SOIL AND WATER CONSERVATION PRACTICES IN THE ULUGURU MOUNTAINS: THE INFLUENCE OF HIGH VALUE CROPS PROMOTION

BY

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ABSTRACT

In western Uluguru Mountains, professionals have introduced soil and water conservation (SWC) practices which, if properly followed, would conserve the soil and promote agriculture. Various high value crops (HVC) promotion interventions and others which could serve as incentives were executed to aid attainment of this objective. Despite these efforts, today, in most fields we see more of annual ridges, the conventional farming practice which is not effective in SWC and other forms of unsustainable agriculture practices. This study sought to determine the influence of HVC promotion interventions on investment in SWC in Mgeta. It also investigated whether or not appropriate incentives for overcoming adoption barriers have been used. Data were collected through unstructured interviews, observations and interview schedules. Descriptive statistics and multinomial logistic regression were the main methods of analysis. Results were as follows: Age, education and income; farm size and slope have significant influence on investment in SWC. Household size, labour force and occupation were not significant. Land security was the number one incentive followed by agricultural sustainability, farm implements, extension services, irrigation improvement, labour sharing and suitability for growing HVC. The four lowest incentives were rewards and prizes, market development, food-for-work and credit. From regression analysis introduction of HVC had the highest predictive effect on investment in SWC followed by irrigation improvement. Slope and income were also significant. Recommendations are as follows: Promote SWC measures which are cost-effective and can be integrated into existing farming system and promote HVC for cultivating on terraces. In this respect, contour strip cropping,

ladder and *fanya juu* terraces are suggested for Mgeta. Secondly, SWC programmes and policy makers to use the right set of incentives to stimulate SWC adoption. Extension improvement by empowering paraprofessionals and formulation of policies to improve land use security and market access are necessary incentives in that regard.

DECLARATION

I, Emmanuel Timothy Malisa, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work and has not been submitted for a higher degree in any other university.

_____ _____

Emmanuel Timothy Malisa Date

(M.A. Candidate)

The above declaration is confirmed

_____ _____

Professor A.Z. Mattee Date

(Supervisor)

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DEDICATION

This work is dedicated to my father Timothy Ndesamburo Malisa and my mother, the late Elise who laid the foundation of my education.

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LIST OF ACRONYMS

DAI PESA	-	Development Alternatives Inc. – Private Enterprises Support Activities
DALDO	-	District Agricultural and Livestock Development Officer
DSI	-	Development Studies Institute
FR	-	Forest Reserve
HVC	-	High Value Crop
KIOF	-	Kenya Institute of Organic Farming
MDGs	-	Millennium Development Goals
MNL	-	Multinomial Logistic
MVIWATA	-	*Mtandao wa Vikundi vya Wakulima Tanzania* (Network of Farmers Groups in Tanzania)
MWAP	-	Morogoro Women Agroforestry Project
NSGRP	-	National Strategy for Growth and Reduction of Poverty
SACCOS	-	Savings and Credit Cooperative Society
SPSS	-	Statistical Package for Social Sciences
SUA	-	Sokoine University of Agriculture
SWC	-	Soil and Water Conservation
TARP II	-	Tanzania Agricultural Research Project II
TIP	-	Traditional Irrigation Project
UDSM	-	University of Dar es Salaam

ULUS	-	Uluguru Land Usage Scheme
UMADEP	-	Uluguru Mountains Agricultural Development Project
UMEMCP	-	Uluguru Mountains Environmental Management and Conservation Project
UMHODEP	-	Uluguru Mountains Horticulture Development Project
URT	-	United Republic of Tanzania
VTTP	-	Village Travel and Transport Project
WCST	-	Wildlife Conservation Society of Tanzania

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

South Uluguru Forest Reserve (FR) is the source of water used in Dar es Salaam city and Morogoro municipality. Despite its significant importance to national development, encroachment into the forest in the search for virgin agricultural land and other forest products is continuing. According to Chamshama *et al.* (2009), among other root causes of the threats that the Uluguru FR faces are extensive and inefficient land use practices. SUA (2006) observed that environmental degradation is more serious in semi-arid and in sub-humid steep slopes of the highlands and mountainous slopes that are under annual crop cultivation. The main practices contributing to environmental degradation are overgrazing, bad tillage and cropping practices, poor fertility management and deforestation. In the Uluguru Mountains, the most common form of land degradation is soil erosion by water. High population density, intensive cropping, steep slopes and highly erodible soils are some of the factors which aggravate soil erosion in the area (Magayane, 1995).

Promoting soil and water conservation (SWC) and agricultural productivity has been advocated by various sustainable agriculture development and environmental conservation programmes as a way out of the land degradation problem. The Poverty and Human Development Report (URT, 2005) contends that if the National Strategy for Growth and Reduction of Poverty (NSGRP) targets are to be met, agriculture must grow at a sustained rate of at least six per cent per annum. The government indicates that improvement of land husbandry through soil erosion

control and soil fertility improvement is one of the specific national environmental policy objectives (URT, 1997).

Farmers' response to SWC promotion programmes vary from one place to another. There is increasing concern that while many more farmers now seem to be more aware of the negative environmental and social consequences of conventional agricultural systems, this has not translated into a major shift towards the adoption of sustainable practices (Green & Heffernan, 1987; cited by Alonge and Martin, 1995). Factors that influence adoption of SWC practices include perceived relative advantage of the practices, effectiveness of technology dissemination methods and compatibility of the measures to existing values, experiences and needs.

In the Uluguru Mountains the history of SWC dates back to 1909 when the German colonial administration declared an area of 277 km^2 as forest reserve in order to halt shifting cultivation into the Uluguru Mountains forest. According to Delobel *et al.* (1991), vegetable crops of the temperate origin were introduced by Germans at the beginning of this century. The most represented vegetables were green peas, cabbages and cauliflower. The most intensive crop management was devoted to these crops.

In 1980s-90s Uluguru Mountains Horticulture Development Project (UMHODEP) whose primary objective was horticulture development endeavoured to promote terracing in Mgeta Division (West Uluguru Mountains) as a pre-requisite for increased and sustained vegetable and fruits production. In this regard a group of

farmers was engaged in a study tour to Lushoto, Tanga where they learned about SWC practices. On their coming back, the farmers and project staff worked towards promoting the technologies they had observed. The main emphasis was placed on enticing farmers to follow the necessary measurements in terracing. They stressed the use of 'A' frame in contouring as well as determining the land slope as guidance towards gauging terrace width.

In 1993 UMHODEP was restructured to diversify its activities and thereby given the name of Uluguru Mountains Agricultural Development Project (UMADEP), the project which continued the SWC efforts initiated under UMHODEP. This project facilitated some farmers' representatives and field extension officers to go on a study tour to Kenya Institute of Organic Farming (KIOF) in Nairobi where they participated in intensive training on sustainable agriculture practices. Back home, the representatives in collaboration with the project staff promoted terrace stabilization using livestock fodder plants and other plants. Other SWC practices which were promoted by UMADEP in Uluguru Mountains are agroforestry and organic farming in Mgeta and Mkuyuni divisions and contour strip cropping in Mkuyuni (East Uluguru Mountains). During this time UMADEP introduced and/or promoted four high value vegetable crops in Mgeta. These crops are tomato *(Lycopersicon esculentum)*, Irish potatoes *(Solanum tuberosum)*, cabbages *(Brassica oleracea* var. *capitata)* and garden peas *(Pisum satium)*.

In order to achieve high value crop production and the ultimate goal of increasing farmers' income from crop production UMADEP engaged in other activities namely

improvement of traditional irrigation systems, enhancing market access, establishment of rural micro finance services, formation of farmers' groups and overall extension service provision. Like other crops, high value crops are known to perform better on well managed conserved land. This implies that someone who is adopting improved SWC measures will realize higher farm incomes. In such case, the aforementioned interventions could act as incentives to adoption of SWC measures. According to Giger *et al.* (1999), the profitability from the point of view of the farmer may itself be considered as a strong motivation and incentive for the land user to adopt SWC. A study undertaken in Thailand shows that 90% of families who had adopted bench terracing took up the technology without direct incentives because they grew cash crops (Liniger and Critchley, 2007). High value crops in this study refer to highly marketable and revenue fetching crops. Low value crops are such as maize. Antle and Diagana (2003) contend that, if productivity increases and the conservation practice becomes more profitable, the farmer will not dis-adopt at the end of the contract.

Incentives can be direct or indirect. Direct incentives can be provided in cash in the form of wages, grants, subsidies and loans, or in kind through the provision of food aid, agricultural implements, livestock, trees, and seeds, or as a combination of the two. Indirect incentives include fiscal and legislative measures such as tax incentives, guaranteed inputs and input prices and land tenure arrangements. They include services such as extension services, technical assistance, the use of agricultural equipment, marketing, storage, education and training. Indirect incentives include also social services, community organization and the

decentralization of decision making (Sanders *et al.*, 1999). The incentive may have the positive effect of speeding up the diffusion of a technology that would otherwise be spreading more slowly (Giger *et al.*, 1999). According to Sanders *et al.* (1999), indirect incentives are by far the most important.

1.2 Problem Statement and Justification

It can be generalized that there is a long history of attempts to solve soil degradation through development of improved agricultural practices and related conservation technologies. These technologies have been successful in some parts of the world and not in others. Antle and Diagana (2003) suggest that there is clearly a need for a better understanding of the causes of chronic land degradation in the places where existing technologies have not been adopted, and ways in which incentive mechanisms could help address the problem.

Mountainous areas of Tanzania have experienced rapid population growth resulting into increased food demand and need for more agricultural land. According to Chamshama *et al.* (2009), the root causes of anthropogenic threats that the Uluguru FR faces include widespread poverty which is exacerbated by population growth. Increased pressure on the hilly slope leads to soil erosion and other forms of land degradation since the same farm size will be required to support more people. This means crop production will be intensified and the overall people's demand from the environment increases unproportional to its capacity. As a result agricultural sustainability in the area continues to be threatened. Hymas (2000); Bracebridge *et*

al. (2005a, b) observed that in the Ulugurus cultivation occurs up to the borders of the forest reserves and occasionally within the reserve.

Experts and technocrats have introduced improved SWC practices which, if properly followed, would conserve the soil while at the same time promoting agricultural productivity. Today, in the Uluguru Mountains we see in most fields more of annual ridges, the conventional way of farming which is not effective in SWC and other forms of unsustainable agriculture practices. According to Paulo *et al.* (2007), most communities in the landscape outside the Uluguru forest reserve practice unsustainable agriculture. Contrary to the recommendation that terraces are the appropriate measure for slope range of 35-55%, most commonly annual ridge farming is practiced on such steep slope. Cases of farming activities on lands with very steep slope (above 55%) are also evident. According to Magayane (1995), the adoption of improved SWC practices is not widespread. The basic question here is: has use been made of incentives which are most appropriate for overcoming adoption constraints in the Uluguru Mountains? This study regards adoption as the stage in which a technology is selected for use by an individual.

In the course of executing their programmes, agriculture development organizations implement various activities which are meant to improve returns from crop production. In this respect, in the Uluguru Mountains UMADEP and other organizations have been implementing such activities as introduction/promotion of high value crops, improvement of traditional irrigation systems, livestock keeping, market access and overall extension service delivery, establishment of rural micro

finance services and formation and strengthening of farmers groups. Being the basis for agricultural sustainability in mountainous areas, SWC practices such as terracing, agroforestry, organic farming and tree planting have been promoted and in that regard treated as cross cutting issues. On the one hand these interventions have promoted production for sale which in turn necessitates intensive cropping and use of inputs such as fertilizers and pesticides to ensure high yields. On the other hand, it is proven that crop production is more successful when undertaken on conserved land and hence the interventions could motivate farmers to implement SWC measures. Posthumus (2005) observed that due to the improved growing conditions caused by terracing, crops can be planted more densely and high value crops like vegetables, potatoes or improved maize varieties can be cultivated. This results in higher productivity, and thus higher profitability of the terraces. This study therefore attempts to determine the influence of high value crops promotion interventions on investment in SWC practices. According to Kessler (2006), successful examples of strategies that motivate farmers for the large-scale execution of SWC practices are scarce.

The hypothesis behind the experts who introduced high value vegetable crops in the area was that the technology is an incentive for adoption of SWC. This was based on consideration that while the high value vegetable crops require terraces to perform best, terraces require high value vegetable crops to be profitable. According to FAO (1995), a conservation strategy will not be successful unless it is closely linked with strategies for increasing agricultural productivity and profitability. Kessler (2006) argues that due to the fact that conservation practices rarely generate profits, at least

not in the short run, SWC projects have often stimulated farmers by means of incentives to conduct SWC practices. Now the question is whether the introduction of high value vegetable crops in Mgeta has motivated farmers to invest in SWC.

Many soil erosion and conservation studies in Tanzania (e.g. Semgalawe, 1998; Tenge *et al.*, 2004; Tenge, 2005) have concerned themselves with factors influencing adoption of SWC practices. This study is more specific in that it focuses on the influence of various project interventions on investment in SWC practices.

The study is further justified by Goal seven of the Millennium Development Goals (MDGs) (UN, 2006), (Ensure Environmental Sustainability) which prescribes the reversal of the loss of environmental resources as a target following the continuation of rapid deforestation. Moreover, Sokoine University of Agriculture has in its research agenda 2005-2010, promotion of good land husbandry practices among the priority research areas (SUA, 2006). Chamshama *et al.* (2009) mention conservation agriculture including the use of organic farming and introduction of high value crops as priority research areas. This therefore implies a need for further research in this area.

