuka, A. K. (1987) Women's Participation in Soil and Water Conservation in the SADCC Region, In: *People's Participation in Soil and Water Conservation. Soil and Water Conservation and Land Utilization Programme Report No. 10* 2-6 March, 1987 Maseru, Lesotho. pp 10.

Ministry of Agriculture and Co-operatives (1997) *Agricultural and Livestock Policy* United Republic of Tanzania. pp 155.

Warner, K. (1993) *Patterns of Farmer Tree Growing in Eastern Africa: A Socio-economic Analysis*. International Centre for Research in Agroforestry, Nairobi. pp 270.

**APPENDICES**

**APPENDIX 1: QUESTIONNAIRE FOR FARMERS**

**Factors Influencing Adoption of Soil Conservation Measures: A Case  
Study in Gairo, Kilosa District**

**A. Household Data**

1. Date of interview.....
2. Name of the respondent.....
3. Village.....
4. Ward.....
5. Age of the household head.....years
6. Gender of the household head 1 Female ( ) 2 Male ( )
7. Marital status of the household head
  1. Single ( ) 3. Widowed ( )
  2. Married ( ) 4. Divorced/separated ( )
8. Education level of the household head
  - 1). No formal education ( )
  - 2). Adult education/Primary education (i-iv)( )
  - 3). Primary education ( )
  - 4). Secondary education ( )
9. Number of individual within the household .....
10. Number of individuals within the household able to work

1). Female ( ) 2. Male ( )

### B. Land Use, Ownership and Farming Data

1. How many acre of land do you have? Give type of ownership, area farmed last season, area left fallow, type of crop grown, topography and type of cultivation

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Plot no (acres)	Owner - ship	Area farmed (acres)	Land preparati on	Crop grow n (type )	Fallo w (acres )	Duratio n of fallow (years)	Topograp hy of the farm
i							
ii							

Key: (2) 1. Privately owned 2. Family owned 3. Allocated by the village 4.

Rented

(4) 1. Hand hoe 2. Tractor 3. Oxen (5) 1. Maize 2. Soghums and millets 3.

Sunflower 4. Legumes 5. Sweet potatoes (8) 1. Flat land 2. Medium hilly 3.

Very hilly

2.(a) What system of cropping do you use ?

1. Monocropping ( ) 2. Intercropping ( ) 3. Relay cropping ( )

(b). If you monocrop/intercrop/relay crop what is the reason ?

1. To get more produce per unit area ( ) 3. Maximize cropping season ( )

2. To increase fertility ( ) 4. Have adequate land ( ) 5. Other (specify).....

3.(a) Would you think of expanding agricultural land ?

1. Yes ( ) 2. No ( )

(b) If Yes, how much is available for expansion ?

(c) If No, explain.....

4. (a) Did you use chemical fertilizer in your crop last season ?

1. Yes ( ) 2. ( )

(b) If Yes, what type of fertilizer did you use ?

(1)	(2)	(3)
Type of fertilizer	Quantity used	Availability

Key: (1). TSP 2. CAN 3. UREA 4. NPK 5. SA 6. Other

(3) 1. Easy 2. Relatively easy 3. Not easy 4. Very difficult

(c) Where do you get your fertilizer supplies and what is the mode of payment ?

(1)Source of fertilizer supplies	(2)Mode of payment
1. Private stockist	
2. Cooperative society	
3. Extension service	
4. Other (specify).....	

Key: (2) 1. Cash 2. Credit

(d) If No, give reason as to why you did not use chemical fertilizer?

1. Not available ( ) 2. Lack of cash ( ) 3. Expensive ( ) 4. Don't prefer ( )

5. Other reasons (Specify.....)( )

5 (a) Did you use Farm yard manure (FYM) in your farm last season?

1. Yes ( ) 2. No ( )

(b) If Yes where did you get it?

(1)	(2)
Source	Availability

Key: (1) 1. From own boma 2. Purchased 3. Given free of charge.

(2) 1. Easy 2. Not easy 3. Very difficulty

(c) If No, give reasons why you did not use FYM?

1. Not available ( ) 2. Labour intensive ( ) 3. Don't prefer ( ) 4.

Other.....( )

6.(a) Do you keep livestock ? 1. Yes ( ) 2. No ( )

(b) If Yes, Give type kept, management used and purpose for keeping

(1)Type of livestock	(2)Total	(3)Management used	(4)Purpose
1.Cattle			
2.Sheep			
3.Goats			
4.Donkeys			
5.Pigs			
6.Others			

Key: (3) 1. Extensive 2. Intensive 3. Other

(4) 1. Cash 2. Food 3. Cash and food 4. Traction

7. (a) Livestock keeping is always cited as a cause of land degradation. In response to advice of the extension service have you ever made changes in your livestock management system 1.Yes ( ) 2. No ( )

(b) If Yes, which changes have you ever taken ?