1.3 Study Objectives

1.3.1 General objective

To determine the influence of high value crop promotion on farmers' investment in soil and water conservation practices in the Uluguru Mountains.

1.3.2 Specific objectives

- To examine the existing SWC practices in western Uluguru Mountains
- To compare SWC practices on high value crop plots with those on low value crop plots.
- To examine the reasons for investing in SWC practices
- To identify the cash crops promotion interventions in Mgeta
- To determine the significance of each intervention to investment in SWC practices

1.4 Research Questions

- What are the existing SWC practices in western Uluguru Mountain and how do they differ between high value crops and low value crops plots?
- What are the reasons for the farmers' investment in SWC practices?
- What are the cash crop promotion interventions in Mgeta?
- What is the influence of cash crop promotion interventions on investment in SWC?

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

Environmental degradation and food insecurity are problematic in many parts of the world. According to Thrupp and Megateli (1999), the magnitude and severity of environmental degradation problems are extreme and alarming in the Greater Horn of Africa. The region's environmental and food problems tend to be concentrated in zones of intense resource use (Thrupp and Megateli, 1999). According to Hutchinson *et al.* (1991), some analysts have suggested that if the current environmental degradation is permitted to continue, human settlement in many parts of the region could become unsustainable.

Overall in Africa in the past half-century approximately two billion hectares of land have been degraded, with 300 million affected by extreme degradation (i.e. high levels of soil erosion, nutrient depletion and desertification) (Pinstrup-Andersen and Pandya-Lorch, 1995).

In the Uluguru Mountains agriculture is the primary livelihood activity. However, the ongoing unsustainable farming practices pose a serious threat for future agriculture in the area. According to Chamshama *et al.* (2009), after reservation of the Uluguru forest reserves, exploitation of the non-reserved land using poor agricultural methods intensified, resulting in soil erosion and loss of soil fertility. The land is highly degraded in such a way that agriculture is mostly practiced on unfertile subsoil.

2.2 Land Degradation Defined

Liniger and Critchley (2007) mention soil degradation as one of the most important inter-related land degradation components, defining it as the decline in the productive capacity of the soil as a result of soil erosion and changes in the hydrological, biological, chemical and physical functions of the soil. The major types include water erosion (such as inter-rill erosion, gully erosion, mass movement, off-site sedimentation), wind erosion, chemical deterioration (such as fertility decline, reduced organic matter, acidification, salinisation, soil pollution) and physical deterioration (such as soil compaction, surface sealing and crusting, water logging).

2.3 Soil Erosion as a Problem

Soil erosion is a widespread problem in Tanzania. Many studies (Kilasara and Rutatora, 1993; Lulandala *et al.*, 1995; Semgalawe, 1998; Kajembe *et al.*, 2005; SUA, 2006) report soil erosion and declining soil fertility being a serious problem especially in mountainous areas. The densely populated mountainous areas (e.g. Uluguru and Usambara Mountains) and the semi-arid interior plains (e.g. the Lake and the Central zones) are said to be the most eroded areas in the country (Rapp *et al.*, 1972). By the mid 1940s soil erosion was reported to be so serious that a family had to cultivate four to five times as much land as was necessary thirty years earlier (Savile, 1947 quoted by Magayane, 1995).

2.4 Soil and Water Conservation (SWC) Measures

There are many types of SWC measures. These include biological (crop rotation, mixed cropping, strip cropping, grass strips and trash lines); cultural (contour farming, early planting, zero/minimum tillage, ridging, mulching and use of organic fertilizers); physical measures (developed and excavated bench terraces, ridge terraces and stone terraces); cut-off drains; artificial water ways and water harvesting (Assmo and Eriksson, 1999). The most common methods used to develop bench terraces are *fanya juu/fanya chini* terraces and grass strips. Others are trash lines and stone ridges (Assmo and Eriksson, 1999).

Fanya juu means a ditch is dug and the soil thrown uphill from the ditch to form a ridge. The ridge catches the soil that is moved downhill by erosion and cultivation. *Fanya juu* can be slightly graded to discharge excess water from farmland or level to facilitate infiltration of water. The *fanya juu* will gradually develop into a bench terrace. According to Assmo and Eriksson (1999), *Fanya juu* will develop faster than *fanya chini*, trash lines or grass strips.

Excavated bench terraces are labour intensive and not suitable for shallow soils and result in loss of production in the first and second year after construction (Assmo and Eriksson, 1999). Usually the subsoil is brought to the surface on the inner part of the terrace which becomes infertile. Developed bench terraces are the most commonly used bench terraces in Tanzania and are generally more suitable for small scale farms (Assmo and Eriksson, 1999).

Morgan (1986) recommended the use of ladder or *fanya juu* terraces as an alternative conservation measure in the Uluguru Mountains. According to Temple (1972), the most commonly identified SWC techniques, used especially in Mgeta area are ladder (step) terraces, tree planting, intercropping and the laying down of weeds and grass in ridges along contours to counteract sheet wash. Ladder terraces are commonly referred to by Mgeta people as *"matuta ya kudumu"*, a Swahili term that literally means permanent ridges which are made by heaping soil from an upper position of an area. The soil is heaped on grass, weeds or any vegetation that is scrapped and heaped prior to being covered by the soil. Successive terraces make a ladder-like structure.

Relative to bench terraces, ladder terraces are narrower and require less labour to make (Magayane, 1995). When cultivating ladder terraces, grass and crop residues are incorporated in the terrace. Incorporated crop residues, weeds and grass rot and add organic matter to the soil. Organic matter improves plant nutrients and also improves water infiltration. Improved water infiltration minimizes excess overload water and reduces soil erosion (Magayane, 1995).

2.5 Effectiveness of SWC Measures

Herweg (1993) quoted by Shaxson (1999), found that in Ethiopia, level and graded *fanya juu* terraces that were one to four years of age, decreased maize yields by 73% and 24% respectively. The respective decrease in beans yields were 36% and 52%. Conversely, a study undertaken in Usambara Mountains by Tenge (2005) found that the improved SWC measures namely bench terraces, *fanya juu* terraces and grass

strips are physically effective if implemented and maintained according to the recommendations, and for appropriate soil and slope conditions. According to the study, *fanya juu* is the most physically effective followed by bench terraces and grass strips. Surface run off was reduced by 74% on *fanya juu*, 49% on bench terraces and 25% between grass strips. Bench terraces increased maize yield by 88%, *fanya juu* by 57% and grass strips by 14%, with reference to the yield level in the situation without measures. Research conducted by Kisanga *et al.* (1992) at Mgeta revealed that bench terraces had less fertile soils compared to ladder terraces and uncultivated comparable soil.

The contradicting results reported by the studies above imply that increased crop production requires more than terracing. Assmo and Eriksson (1999) suggested that physical measures should always be combined with biological and cultural measures for optimal agricultural production. According to Posthumus (2005), terraces will only result in increased production if it is combined with intensified crop management or with crops of high market value.

2.6 Adoption of SWC

Factors that influence the adoption of SWC practices can be classified into socio-economic, institutional, cultural, personal and technological. Hatibu *et al.* (2000) identified the important socio-economic characteristics influencing adoption of SWC as farm labour, land tenure, farm size, economic status, off farm income earning, lack of short-term benefits and perceived relative advantage. Another important factor is compatibility to existing values, experience and need.

Institutional factors include level of extension visits, awareness on costs and benefits, technical know-how and membership in farmers groups. According to Semgalawe (1998), institutional support from SWC programmes especially educational activities such as village-level training, village tours, information from mass media and participation in conservation planning enhance the level of investment in soil conservation significantly. Membership in farmers' groups and contacts with extension agents have positive influence on the adoption of SWC measures (Tenge, 2005).

Magayane (1995) identified access to land and capital, risk considerations and number of family members working on the farm being farm structural variables influencing the adoption of conservation techniques in Mgeta.

2.6.1 Socio-economic factors influencing adoption of SWC practices

Socio-economic factors play an important role in determining the decision to use improved SWC measures.

2.6.1.1 Economic returns

To be adopted, SWC practice should fulfill its prescribed social and economic roles. It is important that people see the advantage of using the introduced practice. According to Liniger and Critchley (2007), socially, SWC helps secure sustainable livelihoods by maintaining or increasing soil productivity, thus improving food security and reducing poverty. It can also support social learning and interaction, build community spirit, preserve cultural heritage, and counterbalance migration to

cities. Economically, SWC pays back investments made by land users, communities or governments. Despite the benefits accruing from SWC as Liniger and Critchley (2007) point out, the adoption of the practices in most parts of the country is generally disappointing. Implicit in this is that there is a problem with adoption of SWC practices.

Usually, the results of SWC benefit not only the land user but the society in general. The introduction of high value crops in the Uluguru Mountains was meant to improve the individual benefits (make the measure more financially attractive) so that the land users would be motivated to invest in the SWC. It is difficult for farmers to aim to meet social objectives before meeting the individual ones. According to Shiferaw *et al.* (2003), in absence of private benefits for the farmer, there is no incentive or rationale for him to invest in SWC even though there are substantial social benefits.

The introduction of high value crops in the Uluguru Mountains was also based on the understanding that the short-term benefits accrued from SWC are negligible. The intervention was therefore meant to improve these benefits. As capital-constrained farmers heavily discount long-term benefits in order to meet short-term needs, the negligible short-term benefits work as a disincentive for private investments (Shiferaw *et al.*, 2003). Sanders (1990) stressed that for any conservation programme to be effective, every effort must be made to develop practices that not only conserve the soil but also provide short-term tangible benefits to the farmers.

2.6.1.2 Labour

Agriculture is generally absorbing more labour than many other sectors. Among the rural poor, labour for conservation activities will have to be derived from either of the four categories of farm household activities namely productive and general farm activities, off-farm activities, home and social activities and leisure (De Graaff, 1996). Often, soil conservation will be given a lower priority than for example firewood or water collection. Compared to Asia, labour availability in Africa is frequently a greater constraint to increasing agricultural productivity than availability of land. As a result technological innovations, which require a higher labour input, often may not result in the full realization of potential production increases (De Graaff, 1996).

In Mgeta, all farming tasks are undertaken by human labour. Heavy labour demand for bench terracing was cited by Page-Jones and Soper (1955) as one of the reasons for the failure of the Uluguru Land Usage Scheme (ULUS) in the 1950s.

2.6.1.3 Land tenure

Land tenure refers to both ownership and utilization rights, which are very complex issues in Africa and differ widely from one part to another (Cook and Michael, 1991).

SWC measures require some costs to implement. It is therefore logical that someone would be willing to invest in land he/she owns rather than a rented one. According to Hella (2003), farmers who cultivate their own land are more likely to invest in SWC

than those renting, leasing or sharecropping someone else's land. Arguably, it is due to this that Liniger and Critchley (2007) stress that policies to improve the rights of individual land users and/or rural communities to use their local land resources on a secure and long-term basis must be recognized as an important means of supporting SWC.

To some tribes like Waluguru (the inhabitants of Uluguru Mountains) lineages hold property rights over portions of the territories. To them traditionally, land is an inalienable possession of the lineage. Due to this, some tribes have limited access to land and therefore have to rent some on annual basis. Thus, for the hired lands adoption of improved SWC practices is hardly expected.

2.6.1.4 Farm size

Scattered fields contribute to low adoption of improved SWC measures, as farmers have to decide where to invest first, depending on walking distance, labour requirements for fertilizer transport and production objectives (Tenge *et al.*, 2004). The study reveals further that some farmers are reluctant to implement SWC measures such as terraces and *fanya juu* out of fear that their small fields will be further reduced by these measures.

2.6.1.5 Compatibility with existing values and experiences

Conservation practices should be appropriate to local conditions and capable of being integrated into local farming systems while at the same time preventing or controlling erosion (Hudson, 1995). Magayane (1995) postulated that the

recommended package for conservation under the ULUS might have been more easily accepted if it capitalized on the wide spread use of ladder terraces that already existed rather than the unfamiliar bench terracing that ULUS was enforcing. More attention should be given to local innovation as well as to traditional systems, rather than focusing solely on project-based SWC implementation of standard technologies (Liniger and Critchley, 2007).

2.6.2 Institutional factors influencing adoption of SWC practices

Institutional factors are known to have influence on the level of investment households commit to soil conservation. According to Semgalawe (1998), institutional support from SWC programmes especially educational activities such as village-level training, village tours, information from mass media and participation in conservation planning enhance the level of investment in soil conservation significantly. To ensure success of SWC programmes it is important to make use of participatory approaches that seek to continuously involve all stakeholders. Liniger and Critchley (2007) suggest that SWC research should seek to incorporate land users, scientists from different disciplines and decision-makers. Magayane (1995) wrote while soil conservation is the solution to soil erosion from scientists' view point, the people of Mlali and Mgeta see themselves as incapable of doing anything to control soil erosion. He adds that there are differences in the conceptualization of soil erosion between farmers and scientists and technocrats.

Information sources will determine the level of awareness of soil erosion as a problem. The information sources will enhance the knowledge on costs and benefits of SWC practices and technological requirements.

2.6.2.1 Awareness on costs and benefits and erosion as a problem

It is unlikely that farmers will engage in SWC practices unless they become aware of land degradation problems (Anim, 1999; Kangalawe, 1995). Awareness of the land degradation and perception of the profits to be accrued out of the soil conservation practices are crucial factors for investment in any conservation measure (Anim, 1999).

2.6.2.2 Technical know-how

For improved SWC practices to be adopted, people should have the necessary technical knowledge. According to Liniger and Critchley (2007), investment in training and extension to support the capacity of land users and other local and national stakeholders must be a priority to adapt better to changing environmental, social and economic conditions and to stimulate innovation.

2.6.2.3 Membership in farmers groups

Farmers in groups are more likely to adopt SWC innovations than individual farmers (Tenge, 2005). According to Jones and Rolls (1982), the group offers a more effective learning environment through mutual reinforcement and pressure against the rejection of new practices or ideas. Decisions which are the results of group processes are more binding. In group farmers have the opportunity of sharing labour and hence mitigating the problem of labour intensiveness in some SWC measures.

2.6.3 Incentives for Adoption of SWC

Incentives refer to stimulus from external institutions (e.g. market, programmes or government) that influence the behaviour and decision-making of farm households (Posthumus, 2005). In a broad sense incentives could cover all activities which increase the chance that a land user will adopt the recommended SWC activities (De Graaff, 1996). Many SWC projects use incentives as a way of promoting technology adoption. However, the role of incentives in promoting adoption is debatable (Posthumus, 2005).

2.6.3.1 Types of incentives

In conservation, an incentive that encourages conservation is referred to as positive incentive. It can be distinguished from disincentives which discourage behaviour towards conservation and perverse incentives which, according to De Graaff (1996), are measures or policies which induce behaviour that accelerates land degradation. In this study, unless specified otherwise the term incentive refers to positive incentive.

Incentives can be direct or indirect. Whereas direct incentives can be provided in cash or in kind, indirect incentives include services, fiscal and legislative measures. Indirect incentives can be provided at the local level through creation of certain services and infrastructure such as the establishment of village nurseries, where interested farmers could buy seedlings at low prices; farm inputs supply centres; creation of savings and credit schemes; and a whole range of development activities which indirectly stimulate farmers to undertake conservation measures (De Graaff,

1996). Posthumus (2005) classifies the indirect incentives into variable, regulating and enabling incentives which include land security, credit facilities and market development. De Graaff (1999) mentions social instruments that are used to raise awareness or moral persuasion through extension efforts as another type of enabling incentives. Regulating incentives can be regulatory measures like legal and institutional arrangements (De Graaff (1999). Variable incentives which include input and output prices, subsidies and interest rates alter the net returns that farm households receive from their SWC activities (Posthumus, 2005).

Incentives used for conservation in the Uluguru Mountains and therefore pertinent for this study include those described below:

Food-for-work

The term food-for-work also referred to as food aid is expressed in various studies (De Graaff, 1996; Critchley, 1999; Kamar *et al.*, 1999; Scherr and Current, 1999; and Sanders *et al.*, 1999) to imply giving people a certain quantity of food on completion of a specific task. These studies show that the incentive has not been effective in providing sustainable results in conservation. The food-for-work incentive referred to in this study is that of giving farmers food to be eaten at work when they participate in educational programmes for conservation. This may take the form of lunch, breakfast or dinner depending on the nature and timing of the programme.

In the Uluguru Mountains, during the SWC training and demonstration activities, participants are usually provided with food which is eaten on-site during the programme implementation. Food provision is based on two main reasons. Firstly, farmers are usually fully engaged in the programme for most part of the day including the lunch time since such programmes do not allow them time to go home to prepare food. The restriction is based on project approach which considers going home for lunch as inconvenient as there are chances that the farmer, with his multiple objectives may find something more interesting or troublesome at home and refrain from returning for the programme or failing to concentrate. There are also some educational programmes in which farmers have to stay for a number of days in a training centre and hence provided with breakfast, lunch and dinner. Secondly, it is during meal times that farmers socialize and strengthen their group. Often the participants form a group which implements terracing at each others field in a labour sharing style.

Savings and credit schemes

Savings and credit schemes aim at availing people with credit whose conditions are usually site-specific and hence more suitable for particular population. There are cases where credit schemes are designed to offer credit for specific activities such as agriculture and hence agricultural credit, or agroforestry and hence agroforestry credit. Based on an Indonesian case, De Graaff (1996) found that credit for investment in conservation measures, with their long term impact is an unlikely option. Scherr and Current (1999) argue that formal lines of credit for agroforestry and particularly subsidized credit may not be essential in promoting smallholder

agroforestry, and in fact, tends to be diverted to better-off farmers who do not need the risk-reducing benefits.

In the Uluguru Mountains, UMADEP has facilitated emergence of savings and credit cooperative societies (SACCOS) by facilitating mobilization of financial resources from farmers, training of local clerks and SACCOS management committees as well as linking the SACCOS with service providers like auditing institutions. The SACCOS were also supported with safe and industrial building materials. From the SACCOS farmers can obtain credit/loans for funding farm and non-farm activities.

Improvement of irrigation systems

Usually, supplementary irrigation is crucial for extension of the planting season into the dry period. Attaching an irrigation improvement component to a SWC measure may enhance adoption of the particular measure. However, this may not work in an area where irrigation is not a priority. In West Usambara Mountains where Traditional Irrigation Project (TIP) required farmers to implement afforestation and terracing as pre-requisite for being granted irrigation support, successes were observed where there was growing dependency on irrigation and farmers' awareness of the need for SWC (Tenge, 2005).

With irrigation, in the Uluguru Mountains production of vegetable crops can be done all year round. Endeavouring to improve agriculture in the area, together with other interventions UMADEP worked on improvement of traditional irrigation systems.

The initially promoted terraces had a channel at the bottom of the riser which connected to subsequent terraces forming ‘S’ shape and hence named S-form irrigation. The S-form irrigation provided an efficient way of using water in that the irrigation water was controlled from washing away the top soil on steep slopes and destroying crops, and could be collected on one terrace to seep sufficiently deep before being allowed to the next terrace. A farmer with terraces does not have to irrigate as frequently as the one without terraces since water seeps deeper on terraced land. Moreover, irrigating on terraces is easier than on non-conserved land with steep slope.

Promotion of high value crops to be grown on conserved lands

This indirect incentive has a market development effect and awareness raising effect. The later takes place when a farmer participates in crop promotion programme and also learns about SWC as a pre-condition for successful crop production. Market development results from production of highly marketable crops. In Kenya, a programme of upgrading cattle improved conservation as it was an incentive for farmers to plant fodder grasses and improve natural pastures (Kamar *et al.*, 1999).

The high value crops considered in the study are improved varieties of tomatoes, cabbages, garden peas and Irish (round) potatoes. All these crops were produced in the Uluguru Mountains even before the project (UMADEP) interventions. However, the crops were produced for subsistence purposes. For instance they produced indeterminate tomato varieties namely marglobe and moneymaker, whose fruits were very perishable (had soft skin so they rotted in about three days) and not highly marketable. The introduced dwarf varieties namely Cal J, Tanya, Roma VF etc are

highly marketable, high yielding, have harder skin and therefore can survive harsh transportation from the area to Dar es Salaam (the main market) and take long time (more than seven days) in the market. The mentioned vegetables are also produced on the steep slopes (non-conserved land) but with lower yield and more production costs (due to irrigation and land preparation difficulties requiring more labour).

In the course of promoting the high value vegetable crops, farmers were organized to form inputs selling centre, partly as an income generation activity for the responsible group and as way of bringing the service closer to farmers. Farmers were also facilitated to establish marketing groups to enhance farmers' negotiation power to obtain better crop prices. This attempt aimed at improving people's income from cash crop production as well as promoting terracing.

Extension services and educational programmes

Education incentives can take the form of distributed booklets or leaflets, newsletters, public or personal talks and on-farm demonstration of conservation measures free of direct cost to land users. Ideally, no conservation incentive programme should be without education incentives (Cumming, 2007).

Stressing the importance of extension services in ensuring adequate response to incentives, De Graaff (1996) contends that farmers can only respond to incentives if they are well informed about appropriate technical solutions and their short and long-term effects, and when they have received extension training in these techniques.

In the Uluguru Mountains, farmers involved in conservation had their representatives engaged on training programmes in Kenya and Lushoto (western Usambara Mountains). Training programmes involved also various farmer to farmer visits and indoor training. In all these cases, farmers were learning also other things which are important for their lives. Exchange of information took place especially when farmers were engaged in programmes that involved visiting fellow farmers.

During the implementation process close follow up was ensured. In this regard, extension agents visited farmers on farm to see the progress in terracing and reinforce the training. Moreover, they encouraged and participated in farmer to farmer visits. Extension agents worked also with non-trained farmers who were interested. Sometimes farmers were asked if they were ready to invest in SWC. Also few farmers contacted the extension agents to seek their support in terracing skills.

Group formation

Where people are aware, well organized, discussing options and working together, a positive atmosphere is created for implementation of conservation measures (Palmer *et al.*, 1999). On the other hand, cooperation is not cost free and may impose psychic and social costs on people who prefer not to associate with other members of the group from other communities (Kerr and Sanghi, 1993).

In the course of learning the SWC practices, in the Ulugurus farmers came to know each other better and agreed to form conservation groups. Each group member was responsible for implementing terracing in each other’s field. This labour sharing was

planned to reach at least one of the plots owned by each group member. Individual group members were responsible for the rest of their plots. Where applicable, the group members were also assisting the non-group members with terracing skills. The conservation groups were also networking with other farmers groups in the area. During the network meetings which took place once in a month, the group exchanged information with other groups. In this way they received advice both from fellow farmers and from extension agents participating in the meetings.

2.6.3.2 Justification for using soil conservation incentives

There are two schools of thought about the use of soil conservation incentives. There are those who support the use of incentives for the reason that soil conservation results in benefit not only for the land user but also the society in general. This justification is actually about the distance in time and space from the cause and the effects of erosion. Sanders *et al.* (1999) argue that incentives may be necessary to overcome barriers to the adoption of profitable conservation measures and they are definitely justified when these measures yield external benefits. The second school of thought is those who oppose the use of incentives for the reason that when the incentives are removed farmers will not maintain the measures.

At any rate there are instances where incentive use is justifiable. Use of the right set of incentives can be justified, for instance, when the adoption of SWC measures is not profitable to the land user but the downstream communities and future generations. De Graaff (1996) argues that in soil and water conservation and watershed development programmes incentives are often required to assure that

(national) economically viable measures are also financially attractive for the groups that are supposed to implement these measures. Conversely, in a situation where the land user stands to benefit directly from the conservation measure in question and he/she has the means to implement the measure, use of incentives is not justifiable. Sanders and Cahill (1999) suggest that a farmer may not require provision of any subsidy to adopt a conservation-effective practice like minimum tillage if it is within his/her financial means and if that farmer perceives a direct advantage in acquiring the necessary equipment and changing his/her management practices.

2.6.3.3 Effectiveness of incentives

An incentive should aim at altering the long-term behaviour of the land user. De Graaff (1996) stresses that to be effective, the incentive must be oriented towards farmers' needs and problems, instead of focusing on wide scale implementation of technical measures whose relevance farmers do not understand or do not have the resources to maintain. Likewise, Sanders *et al.* (1999) emphasize the need of devising incentives that work within the particular institutional structure within which the soil conservation problem exists, and building incentives into the social and economic system for the maintenance and long-run continuation of soil conservation activities. It is also important that an incentive is accompanied by training that makes beneficiaries aware of why they receive the incentive and when it ends.

Comparing direct and indirect incentives, Sanders *et al.* (1999) argue that projects need incentives to influence farmers' behaviour in the short term, and that indirect incentives are by far the most important when compared to direct incentives. Various

studies (e.g. Bunch, 1999; Sanders *et al.,* 1999 and Kessler, 2006) show that direct incentives have the danger of creating dependency. Moreover, direct incentives have a discriminating effect where only adopters benefit from them while indirect incentives affect the whole community or population whether they adopt the new technology or not (Posthumus, 2005). Nevertheless, it is important to stress here that an incentive that works well in one area may not work in another area. Sanders *et al.* (1999) cite an example of food-for-work incentive for tree and fodder crops which was found to be appropriate and effective in Tunisia, but leading to dependency and reluctance to undertake subsequent agro forestry efforts without payment in Central American agro forestry projects.

In evaluating economic incentives, attention is not only paid to their effectiveness and efficiency, but also to the extent to which target groups are reached, to the timeliness of incentives, to side effects, to equity and to flexibility and ease of administration (De Graaff, 1999).

2.7 Chapter Summary

Soil erosion is a widespread problem in Tanzania. Measures to control erosion include biological (crop rotation, mixed cropping, strip cropping, grass strips and trash lines); cultural (contour farming, early planting, zero/minimum tillage, ridging, mulching and use of organic fertilizers); physical (developed and excavated bench terraces, ridge terraces and stone terraces); cut-off drains; artificial water ways and water harvesting. Various studies report contradicting results regarding effectiveness of the physical erosion control measures in crop yield improvement implying that

increased crop production requires a combination of physical, biological and cultural measures. Overall, physical measures should be combined with biological and cultural measures for optimal agricultural production.