1. Destocking ( ) 2. Zero grazing ( ) 3. Shifted the livestock ( )

4. Others (specify).....( )

(c) What is the reason for adopting the system you have chosen ?

- 1. Obliged by the government ( )
- 2. No adequate land ( )
- 3. No adequate pasture/fodder ( )
- 4. The land is too degraded ( )
- 5. Other (specify).....( )

(d) If No, why didnt you change the management system ?

- 1. No problem with the current sysem ( )
- 2. Lack of cash ( )
- 3 Have not been advised
- 4. Other (specify).....( )

8. (a) Would think of expanding your livestock herd from the current size ?

- 1. Yes ( )
- 2. No ( )

(b) If Yes, How much is available for the expansion ?.....(acres)

(c) If No, Explain why.....

9. (a) Do you face problems with regard to livestock keeping ?

- 1. Yes ( )
- 2. No ( )

(b) If Yes what are those problems ?

10. How do you solve those problems ?

**D. Soil Conservation Data**

1. What are the most pressing problem in your farm ?

(1)Problem	(2)Do you have this problem	(3)Is it small or big
1. Soil erosion		
2. Decrease of trees		
3. Decrease of fertility		
4. Other (specify).....		

Key: (2) 1. Yes 2. No (3) 1. Small 2. Big

2. What is the trend in crop yield for the past ten years ?

1. Increasing ( ) 2. Decreasing ( ) 3. Constant ( )

3. If decreasing what is the main cause ?

1. Pest and diseases ( ) 2. Inadequate rainfall ( ) 3. Soil erosion ( )

4. Low fertility ( ) 5. Others(specify).....( )

4.(a) Do you associate the current soil degradation with the type of cropping system you are practicing ? 1. Yes ( ) 2. No ( )

(b). If, Yes, explain.....

(c) If, No explain.....

5. (a) What is the trend yield of livestock production for the last ten years ?

1. Increasing ( ) 2. Decreasing ( ) 3. constant ( )

(b) If decreasing what is the main cause ?

1. Diseases and pests 2. Inadequate pastures ( )

3. Inadequate grazing land ( ) 4. Others (specify).....

6.(a) Do you associate the current soil degradation with the type livestock management you are using ? Yes ( ) 2. No ( )

(b) If Yes, explain.....

(c) If No, explain.....

7. (a) Do you undertake any measures to protect your land ?

1. Yes ( ) 2. No ( )

(b) If Yes, which of the following Soil Conservation/fertility improvement measures have you ever undertaken ? Give duration and source of the practice

(1) Soil conservation	(2)Used	(3)Duration	(4)Source	(5)Labour required	(6)Cost
1.Contour ridging					
2.Terracing					
3.Use of FYM					
4.Use of fertilizer					
5.Applying mulch					
6.Leave crop residues					
7.Zero graze					
8.Plant perennial grasses/sisal					
9.Other(specify)					

Key (2) 1. Yes 2. No(3)1. Less than 5 years 2. More than 5 years (4) 1.

Government extension staff 2. NGO extension staff 3. Neighbour (5) 1. High  
2. Low 5.

8. (a) Where did you put up the soil conservation structures ? 1. All farm plots  
( ) 2. Few farm plots ( )

(b) If few farm plots, why is it the case ?

1. Labour inadequate( ) 2. Don't have time ( ) 3. Don't have money ( )  
4. Slope of land ( ) 5. Other (specify) .....( )

9. If trees were planted, Give type, location, purpose, source of seeds and date when planted

(1)Type of (Spp)	(2)Where planted	(3)Duration	(4)Source of seedlings	(5) Purpose	(6) No planted	(7) No surviving
1.....						
2.....						
3.....						

Key (2) 1. Private woodlot 2. Around homestead 3. Communal woodlot/forest 4. Mixed with crop (3) 1. Less than five years 2. More than 5 years (4) 1. Purchased 2. Given free of charge 3. Other (specify) 1. Fuelwood 2. Construction / timber 3. Fodder 4. Increase Soil fertility 5. Felt obliged by the government 6. Control soil erosion 7. Delimitate land 8. Wind break / live fence 9. Other (specify).....

10. (a) Do the planted trees suffer damage after planting ?

(

1. Yes ( ) 2. No ( )

(b) If Yes, which of the following is causing most of the damage

1. Theft ( ) 2. Drought ( ) 3. Insect/diseases ( )

4. Livestock grazing ( ) 5. Wildfires ( ) 5. Others (specify) ( )

11. (a) Were you involved in identifying the type of soil conservation measures you are implementing ?

1. Yes ( ) 2. No ( )

(b) If Yes, how were you involved ?

- 1.Consulted individually ( ) 2. Village assembly decided ( )  
 3. Others (Specify).....( )

12. (a) Have you ever attended any training on soil conservation ?

Yes ( ) 2. No ( )

(b) If Yes, give type, duration, date and organizer

(1)Type of training	(2)Duration	(3)Location	(4)Date	(5)Organizer
1.....				
2.....				