Adoption of SWC practices can be influenced by socio-economic, institutional, cultural, personal and technological factors. To promote adoption of SWC practices, many SWC projects use incentives. Incentives used for conservation in the Uluguru Mountains include food-for-work, savings and credit schemes, improvement of irrigation systems, promotion of high value crops, extension services and education programmes and groups formation.

In general, use of the right set of incentives can be justified. However, the role of incentives in promoting investment in SWC practices among small-scale farmers is still debatable notwithstanding extensive research on the use of incentives. Studies recommend a more adequate understanding of factors and household specific incentives that favour adoption of SWC practices.

This study focuses on the influence of cash crop promotion interventions in promoting adoption of SWC measures in the Uluguru Mountains, Tanzania. Basically, the cash crops promotion interventions concurrently with the promoted SWC technology is meant to increase the net returns that farm households receive from SWC activities. The promoted crops to be cultivated on terraces are high value in the sense that they are highly marketable and better performing on terraces than on non-terraced land. Therefore, farmers will see a reason to invest in terracing. In

Kenya, market creation provided farmers with a strong incentive to seek ways of increasing production by better conservation, improvements in soil fertility and use of irrigation (Tiffen *et al.*, 1994 cited by Kamar *et al.*, 1999). These kinds of incentives, which are intended to increase profitability from mountain agriculture, and hence in support of assertion by Kessler (2006) that for farmers to be interested in SWC it is important to enhance the profitability of agriculture, are also about market improvement and hence closely related to market-based incentives. This is based on the definition by Doremus (2003) that market-based incentives refer to creation of a market for ecologically sound land management, or the goods and services accruing from such management.

According to Ruben and Vaessen (2000), a more adequate understanding of factors and household specific incentives that favour adoption would benefit SWC programmes. This study therefore attempts to investigate the influence of the promotion of cash crop production on adoption of SWC measures in the Uluguru Mountains.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Conceptual Framework

Soil and Water Conservation (SWC) is known to increase income from crop production as a result of increased and sustained crop yields. This is true where appropriate crop husbandry practices have been adopted. Implicit in this is that cultivation of high value crops on soil with inadequate fertility and/or moisture translates to poor performance in terms of crop quality and quantity. Hence soil property and possibility of irrigation are important determinants of returns to investment from SWC. Slope of the field and farm size are also important in determining farmer's decision to invest in SWC as they have effect on extent to which effects of soil erosion are observable and amount of labour required to implement a conservation measure.

Introduction of high value crops and the subsequent successful production of the same means enhanced access to markets as the crops are relatively more demanded in the market and hence increased incomes from crop production. Successful production of high value crops is subject to availability of irrigation means, adequate extension services, accessibility to loans and markets and strong farmers' organizations to improve their ability to lobby for favourable production environment, better crop prices and to facilitate the learning process. Increased incomes from cash crop production will motivate more farmers to produce for sale leading to crop production commercialization.

On one hand, lucrative incomes from production of high value crops may result into intensive cropping which necessitates use of fertilizers and pesticides. On the other hand, since SWC helps to increase as well as to sustain crop yields, the resulting higher farm income may serve as an incentive to invest in SWC. Moreover, the profit accruing from high value crop production can be used to finance SWC.

SWC being a pre-requisite for successful production of high value vegetable crops, it is logical that the high value crops promotion programmes will enhance people's awareness on SWC and therefore increasing the chances of adoption of the technology. However, adoption could be influenced by characteristics like age of the farmer, sex, education, income and household composition. While female-headed households might have less labour available for implementing SWC (Posthumus, 2005); old people are in some cases reluctant to adopt technologies (Tenge *et al.*, 2003). Education level is related to access to educational materials (Tenge, 2005) while income and household composition have an implication on availability of labour for implementing SWC (Kessler, 2006; Semgalawe, 1998) (Fig. 1).

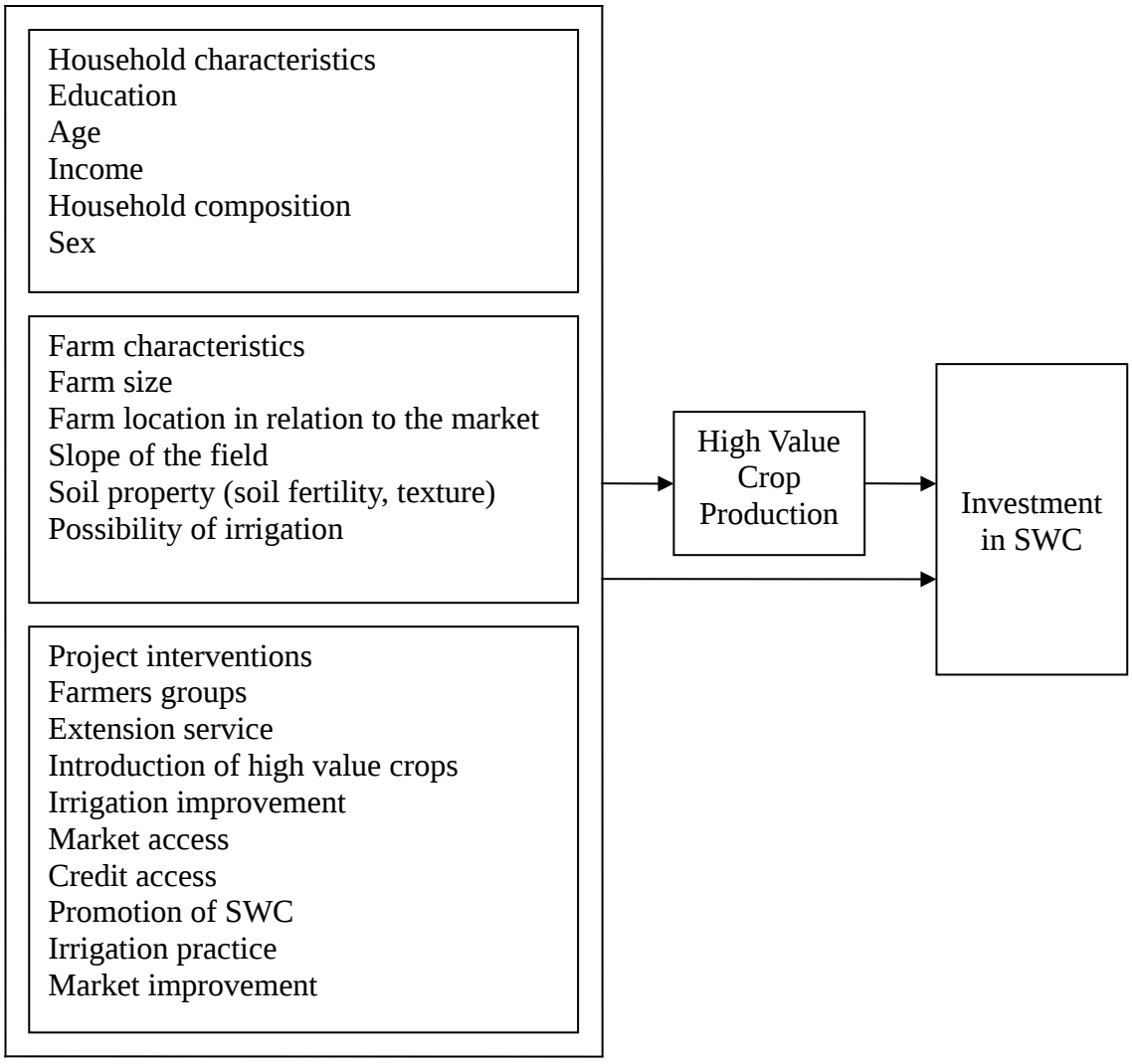

Figure 1: Conceptual framework depicting the relationship of selected explanatory variables, high value crop production and investment in SWC.

3.2 Description of the Study Area

Uluguru Mountains is part of the Eastern Arc Mountains located in central-eastern part of Tanzania, on latitude 7° 01'-7° 12' S and longitude 37° 36'-37° 45' E (Lovett and Pocs, 1993; Hymas, 2000) (Fig. 2).

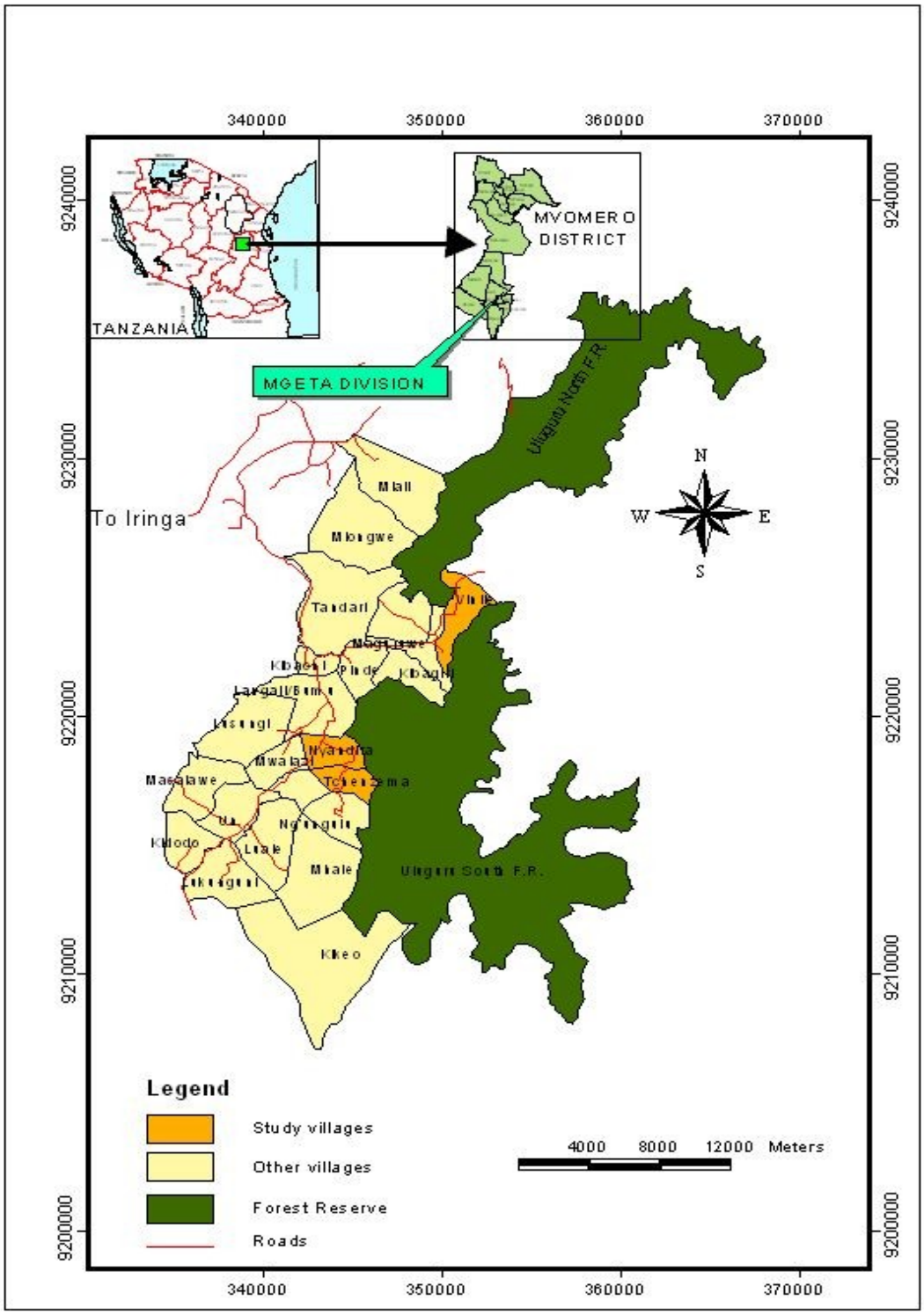

Figure 2: Map of Mvomero District showing the study area

The area is located approximately 180 km from Dar es Salaam, the capital city of Tanzania and the Indian Ocean. The Uluguru Mountains landscape topography ranges from about 600 masl on the mountains' foothills to 2 634 masl at the highest peak at Kimhandu in Uluguru South Forest Reserve (Chamshama *et al.*, 2009).

The study was conducted in the villages of Tchenzema, Nyandira and Vinile of Mvomero District, Morogoro. The villages are located in Mgeta Division, 50 km southwest of Morogoro municipality on the western side of the Uluguru Mountains.

Mgeta which consists of sub-tropical to temperate climatic features lies between 900 masl to 2000 masl. Above 2000 masl is the primary forest reserve. Rainfall ranges from 1000 mm to 2000 mm per annum and annual temperature from 15.3º to 20.5º C depending on the location (Pocs, 1976).

Due to favourable climate, in Mgeta cultivation of vegetables and fruits goes on all year round. Cultivation occurs up to the borders of the forest reserve and occasionally within the reserve (Hymas, 2000; Bracebridge *et al.*, 2005a, b). Most communities in the landscape outside the forest reserve practice unsustainable agriculture (Hymas, 2000; Paulo *et al.*, 2007). Due to its hilly topography and the fact that Dar es Salaam and Morogoro Regions depend on the area for supply of vegetables and water, various organizations found it logical to promote sustainable agriculture and environmental conservation in the area. In this regard, use has been made of various conservation incentives to promote investment in SWC. However, it

is still debatable as to whether or not the use of incentives to overcome adoption constraints had been useful. This was the basis for this study.

3.3 Research Design

The study dealt with human beings as its subjects. The subjects were studied at one point in time and hence the use of cross-sectional design. The design is suitable for descriptive analysis and for determining the relationships between and among variables. The study also used randomization particularly during sampling of the subjects.

3.4 Sampling

The target population consisted of individual farmers at household level and UMADEP and government extension staff.

3.4.1 Sampling techniques

The sampling process was carried out through a combination of sampling methods. In this regard stratified and purposive sampling which are probability and non-probability sampling methods respectively were used. While the villages were selected purposively the criterion being having had an intervention for high value crops promotion and SWC, farmer respondents, purposively subdivided into two equal sub samples on the basis of whether or not one had invested in SWC measures were selected randomly using stratified sampling method. UMADEP and government extension staff were selected purposively as they had to have worked in

selected villages during the implementation of SWC and high value crops promotion.

3.4.2 Sample size

The total sample size was 120 farmers, 40 from each of the three villages namely Nyandira, Tchenzema and Vinile all in Mgeta Division. Three UMADEP and government extension officers were also interviewed as key informants. According to Bailey (1994), regardless of the population size, a sample of not less than 30 is the minimum acceptable size for statistical analysis.

3.5 Data Collection

Primary data collection was done through face-to-face interviews and observations. This involved the use of interview schedule combining qualitative and quantitative questions and checklist of questions for unstructured interviews with key informants. The interview schedule was developed in Kiswahili, Tanzania's national language which is well understood by all Tanzanians and an English version developed by translating the Kiswahili one. Both open and close-ended questions were used. Observation of phenomena was employed to verify and supplement some of the information given by respondents. Indices and ranking was used to explore farmers' attitudes to particular incentives as well as their willingness to implement particular SWC measures. Checklist of questions was used in interviewing 2 UMADEP staff, 1 government extension officer and 4 farmers as key informants. Field observation was used to validate the information on existing SWC measures as well as to distinguish types of crops grown on conserved and non-conserved plots.

Secondary data on SWC practices and farmers investment in SWC were collected from Sokoine University of Agriculture (SUA), Wageningen University in the Netherlands, Uluguru Mountains Environmental Management and Conservation Project (UMEMCP), DALDO's offices for Mvomero and Morogoro.

In the course of collecting data, the researcher was assisted by three interviewers who underwent three days training and participated in a pilot study. The purpose of conducting a pilot study was to achieve validity. In this regard the first draft of the interview schedule was pre-tested in Nyandira village.

3.6 Data Processing and Analysis

Qualitative data from key informant interviews were summarized and used to supplement the information on SWC efforts and high value crop promotion interventions. Quantitative data were processed and analyzed using the Statistical Package for Social Sciences (SPSS). During analysis, the data were coded, entered into a computer and cleaned. Descriptive statistics namely frequency distributions and measures of central tendency were employed to describe major variables of the study as well as finding the distribution of responses among the respondents. Since in the study area there are many interventions that influence investment in SWC, prediction of investment in SWC as a result of such variables or not necessarily utilizes multinomial logistic (MNL) regression, which deals with more than two alternatives e.g. when decision maker has to choose each alternative. According to Ott and Longnecker (2001), the model often used to study the association between a

binary response and a set of explanatory variables is given by logistic regression analysis.

The MNL regression model was used to examine the predictive role of seven SWC promotion interventions, two farm characteristics and one household characteristic on variation in investment in SWC among the population of the area. In this regard, investment in SWC was regressed on eight independent variables. The following equation was used for empirical estimation:

$$Y_i = \beta_0 + \beta_1 X_1 + \ldots + \beta_{10} X_{10}$$

where:

Y_i is the dependent variable, investment in SWC

β_0 is the intercept

X_1 is farm size

X_2 is market access

X_3 is slope

X_4 is total income

X_5 is irrigation improvement

X_6 is high value crops introduction

X_7 is extension service

X_8 is farmers group

X_9 is irrigation practice

X_{10} is market improvement

The likelihood ratio statistic, like in other probability models, was the basis for results interpretation, particularly gauging the extent to which investment in SWC was associated with high value crop promotion interventions.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents and discusses the findings of this study. It is divided into seven sections namely background characteristics of the respondents, soil and water conservation (SWC) measures existing in western Uluguru Mountains, the influence of household and farm characteristics on investment in SWC, SWC measures on high value crops plots vis a vis those on other plots, incentives for investment in SWC practices, high value crops promotion interventions and significance of crop promotion interventions to investment in SWC practices.

4.2 Background Characteristics of Respondents

The background characteristics of the respondents in the study area are shown in Table 1. The table shows frequency distribution of the respondents with respect to their age, marital status, household size, education, occupation, income, farm size, number of farm plots, slope of their fields and land ownership.

4.2.1 Age

Respondents' age ranged from 22 to 73 years. The majority (43.3%) were of the age range of 22 to 36 (Table 1). The area has very few employment opportunities outside agriculture. This implies that the most active age group is well involved in agriculture the predominant activity in the area, and therefore the labour intensive nature of SWC practices may not be an important reason for low investment in SWC. Only 12.5% were aged above 51 years.

Table 1: Percentage of respondents by background characteristics

Characteristics	Description	Frequency (*n* = 120)	Percentage	Mean
Age (years)	22 – 36	52	43.3	40
	37 – 51	47	39.2	
	52 – 66	15	12.5	
	67 – 81	6	5.0	
Education level (years)	No formal education (< 1)	11	9.2	
	Primary education (5 - 8)	102	85.0	
	Secondary education (9 - 12)	6	5.0	
Household size	1 – 3	65	54.2	3.5
	4 – 6	42	35.0	
	7≤	11	9.2	
Labour force	1 – 3	114	95.0	2.1
	4 – 6	5	4.2	
	7≤	1	0.8	
Occupation	Farming	118	98.3	
	Salaried employment	2	1.7	
Farm size (acre*)	0.1-4.0	68	56.7	4.4
	4.1-8.0	40	33.3	
	8.1-12.0	10	8.3	
	12.1-16.0	2	1.7	
Number of farm plots owned	1-2	8	6.7	5
	3-4	45	37.5	
	5-6	48	40.0	
	7≤	19	15.8	
Income (Tshs)	50 000-475 000	79	65.8	549 249
	475 001-900 001	16	13.3	
	900 002-1 325 001	12	10.0	
	1 325 002≤	13	10.8	
Slope of farm plots (per cent)	Gentle (5 - 12)	27	23.9	
	Moderate (12 - 35)	50	44.2	
	Steep (35 - 55)	27	23.9	
	Very steep (55<)	9	8.0	

4.2.2 Education level

In the study area three groups can be distinguished: Those who completed secondary education (9-12 years in school), those with primary education (5-8 years in school) and those who undertook non-formal education (< 1 year in school). The majority of the respondents (85%) had primary education. Only 9.2% were lacking formal education (Table 1). Thus, in the area education level-related obstacles to access to

* 1 acre = 0.4047 hectares (ha)

information usually presented in the form of leaflets, booklets or flip charts during training are not important.

4.2.3 Household size and labour force

The size of the respondent's households ranged from 1 to 10, with an average of 4 members. The majority (54.2%) of the households had 1 to 3 members (Table 1). Household size and composition gives an indication of labour availability for implementing SWC measures.

Regarding the labour force, results show that the majority (95%) of the households had a labour force of 1 to 3 persons. The average labour force was 2 persons. This indicates labour shortage, which may have negative effect on investment in SWC.

4.2.4 Occupation of the respondents

Occupation of the majority (98.3%) of the respondents was farming (Table 1). Only 1.7% of the respondents were employed. Implicit in this is that agriculture is the predominant income earner in the study area and it contributes significantly to the people's livelihood security.

4.2.5 Farm size and number of farm plots

Results (Table 1) show that the respondents' farm size ranged from 0.5 to 16 acres with an average farm size of 4.4 acres divided over 2 to 7 fields scattered within the village of residence and/or in the neighbouring villages. Most (56.7%) of the respondents owned 0.1 to 4.0 acres. Only 1.7% owned more than 12.1 acres. Results

show further that 40% of the respondents owned 5 to 6 plots, the average being about 5 plots. Due to land tenure system in the study area, where land ownership by inheritance is the most common system, the available farm plots have continued to be sub-divided among the growing population leading to ownership of only small plots per person. On one hand, smaller plots could imply the need for intensification and hence likelihood of increased investment in SWC. On the other hand, land fragmentation could have some negative influence on investment in SWC as farmers will have to divide the available labour and other resources among the available plots and will have to incur extra cost to walk from one plot to another during field management. As a result, plots which are distant from home might receive little attention during decision making for investment in SWC.

4.2.6 Slope

As shown in Table 1, the visited respondents' plots had slope ranging from gentle (5-12%) to very steep slope (over 55%). The majority (51.7%) of the plots were steep (35-55% slope). Steep slope fields are more likely to draw land users' attention towards SWC since erosion symptoms are more conspicuous than on gentle slope fields.

4.2.7 Income

Results show that the majority of the respondents (65.8%) had annual income ranging from 50 000/= to 475 000/= Tshs and that only 10.8% had annual income exceeding 1 325 001 Tshs (Table 1). Average annual income was 549 248/= Tshs. Basing on the economic measure of poverty, one can say that most of the households

were living below the poverty line of one USD per day (exchange rate of 1300 Tshs per USD). Low income might inhibit the land users to pay for extra labour to support the implementation of SWC activities.

4.3 Soil and Water Conservation Practices Existing in Western Uluguru Mountains

One of the objectives of this study was to examine the existing soil and water conservation practices in western Uluguru Mountains. Table 2 presents the results of the findings related to this objective.

Table 2: Percentage of farm plots by SWC practice in western Uluguru Mountains

SWC measure	Number of plots	Percentage
Excavated terraces	90	15.8
Fanya juu terraces	15	2.6
Contour strip cropping	3	0.5
Agroforestry	4	0.7
Annual ridges	459	80.4
Total	571	100

Results show that the majority (80.4%) of the farm plots had annual ridges which is a conventional farming method in the study area. In this study, ridging is not considered a SWC measure as the ridges are easily washed away with high velocity water from rain or irrigation canal. Study conducted by Leeuw (2009) in the Uluguru Mountains found out that ridging is not a sufficient measure against soil erosion and that terraces are more effective. Arranged in order of decreasing adoption by the respondents, the SWC practices existing in the study area were excavated terraces (15.8% of the farm plots), *fanya juu* terraces (2.6%), agroforestry

(0.7%) and contour strip cropping (0.5%). Therefore, investment in SWC in the study area covers only about 20% of the farm plots.

Excavated terraces referred to in this study are bench terraces and ladder terraces. It was difficult for most farmers to distinguish between the two. However, based on physical observations ladder terraces were more common than bench terraces. This is probably because bench terraces are relatively more labour demanding to make and more vulnerable to yield reduction during the first three years. A study conducted by Kisanga *et al.* (1992) in Mgeta revealed that bench terraces had less fertile soils compared to ladder terraces.

Higher extent of adoption of excavated terraces than other conservation measures was expected since it was one of the earliest promoted measures in the area. This means that people have had long time (before 1950s) to test and learn about the technology. Moreover, excavated terraces especially ladder terraces are more compatible with existing experiences and needs because the method of preparation and essence of annual ridges, the traditional practice are similar to that of ladder terraces. Only that the later practice, though more effective in SWC requires more labour to make and is more susceptible to yield reduction resulting from more exposure of the subsoil compared to annual ridges.

4.4 Influence of Household and Farm Characteristics on Investment in SWC

Research (Semgalawe, 1998; Posthumus, 2005; Amsalu and De Graaff, 2006) shows that household characteristics (age, education, household size, income) and farm characteristics (farm size, slope, soil fertility) have influence on the level of investment households commit to soil and water conservation measures. In order to determine the influence of household and farm characteristics on investment in SWC, cross tabulation was carried out to compare the results between the adopters and non-adopters and chi-square computed to test the relationship between the identified characteristics and investment in SWC. In this regard, the household and farm characteristics dealt with were age, education level, household size, labour, occupation and income; and farm size, number of farm plots and slope respectively.

4.4.1 Age

Results show that the majority (43.3%) of respondents who had invested in SWC belong to the age group of 37-51 (Table 3). The youngest age (22-36) are the second (40%) in SWC implementation. Only 3.3% of the old age group (67-81) had invested in SWC. This is logical because SWC measures such as excavated terraces and *fanya juu* terraces require energetic people to put up. Also since returns to investment in SWC are usually expected after some years of working on the farm, it is more likely for younger farmers who have longer planning horizon to invest in SWC than for the old ones to invest in SWC. Old farmers are also known for reluctance to adopt technologies.

Statistically, from the chi-square test there is a significant ($p < 0.1$) association of age of the respondents with investment in SWC.

4.4.2 Education

Based on the results, adoption of SWC increased with increase in the level of education of the respondents. 91.7% of the SWC adopters had formal education (Table 3). Comparing the adopters and non-adopters, the results show that 66.7% of the secondary education category had adopted SWC while for those without formal education, the proportion of SWC adopters was 45.4%. This was expected because education is necessary for access to information related to SWC. Similar findings were reported by Semgalawe (1998) who contended that household education level influences the level of investment households commit to soil conservation.

The Pearson based chi-square value is also statistically significant ($p < 0.05$) implying that the two variables, education and investment in SWC are associated.