Key (2) 1. Less than a week 2. One week 3. More than a week y (3)1. On my farm 2. On my neighbours farm 3. Outside the farm (4)1. 1990 - 1994 2. 1995 - 1998 (5) 1. Government Extension Staff 2. NGO extension Staff 3. Other (specify)

13. (a) Do the instituted soil conservation measures have any direct benefits to your household ? 1. Yes ( ) 2. No ( )

(b) If Yes, what are those direct benefits ?

Type of soil conservation	Benefits
1	
2.	
3.	

c. If No explain .....

14. If you do not use any soil conservation measures in your farm, could it be because of the following reasons ?

1. Don't have enough information about them ( ) 2. Difficult to maintain ( )  
 3. Labour intensive to make ( ) 4. Time consuming to make ( ) 5. Does not

increase yield ( ) 6. The land I cultivate is not mine ( ) 7. The land is too small to accommodate the measures ( ) 8. The structures are destroyed by livestock ( )

15. Within the family who is physically involved in soil conservation works ?

1. Father ( ) 2. Mother ( ) 3. Children ( ) 4. All family members ( .)

16 (a) Is the family labour sufficient in carrying out soil conservation ?

1. Yes ( ) 2. No ( )

(b) If No, how do you meet the labour deficit ?

1. Hire labour ( ) 2. Use co-operative work group ( ) 3. Use relatives ( )

4. Other (specify) .....( )

(c) If you use hired labour how many mandays do you need?

17. (a) Do you know rules which enforce soil conservation measures ?

1. Yes ( ) 2. No ( )

(b) If Yes, which ones ?

(c) Are the rules effective to enforce soil conservation measures ?

1 Very effective ( ) 2. Slight effective ( ) 3. Effective ( ) 4. Ineffective ( )

5. Very effective

**C : Income and Investment Data**

1. How much money did you get last year from various farm / forest enterprises ?

Surce of income	Amount produced	Amount consumed	Amount sold	Price per unit	Money obtained
	Kg/Bag/No			Tsh	
<b>(a) Crop Sale:</b>					
1.Maize					
2.Sorghum					
3.Millet					
4.Sunflower					
5.Beans					
6.Sweet potatoes					
7.Other					
Sub total					
<b>(b) Livetock sale:</b>					
1. Cattle					
2. Sheep					
3. Goats					
4. Poultry					
5. Pigs					
6. Others(specify)					
Sub total					
<b>(c)Trees/grass sale</b>					
1. Fuelwood					
2. Poles/timber					
3 Grasses/fodder					
Other(specify)					
Sub total					
Grand total					

2. How much money did you get last year from various off-farm sources ?

Source of income	Approximate money obtained (Tsh)
(a) Employment/Remittance	
1. Husband employed	
2. Wife employed	
3. Children employed	
4. Remittance from relatives	
Sub total	
(b) Petty trading	
1. Shop keeping	
2. Operating kiosk/genge	
3. Mama ntilie	
4. Selling local brews	
5. Selling crafts art work	
6. Other (specify).....	
Sub total	
Grand total	

3. (a) In the last five years have you spent some money to prevent soil erosion?

1. Yes ( ) 2. No ( )

If yes, how much did you spend on average per year ?.....(Tshs)

If No, Explain .....

4. When you get money what investment priority would you consider ?

1. Crops ( ) 2. Livestock ( ) 3. Land improvement ( )

4. Education for the children ( ) 5. Household improvement

6. Other (specify).....( )

5. (a) Since you started implementing soil conservation measures do you see land degradation decreasing ?

Yes ( ) 2. No ( )

(b) If No, what are the reasons

6. Based on your experience, what do you think are the main constraints in soil conservation in Gairo ?

7. What do you think should be done to overcome such constraints ?

**APPENDIX 2: CHECK LIST FOR SEMI-STRUCTURED INTERVIEW FOR  
DISTRICT/DIVISION/VILLAGE LEADERS**

**Factors Influencing Adoption of Soil Conservation Measures : A Case  
Study in  
Gairo, Kilosa District**

1. Is land degradation a priority problem in the district/division/ward/village?
2. What organisation structure were in place for to facilitate the day to day activities of soil conservation?
3. What type of contribution was offered by the district/division/ward/village to sustain soil conservation activities?
4. What tangible benefits could be counted on the side of instituted soil conservation measures?
5. Which soil conservation measures are liked most by the farmers?  
Similarly, which are disliked?
6. Are there any legislation (rules) to enforce soil conservation at district/division/ward/village level?
7. To what extent have the people participated in enacting these rules?
8. What are the rewards and punishment for those complying and going against respectively?

9. Who is responsible to enforce these rules?
10. Given that GALUP has ended as a project what initiatives are in place to make soil conservation works sustainable?
11. What aspects would you see them as constraints in carrying out soil conservation work?
12. What aspects would you see them as an opportunity in carrying out soil conservation work?
13. Is there institutional (organizational) cooperation between different actors with similar type of work (soil conservation).