4.4.3 Household size and labour force

Household size did not have any significant association with investment in SWC. However, comparing adopters and non-adopters, results show that households which had more labour force had more adopters of SWC. 5% of the respondents whose households had 4 to 6 members capable of providing labour force had adopted SWC compared to 3.3% who were non-adopters (Table 3). This can be explained by the fact that to excavate SWC measure, say bench or ladder terraces which are the most

common in the study area, substantial amount of labour is required. However, chi-square test shows that there was no statistically significant relationship between labour force and investment in SWC.

Table 3:Chi-square tests for the background characteristics of respondents by adopters and non-adopters of SWC

Variable	**Description**	**Adopters** ***n*** **= 60**	**Non adopters** ***n*** **= 60**	χ^2
Age (years)	22 – 36	24(40.0)	28(46.7)	24.275∗
	37 – 51	26(43.3)	21(35.0)	
	52 – 66	8(13.3)	7(11.7)	
	67 – 81	2(3.3)	4(6.7)	
Education (years)	No formal education (< 1)	5(8.3)	6(10.0)	24.399∗∗
	Primary (5 – 8)	51(85.0)	52(86.7)	
	Secondary (9 - 12)	4(6.7)	2(3.3)	
Household size	1 – 3	28(47.5)	38(63.3)	16.667∗
	4 – 6	26(41.1)	16(26.7)	
	7≤	5(8.5)	6(10.0)	
Labour force	1 – 3	57(95.0)	58(96.7)	n.s
	4 – 6	3(5.0)	2(3.3)	
Occupation	Farming	60(100)	58(96.7)	n.s
	Salaried employment	0(0)	2(3.3)	
Farm size (acre)	0.1 - 4.0	36(60.0)	32(53.3)	46.373∗∗
	4.1 – 8.0	19(31.7)	21(35.0)	
	8.1 – 12.0	5(8.3)	5(8.3)	
	12.1 – 16.0	0(0)	2(3.3)	
Number of farm plots owned	1-2	2(3.3)	7(11.7)	n.s
	3-4	19(31.7)	25(41.7)	
	5-6	29(48.3)	19(31.7)	
	7≤	10(16.7)	9(15.0)	
Income (Tshs)	50 000-475 000	35(58.3)	42(70.0)	n.s
	475 001-900 001	11(18.3)	6(10.0)	
	900 002-1 325 001	7(11.7)	5(8.3)	
	1 325 002≤	7(11.7)	7(11.7)	
Slope of farm plots (per cent)	Gentle (5 – 12)	11(39.5)	16(60.5)	n.s
	Moderate (12 - 35)	28(56.0)	22(44.0)	
	Steep (35 – 55)	16(58.1)	11(41.9)	
	Very steep (55<)	5(56.2)	4(43.8)	

N.B.
χ^2 = Pearson based chi-square
∗ = Significant at 0.1 level

** = Significant at 0.05 level
n.s = Not significant
In parenthesis for adopters and non adopters columns are percentages

This is probably because the study area experiences labour shortage to a large extent, the average labour force being 2 (Table 1) and hence the available data for labour force bearing little statistical influence. Similar findings were reported by Magayane (1995) who observed that available labour has no statistically significant effect on conservation effort in western Uluguru Mountains.

4.4.4 Occupation of the respondents

Only few (2 out of 120) respondents were employed. All these were non-adopters of SWC (Table 3). This is probably because they had another more important means of earning living and thus had little interest in agriculture. It is also possible that the employees had no time for agriculture as they had to use most of their time on their employment. Chi-square test results show no statistically significant relationship between occupations of the respondents with investment in SWC. Since the majority (98.3%) were farmers, the influence of the rest (1.7%) could hardly show up in empirical analysis.

4.4.5 Farm size and number of farm plots

From the results, most (60%) of the adopters of SWC were those who owned farms with size ranging from 0.1 to 4.0 acres. Only few (8.3%) respondents owning over 8.0 acres had adopted SWC (Table 3). The trend depicted by the results is that

investment in SWC decreases with increasing farm size. The negative effect of farm size might be explained in terms of labour requirement for implementing a conservation measure. Since considerable labour is required to put up some of the conservation measures, it is likely that larger farms suffer labour shortage for implementation of some conservation measures. Study conducted in western Uluguru Mountains by Magayane (1995) revealed that individuals with large farm size are less likely to adopt conservation practices compared to individuals with smaller farms. Chi-square test results indicate significant ($p < 0.05$) association of farm size with investment in SWC.

With regard to number of farm plots, there were fewer (3.3%) adopters compared to non adopters (11.7%) for owners of 1-2 plots and more (16.7%) adopters than non adopters (15%) for owners of 7≤ plots (Table 3). The trend suggested here is that investment in SWC increases with increasing number of farm plots. This was not expected but could be explained by assumption that adopters of SWC have seen better returns to investment in agriculture as they are usually the ones who also adopt other technologies and hence are more inclined and have comparatively more access to financial resources to acquire more land for expansion of agriculture.

4.4.6 Income

The majority (58.3%) of adopters of SWC belong to the annual income range of 50 000 to 475 000 Tshs. However, most (70%) of the non-adopters belong to the same income category (Table 3). While the lowest income category (50 000 to 474 000

Tshs) had fewer (58.3%) adopters compared to non-adopters (70%) the succeeding income categories had more adopters compared to non-adopters.

The chi-square test results indicate that there was no statistically significant association between income and investment in SWC. However, from regression analysis results, income has a positive regression coefficient of 1.22 which is statistically significant ($p < 0.05$) (Table 7). A positive coefficient implies a positive relationship between explanatory and dependent variable. Thus, as income increases, investment in SWC also increases. A study conducted by Hella (2003) in central Tanzania showed that the probability of investing in SWC increases with farmer's income level.

4.4.7 Slope

About half (46.7 %) of the adopters of SWC belonged to moderate slope category (12-35%) where also most (41.7%) of the farms in the study area belonged. Comparing the proportion of SWC adopters and non-adopters by slope category, the results show that respondents whose plots were steep (35-55% slope) were the most responsive to investment in SWC as there were more adopters (58.1% compared to 41.9% non-adopters) in this category (Table 3). The findings can be explained in terms of perceived need for conservation by land users based on physical characteristics of the fields. In this case with steep slope, one can see proneness to erosion and/or erosion symptoms while with gentle slope (5-12%) it is hard to envision the possibility of erosion. Also the fact that extension has been advocating putting up SWC measures on steep slopes might have influenced farmers' decisions

as to where to invest. The results are similar to the findings by Semgalawe (1998) who observed that perception of erosion problems are among the factors that positively influence adoption of SWC in the northern mountains of Tanzania.

Regression analysis shows significant ($p < 0.05$) relationship between slope and investment in SWC (Table 7). Since the regression coefficient is positive, it is implied that increase in slope of the farm is accompanied by increase in investment in SWC.

Overall, the results show that household characteristics namely age, education and income; and farm characteristics namely farm size and slope have statistically significant influence on investment in SWC. Household size, labour force, occupation of the farmers and number of farm plots owned on the other hand do not have statistically significant effect on investment in SWC.

4.5 Adoption of SWC Measure Based on Type of Crops Cultivated

Study findings show that there is a relationship between type of crops grown and adopted SWC measure. In this regard crops have been categorized into high value crops and others, the later group being the crops which have low market value. High value crops grown in western Uluguru Mountains include tomatoes, cabbages, Irish potatoes and others (Table 4). Maize and cocoyam are good examples of the crops considered of low value. When asked of the high value crops they cultivate 20.8% of the respondents mentioned tomatoes. Banana was ranked the second (8.3%)

followed by cabbages (5%) and Irish potatoes (5%). Ranking crops based on their importance, 47.5% of the respondents ranked maize the first (Table 4). According to farmers, maize is the staple food in the area and hence very important. Similar results were reported by Chamshama *et al.* (2009) who found that in the Uluguru Mountains 94.3% of the maize produced is mainly for home consumption.

Table 4: Identification of high value crops by respondents and crop ranking by their importance

Category	Crop	Percentage of respondents	Rank
The top four high value crops			
	Tomato	20.8	1
	Banana	8.3	2
	Cabbage	5.0	3
	Irish potato	5.0	3
The top four crops ranked by their importance			
	Maize	47.5	1
	Tomato	23.3	2
	Cabbage	4.2	3
	Irish potato	4.2	3

Maize is not considered as a major cash crop but vegetables, Irish potatoes, green beans, peas, bananas, carrots and onions are among the major cash crops (Chamshama *et al.,* 2009). Tomato, cabbage and Irish potatoes were ranked the second and third respectively due to being high revenue earners.

Relating existing SWC measures with types of crops grown, the study found out that it was mostly the high value crops plots that were conserved. While 34.9% of tomato plots were conserved, mainly by excavated terraces, only 15.4% of the maize plots were conserved (Table 5).

Similar results were reported by Leeuw (2009) whose study in the Uluguru Mountains revealed that food crops are not as highly valued as cash crops and therefore SWC measures are mostly implemented on plots with cash crops. It is therefore logical that farmers conserve mainly for production of high value crops. According to Mkoba (2001), in north-western part of the Uluguru Mountains, bench and ladder terraces are exclusively used for growing vegetables. This finding is in support of the fact that farmers are not interested in SWC per se but the immediate economic returns. It is the high value crops that can generate immediate economic returns.

Table 5: Number of plots by SWC measure and crop type

SWC measure	Tomato	Irish potato	Cabbage	Beans	Maize
Excavated terrace	30(34.9)	7(35.0)	3(18.7)	19(16.0)	37(15.4)
Fanya juu terrace	1(1.2)	1(5.0)	0(0)	5(4.2)	6(2.5)
Contour strip cropping	0(0)	0(0)	0(0)	0(0)	2(0.8)
Number of conserved plots (terraces, strip crops)	31(36.0)	8(40.0)	3(18.7)	24(20.2)	45(18.7)
Annual ridges	55(63.9)	12(30.0)	13(81.3)	95(79.8)	196(81.3)
Total number of plots	86(100)	20(100)	16(100)	119(100)	241(100)

N.B. In parenthesis are percentages

4.6 Incentives for Investing in SWC

Researchers (De Graaff, 1999; Sanders and Cahill, 1999; Posthumus, 2005) identify savings and credit schemes, extension services, market development, land security, farm inputs supply, agricultural subsidies, agricultural implements, food aid, land tenure arrangements and community organization as incentives which can stimulate farmers to undertake conservation measures.

This study examined the influence of twelve incentives on investment in SWC. The incentives are credit availability, market development, extension services, working as a group, SWC programmes, food for work, rewards and prizes, farm implements, land security, suitability of conserved lands for high value crop production, improved irrigation efficiency and agricultural sustainability. Using five point Likert scale and ranking, the respondents were asked to indicate the extent to which each of the incentives influenced/would influence their decision to invest in SWC. The results are presented in Table 6.

Table 6: Percentage of respondents by incentives' influence on decision to invest in SWC.

Incentives	**Influence on decisions to invest**						
	No		**A little**		**Much**		**Rank**
	n	**%**	**n**	**%**	**n**	**%**	
Suitability for high value crops	30	25.2	4	3.4	85	71.4	8
Improved irrigation efficiency	18	15.1	10	8.4	91	76.5	6
Extension efforts	18	15.1	5	4.2	96	80.7	4
Credit availability	30	25.2	13	10.9	75	63	12
Market development	25	21	12	10.1	82	68.9	10
Working as a group	24	20.2	10	8.4	85	71.4	7
SWC programmes	21	17.6	4	3.4	94	79	5
Food for work	29	24.4	9	7.6	81	68.1	11
Rewards and prizes	24	20.2	11	9.2	84	70.6	9
Farm implements	15	12.6	7	5.9	97	81.5	3
Land security	10	8.4	10	8.4	99	83.2	1
Agricultural sustainability	10	8.4	12	10.1	97	81.5	2

From the results (Table 6), 83.2% of the respondents mentioned land security as the number one incentive that stimulated them to invest in SWC. Only 8.4% disagreed that land security was a motivation for them to invest in SWC. In the study area, traditionally land was an inalienable possession of the lineage i.e. land could not be

given away or taken away but was passed from mother to daughter in a matrilineal system of inheritance. Currently, there is a rather unclear mixture of tradition and modern trends where land is becoming individualized and acquiring an exchange value. This being a result of combined effects of the land pressure caused by population increase and development of cash economy.

One would hardly invest in SWC for a land he does not legally own as the conservation benefits which are usually long-term are likely to accrue to another person. This is possibly the reason why people see land security as the most important incentive for investing in SWC. Similar results were reported by Magayane (1995) who identified access to land being among other farm structural variables influencing the adoption of conservation techniques in Mgeta. Also Hatibu *et al.* (2000) found availability and ownership of land resources to have a positive effect on investment in SWC in Pare Mountains.

Land security is an indirect incentive whose importance in SWC was underscored by Sanders and Cahill (1999) who gave an example of Vietnam where introduction of long-term land rights stimulated farmers to change their practices, planting more perennial crops and hence leading to reduced erosion. According to Boyd *et al.* (2000), farmers who rent rather than own land are less likely to invest in SWC.

Though it takes time for some SWC practices to start improving yields, the good thing is that SWC provide sustained high yields. This is probably the reason for respondents to rank agricultural sustainability the second (81.5%) incentive for investing in SWC.

Support in form of farm implements, extension services and SWC programmes (SWC training, farm visits, study tours and demonstrations) were ranked the third (81.5%), fourth (80.7%) and fifth (79%) respectively. Farm implements provision reduces the cost of putting up conservation measures mitigating the loss in case of failure. According to Hatibu *et al.* (2000), risk of failure is a major constraint against adoption of SWC especially where large labour inputs are necessary. Provision of incentives creates a sense of risk sharing and thus encourages farmers to invest in SWC. No wonder the respondents ranked extension efforts and SWC programmes among the top five because as Kamar *et al.* (1999) observed in Kenya, the incentives which are most likely to have sustainable results are those which involve education and training through which farmers' awareness of the need for SWC is raised and the skills to implement appropriate measures are acquired. Hella (2003) observed that the probability of investing in SWC is likely to increase with increase in institutional support in SWC practices. In Kenya, community mobilization and provision of hand tools resulted in a great deal of conservation activity throughout the country (Kamar *et al.*, 1999).

Improved irrigation efficiency (76.5%), suitability of conserved lands for growing high value crops (71.4%) and labour sharing (farmers groups) (71.4%) have been ranked sixth, seventh and eighth respectively. Among other benefits, SWC measures enhance water use efficiency by providing for possibility of irrigation in steep slopes and improving water retention. Improved irrigation and plant nutrient maintenance renders the terraces best suited for high value crops production. The crops perform

better on terraces than on non-conserved land and hence the reason for farmers to find high value crops and irrigation improvement a motivation for them to invest in SWC. Besides performing better, given good management like fertility maintenance and irrigation, high value crops sell better in the market and can therefore also be categorized under market-based incentive. According to Doremus (2003), market-based incentives refer to creation of a market for ecologically sound land management, or the goods and services accruing from such management. The importance of farmers groups can be explained by the observation by Palmer *et al.* (1999) who contended that where people are aware, well organized, discussing options and working together, a positive atmosphere is created for implementation of conservation measures.

Based on the ranking done by the respondents the four lowest incentives for SWC include rewards and prizes (70.6%), food for work (68.1%) and credit availability (63%). These are direct incentives, which according to Posthumus (2005), have a discriminating effect where only adopters benefit from them while indirect incentives affect the whole community whether they adopt the new technology or not. It is therefore logical that it was only the farmers who had been exposed to these incentives who supported their use in stimulating farmers to invest in SWC.

Overall, from the results we see land security, which is usually determined by legislative measures being mentioned to be the number one incentive for investment in SWC. Land security is an important factor for long-term investment decisions such as putting up terraces. The form of tenure security has important influence on

length of planning horizon and hence extent of investment in SWC. Further, we see that the top eight incentives are mostly indirect incentives which include services, fiscal and legislative measures. As the literature informs (Sanders *et al.*, 1999), compared to direct incentives the indirect incentives are by far the most important. Direct incentives like food-for-work or cash payment proved to be the least important and non sustainable for stimulating soil conservation in Kenya (Kamar *et al.*, 1999). Surprisingly, credit was ranked the last and hence the least. In the study area credit mainly benefited the relatively well-off farmers. The poorest feared of penalties usually charged for defaulters. One woman who had stopped seeking credit asserted *"watu wamelazimika kuuza mashamba kwa kushindwa kulipa mkopo benki"*, meaning people have had to sell their plots for failure to repay their bank loans. Poor access to credit for land users and risk of failure is the possible explanation for this finding. De Graaff (1996) argues that agricultural credit is often not a viable option for farmers due to high degree of poverty, the insecure land titles and the large climatic fluctuations combined with risks of other calamities. Thus, credit for investment in soil conservation measures, with their long term impact is an unlikely incentive. However, indirectly credit that supports high value crops production can be considered to impact on investment in SWC in a similar manner to the introduction of high value crops.

4.7 Crop Promotion Interventions in Western Uluguru Mountains

Interviews with key informants including progressive and old farmers, UMADEP and government extension officers in the study area show that the area started seeing

various interventions that aimed at SWC and agriculture development since 1909. Interventions that aimed specifically at promoting SWC include promotion of terracing technologies namely excavated terraces (more emphasis given to bench than ladder terraces), and developed terraces (*fanya juu* terraces and contour strip cropping), laying down of weeds and grass in ridges along contours (trash lines), intercropping, agroforestry and tree planting. Other crop promotion interventions include introduction and/or promotion of high value crops, irrigation improvement, production and use of farm yard manure and hence improvement of livestock keeping, promoting organic farming practices, promoting inputs supply and small scale fruit processing, market linkages and infrastructural development, enhancing extension services, rural micro finance services, formation and strengthening of farmers groups, and introduction of donkeys for facilitating transportation of crops.

Various organizations have been facilitating the execution of the mentioned interventions. These include German colonial administration in 1909, Uluguru Land Usage Scheme (ULUS) by the British Colonial Government from 1945 to 1955, Morogoro Women Agroforesty Project (MWAP) in 1980s, Uluguru Mountains Horticulture Development Project (UMHODEP) from 1988 to 1993, Uluguru Mountains Agricultural Development Project (UMADEP) from 1993 to date, CARE International in Tanzania from 2004 to date, The National Network of Farmers Groups - *Mtandao wa Vikundi vya Wakulima Tanzania* (MVIWATA) from 1995 to date, Wildlife Conservation Society of Tanzania (WCST) from 1998 to 2005, Village Travel and Transport Project (VTTP) from 2000 to 2004, DAI PESA from 2004 to 2007, Tanzania Agricultural Research Project (TARP) II of the Sokoine University

of Agriculture (SUA) from 2002 to 2006, University of Dar es Salaam (UDSM) in 1980s, Morogoro Regional Catchment Forest Project and Mvomero and Morogoro District Councils from 1980s to date.

UMADEP, CARE International in Tanzania, Regional Catchment Forest Project and Mvomero District Council were mentioned to be the organizations with interventions related to SWC in the study area at the time of the study. Key informants and extension officers' interview findings show that for most of the organizations mentioned as promoting SWC, their presence in the field lasted for less than five years. Moreover, coordination among the organizations was minimal.

4.8 Significance of Crop Promotion Interventions on Investment in SWC Measures

Since in the study area there are many interventions that influence investment in SWC, prediction of investment in SWC as a result of such variables necessarily utilizes multinomial logistic regression, which deals with more than two alternatives e.g. when a decision maker has to choose each alternative. The Multinomial Logistic (MNL) Regression Model was used to examine the predictive role of five SWC promotion interventions, four farm characteristics and one household characteristic on variation in investment in SWC among the population of the area. In this regard, investment in SWC was regressed on eight independent variables. The following equation was used for empirical estimation:

$$Y_i = \beta_0 + \beta_1 X_1 + \ldots + \beta_{10} X_{10}$$

where:

Y_i is the dependent variable, investment in SWC

β_0 is the intercept

X_1 is farm size

X_2 is market access

X_3 is slope

X_4 is total income

X_5 is irrigation improvement

X_6 is high value crops introduction

X_7 is extension service

X_8 is farmers group

X_9 is irrigation practice

X_{10} is market improvement

Results of the regression are presented in Table 7. The eight independent variables accounted for 29% (Pseudo R^2 = 0.2922) and 59% (Pseudo R^2 = 0.5924) of the variation in investment in SWC for plot one and plot two respectively. MNL regression would not produce any meaningful results for the rest of the plots because the plots' data suffered too many missing values since all respondents possessed at least two plots while some had up to seven plots. Hence for each respondent data were available at least for two plots.

Results further show that four of the eight variables have statistical significance implying that the variables' effect on investment in SWC is not by chance. The four variables include two interventions namely introduction of high value crops and

irrigation improvement and two farm and household characteristics namely slope of the field and total income of the land user respectively. The finding was true for both plots. Extension service (coefficient -2.6757) was statistically significant ($p < 0.05$) but only for plot one. Farmers groups (labour sharing) (1.8257), market access (-0.0285) and farm size (-1.9834) were statistically significant ($p < 0.05$) but only for plot two (Table 7). Generally, the study considers the variables with statistical significance in any of the two plots to be important in influencing investment in SWC. However, for statistical rationale, the variables which showed empirical significance for both plots would bear more weight. With regard to interventions, the regression coefficients show that introduction and/or promotion of high value crops to be cultivated on conserved land has the largest influence on investment in SWC followed by irrigation improvement. For the farm/household characteristics slope has larger influence for plot one while income has larger influence for plot two (Table 7).

4.8.1 Introduction of high value crops

Out of the four variables with statistically significant influence on investment in SWC, introduction of high value crops to be cultivated on conserved land was the intervention with the highest (regression coefficient of 1.7985 for plot one and 1.5488 for plot two) explanatory effect on investment in SWC (Table 7). The positive regression coefficient that is statistically significant ($p < 0.05$) means a positive effect i.e. increase in high value crops promotion efforts translates to increase in investment in SWC. This was expected since high value crops perform better on conserved land than on non-conserved land and sell better in the market

and hence increasing returns from SWC activities. Besides this market development effect, high value crops promotion has an awareness raising effect. The later takes place when a farmer participates in high value crop promotion programme and learn also about SWC as a pre-condition for successful crop production. Thus, with high value crops promotion, farmers see a reason for investing in SWC because this way they become aware of the profitable crop to be grown on the lands they are conserving. Similar findings were found by Semgalawe (1998) who observed that high value crops influenced household's economic status and hence investment in SWC in North Pare and West Usambara Mountains.

Table 7: Multinomial logistic regression – estimating interventions that influence investment in SWC measures

Variable	**Plot 1 Coefficient**	**Plot 2 Coefficient**
Farm size	-0.50898**	-1.983447 **
	(0.58819)	(0.983060)
Market access	-0.008149	-0.0285333**
	(0.006299)	(0.0101195)
Slope	1.44089**	2.31046**
	(0.70221)	(0.8432848)
Income	0.0000012	0.00000084*
	(0.00000059)	(0.00000050)
Irrigation improvement	0.282587*	0.9561851*
	(1.281886)	(1.290714)
High value crop promotion	1.548753**	1.798489*
	(0.751792)	(0.9901537)
Extension efforts	-2.675734**	-0.2195554
	(1.062462)	(1.155105)
Farmers group	0.7488387	0.82574**
	(0.5789116)	(0.7874373)
Market improvement	-1.4912*	-1.1134
	(0.834699)	(0.9579)
Irrigation practice	0.6169	3.1809***
	(0.6990)	(1.0384)
Constant	-1.745587	-2.392256
	(1.529805)	(1.826456)
Log likelihood	-55.4453	
Pseudo R^2	0.2922	

LR chi2 (20)	45.77	
N	120	120

N.B. Values in parenthesis are asymptotic standard errors.

*, ** and *** denote significance at 10%, 5% and 1% levels respectively.

It is logical to assume that with increased returns from SWC activities, some of the revenues can be re-invested in putting up more SWC measures and/or maintaining the already installed ones.

Lack of tangible benefits, lack of short-term benefits and reduction of farm size available for crop production have been identified by researchers (Tenge, 2005; Tenge *et al.*, 2004; Mkoba, 2001) as important factors with negative effect on investment in SWC. Promotion of high value crops to be grown on conserved lands would mitigate the effects of the mentioned barriers as this would aid to generate more returns to investment in SWC and as Stroud (2000) puts it, compensate for the losses. According to Posthumus (2005), terracing will only result in increased production if it is combined with intensified crop management or with crops of high market value.

4.8.2 Irrigation improvement

Irrigation improvement was found to be the intervention with the second highest influence on investment in SWC among the statistically significant ones. It had regression coefficients of 0.2826 and 0.9562 for plots one and two respectively which is significant ($p < 0.1$) (Table 7). The coefficients are positive implying that increase in irrigation improvement translates into increase in investment in SWC.

Farmers' goal number one in SWC is to increase crop productivity, usually through intensification that involves cultivation of high value crops and having one or more crops in the farm through out the year. This goal can only be achieved through irrigation and hence the basis of the argument that without irrigation possibility, SWC makes little sense to a farmer. Therefore continued investment in SWC in the absence of irrigation possibility is rather unlikely. Similar findings were reported by Tenge (2005) in West Usambara Mountains where the result of the attempt of Traditional Irrigation Project (TIP) requiring farmers to implement afforestation and terracing as pre-requisite for being granted irrigation support was that successes were observed where there was growing dependency on irrigation and farmers awareness of the need for SWC. Study conducted by Hatibu *et al.* (2000) in western Pare lowlands found the risk of loss of rain, irrigation water and the consequent erosion to be the main reasons for investing in SWC.

4.8.3 Slope

Of the farm characteristics included in the model, slope of the field had the highest coefficients (1.4409 and 2.3105 for plots one and two respectively) which are statistically significant ($p < 0.05$) implying that in that category slope was the variable with the largest influence on investment in SWC (Table 7).

The variable had a positive effect meaning that investment in SWC increases with increase in slope of the field. Terracing of steep slope fields makes more sense to a farmer because with steep slopes difficulties of irrigation, loss of rain and irrigation

water and erosion symptoms such as top soil removal and crop yields decline are more conspicuous than on gentle slope. Hence with steeper slope a farmer would be much more convinced to intervene. Similar findings were reported by Kessler (2006) who observed that major SWC investments are made on fields with steeper slopes.

4.8.4 Income

Income of the respondents had coefficients of 1.22 and 8.40 for plots one and two respectively which are significant ($p < 0.1$) implying positive influence on investment in SWC. Thus, increase in income of a farmer translates into increase in investment in SWC. This is expected as it is generally known that implementation of SWC measures requires some financial resources to pay for additional labour. According to Hatibu *et al.* (2000), financial capital is mainly used to pay for additional labour when investing in SWC. The study findings differ from those of Magayane (1995), which showed that total income has no statistically significant effect on the use of innovative farming practices. On the other hand, the results are similar to those of Kessler (2006), who observed that farmers with higher income from agriculture invest more in SWC.

Overall, during identification of SWC incentives, irrigation improvement and the introduction and/or promotion of high value crops to be grown on conserved land were ranked among the top eight. Slope, based on the chi-square test was found to be significantly associated with investment in SWC. Unexpectedly, the same test did

not show empirical evidence for association between income and investment in SWC.

4.8.5 Farmers groups, extension services, market access, market improvement, irrigation practice and farm size

Based on regression analysis results, six parameters namely farmers groups, extension services, market access, market improvement, irrigation practice and farm size had statistical evidence to prove their influence on investment in SWC but each in one of the two plots. This was not expected. Even though significant in only one of the plots, the negative effect of extension, market access and market improvement is against expectation. The possible explanation could be that with market improvement (access, crop prices and overall selling environment) farmers see SWC as an option which delays them from grabbing the opportunity of increased crop prices resulting from markets improvement. Similar results were observed on farmers ranking of the incentives for investment in SWC where market improvement was ranked last but two (Table 7). A study conducted by Hella (2003) observed that extension had negative and non-significant influence to farmers' willingness to invest in SWC.

Farmers groups, though statistically significant for plot two is considered lacking strong statistical basis because for plot one it was not significant. In the study area, people used to work communally in activities like digging the land, laying out a plot for house construction and others. With time however, this spirit has been fading away. This could be a possible explanation for the low predictive effect of farmers

groups to investment in SWC. Similar findings were reported by Kerr and Sanghi (1993) who observed that farmers prefer to invest in SWC individually or in cooperation with an adjacent farmer rather than in large, cooperative groups. The positive effect in plot one could be implying significant influence resulting from labour sharing that, as Semgalawe (1998) argues, works as an incentive to investment in SWC or from the fact that it is an effective means of disseminating SWC technologies.

Farm size behaved in a similar way to farmers groups. It was statistically significant but only for plot 2 (Table 7). The unstandardized regression coefficient (-1.9834) of farm size was significant ($p < 0.05$) and negative. The negative coefficient implies that the variable has a negative predictive effect on the dependent variable. In that regard, increase in farm size is accompanied with decrease in investment in SWC. Smaller farm sizes necessitate intensification in order to earn sustained returns from the same small piece of land, the goal which can only be achieved through investing in SWC. Similar results were obtained with chi-square test which showed that investment in SWC decreased with increasing farm size (Table 7). The findings differ from those of Hatibu *et al.* (2000) who observed that farmers with smaller farm sizes tend not to use SWC on any of their plots. However, similar findings were obtained by Magayane (1995) who reported that in the Uluguru Mountains individuals with large farm size are less likely to adopt conservation practices than individuals with smaller farms.

Overall, as expected, the findings show the introduction or promotion of high value crops to be cultivated on conserved land to be the intervention with the highest influence on investment in SWC. Since the intervention is usually accompanied with training on improved agronomic practices (including irrigation improvement) and that group approach has been followed during training programmes, the considerable influence suggested for the mentioned interventions (Table 7) on investment in SWC was not surprising. Historically, in the Uluguru Mountains promotion of bench terracing could not be sustained for many reasons including crop failure in some of the demonstration plots (Temple, 1972), and the fact that the imposition of the measures was biased on technocrats interest of seeing erosion controlled while paying little attention to farmers interest i.e. improved crop productivity. Lyamuya *et al.* (1994) assert that in July 1955 farmers in the Uluguru Mountains were allowed to choose the conservation measures that they wanted to use, with many of them opting to use none, and that between 1955 and 1980s conservation more or less stopped. No wonder therefore that the introduction and/or promotion of high value crops to be cultivated on conserved land was found to be the most influential and hence commendable variable since contrary to the past engineering approach, the intervention sounds more as intending to improve productivity but having a positive influence on investment in SWC. It is therefore arguable that with high value crops, little by little farmers will improve on investment in SWC.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

The general objective of the study was to determine the influence of high value crop promotion on farmers' investment in soil and water conservation practices in the Uluguru Mountains. Based on the findings of the study, the following conclusions and recommendations can be made:

5.1 Conclusions

(i) The majority of farmers in western Uluguru Mountains were practicing annual ridges, the conventional farming method which is not an effective SWC measure. The existing SWC measures like excavated terraces, *fanya juu* terraces and contour strip cropping were undertaken mainly for the production of high value crops while for other (low value) crops farmers were using annual ridges.

(ii) The most important reasons for investing in SWC measures by farmers was to improve irrigation efficiency and to facilitate the production of high value crops like tomatoes, Irish potatoes and cabbages. Use of the right set of conservation incentives therefore does stimulate investment in SWC. Indirect incentives such as land security and promotion of high value crops to be grown on conserved land are very effective in that regard.

(iii) Since the early 1900s to date, various cash crop promotion interventions have been implemented by various organizations in the Western Uluguru Mountains. The interventions include promotion of SWC practices (terracing, contour strip

cropping, trash lines, agro-forestry and tree planting), introduction of high value crops like tomatoes, Irish potatoes and cabbages, improvement of traditional irrigation systems, agricultural credit and inputs supply, value addition and marketing, improvement of extension services and strengthening of farmers institutional capacities.

(iv) Introduction of high value crops to be grown on conserved land has a significant influence on farmers' decision to invest in SWC. It is an indirect way of promoting SWC as in this way farmers consider SWC a pre-requisite to successful production of high value crops. Irrigation improvement and extension services improvement are also important especially when well linked to promotion of economically viable production option like production of high value crops. Farmers groups provide an avenue for learning together and labour sharing during implementation of SWC activities.

5.2 Recommendations

Based on the study findings, there is empirical evidence supporting the assertion that high value crops promotion influences investment in SWC. Furthermore, the use of right set of incentives can stimulate investment in SWC. The following recommendations are made for enhanced SWC and sustained agricultural production and productivity in sub-tropical mountainous areas in general and in western Uluguru Mountains in particular:

To SWC programmes:

(i) Promote SWC measures which are cost-effective and can be integrated into existing farming system. In western Uluguru Mountains, the study advocates promotion of ladder terraces and *fanya juu* terraces depending on farm characteristics and farmer's production objectives. Where banana is the crop a farmer chooses to produce, *fanya juu* is the appropriate option. At any rate SWC measures should be combined with improved agronomic practices and high value crops.

(ii) Introduce and promote high value crops to be cultivated on conserved land. This is a necessary incentive for investment in SWC as it tends to increase the net returns that farm households obtain from SWC activities. Profitability of a SWC measure is a key factor to ensure sustainable investment in the technology. To be effective, the promotion of high value crops should take into account the necessary aspects of profitability such as market linkage to ensure high crop prices and improved agronomic practices including irrigation and soil fertility improvement for increased yields and hence reliable extension service and on-farm trials and demonstrations. Increased income from high value crop production in turn improves farmers' ability to invest in SWC.

(iii) Use of incentives: SWC results benefit not only the land user but also the society in general. This justifies the use of incentives. Therefore, SWC programmes need incentives to influence farmers' behaviour. It is important to consider the fact that farmers often do not prioritize SWC. They might decide to participate

in the programme because they want, for instance, to access seed subsidies and then learn also about SWC. This gives them an avenue of testing the technology (initial adoption). For continued adoption, incentives should be accompanied by awareness creation to beneficiaries as to why they receive the incentive and when it ends.

To policy makers:

(iv) Improve security of land ownership as this has an influence on planning horizon of a land user and hence level of investment to commit to SWC.

(v) Improve market access to increase profitability of agriculture and enable farmers to invest in SWC.

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APPENDICES

Appendix 1: Interview schedule for the study on incentives for investment in soil and water conservation measures by smallholder farmers of Mgeta Division

Interviewer Id……
Date of interview……

Background characteristics

1. Name of the village:…….

2. Name of the respondent:……..

3. Household head
   1. Father ( )
   2. Mother ( )
   3. Son or Daughter ( )

4. Age of the respondent in years…….

5. Marital status
   1. Single ( )
   2. Married ( )
   3. Divorced ( )
   4. Widow ( )
   5. Separated ( )

6. Education level
   1. No formal education ( )
   2. Adult education ( )
   3. Primary education ( )
   4. Secondary education ( )
   5. Other (specify) ( )……..

7. Occupation of the respondent
   1. Farming ( )
   2. Officially employed ( )
   3. Casual labourer ( )
   4. Business (specify) ( )……
   5. Other (specify) ( )…….

8. Household composition by age and sex

Household member	Sex	Age (years)	Education level	Relationship with respondent
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				

9. What is the farm labour force in your household

	Males	Females
18 and above years		
Less than 18 years		

10. Are you a member to any farmers group?
    1. Yes ( )
    2. No ( )

11. If yes, mention the name of group(s) to which you are a member

    Group name Main activity of the group

    1. ……..
       ……
    2. ……..
       ……
    3. ……..
       ……

A. Land unit information

12. How many farms do you have?.....

    I would like to ask you a few questions about each plot

Plot No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
13. In which village is it located							
14. How far is it from your house (minutes)							
15. How far is it from the market (minutes)							
16. How large is it (acres)							
17. Ownership 1. Owner 2. Family							

3. Short rent 4. Long rent 5. Other (specify)…							
18. Slope (%) 1. 5 -12 (gentle) 2. 12-35 (moderate) 3. 35-55 (steep) 4. > 55 (very steep)							
19. Conservation measure 1. Bench terrace 2. Ladder terrace 3. Ridges 4. Fanya juu terrace 5. Fanya chini terrace 6. Contour strips 7. Agroforestry 8. Other (specify)……							
20. Main reason(s) for implementing a SWC measure……..							
21. Year in which the SWC measure was implemented							
22. Which plot do you consider most important for your agricultural activities? Explain…….							
23. Crops planted in 2007							
24. Quantity harvested per crop per plot (kg)							

25. Irrigation practice 1. Furrow (explain) 2. Hose pipe (explain) 3. Reservoir (explain) 4. NA∗ (explain) 5. Other (specify)….							
26. Labour requirements 1. Family labour only 2. Hired labour (please describe the main activity the hired labour does)… 3. Both family labour and hired labour							
27. Do you have any future plans for your plots (please explain)							

∗ NA = Not Applicable

28. Please list in order of priority the most important crops to you (1 = most important, 6 = least in importance)
    1.
    2.
    3.
    4.
    5.
    6.

29. Please give explanation for the ranking above:
    Most highly ranked crop…….

    Least ranked crop……

    Where would you put maize in the rank above? Explain……

30. Please let me know the amount of income you obtained last farming year for each of the following income generating activities

Item	**Quantity harvested (Unit∗)**	**Quantity sold (Unit)**	**Price per Unit (Tshs)**
Tomato			
Cabbage			
Irish potato			
Peas			
Beans			
Cauliflower			
Sweet pepper			
Squash (Zuccini)			
Lettuce			
Leeks			
Onion			
Chinese cabbage			
Peaches			
Plums			
Pears			
Apples			
Banana			
Maize			
Chicken			
Pig			
Goat			
Goat’s milk			
Manure			
Carnation			
Any other crop (mention…)			

∗ Please be sure of the quantity contained in mentioned unit (kg/gunia/ndoo/kopo/…)

Income received from the following items last year (2007)

Item	**Tshs**
Casual labour	
Remittances	
Local brew selling	
Operating a shop	
Any other activity (mention)……	

B. Adoption of SWC measures

31. Do you do any of the following to solve some of the soil and water problems that you experience?

Practice	**Yes**	**No**
1. Terracing/digging ridges		
2. Incorporating crop residues in the soil during land preparation		
3. Burning crop residues during land preparation		
4. Mulching		
5. Planting perennial grasses along contours		
6. Increasing the use of pesticides		
7. Increasing the use of commercial fertilizers		
8. Increasing the use of manure		
9. Crop rotation		
10. Improving water use efficiency (reservoir, hose pipe, …)		
11. Looking for a new virgin land somewhere		
12. Practicing agroforestry		

32. Please rank the following measures according to your preference by assigning them the values 1 to 5; where 1 indicates the most preferred and 5 the least preferred
    1. Excavated terrace *(Matuta ya kudumu/ngazi)* ( )
    2. Ridges (annual ridges) *(Matuta madogomadogo)* ( )
    3. Fanya juu terrace ( )
    4. Contour strip cropping *(kontua ya mazao)* ( )

33. Please give explanation for the ranking above (why you prefer it most or least):
    Most preferred conservation measure…….

    Least preferred conservation measure……

34. How much do you think an acre of plot would go for?.....Tshs

35. Have you tried to find a plot to expand your farming activities?
    1. Yes (please explain)…….

    2. No (please explain)……

36. I would like to know your opinion on the extent to which the following statements apply to you. Please tick in the appropriate cells according to the scale (1) Strongly Disagree (2) Disagree (3) Undecided (4) Agree (5) Strongly Agree.

Statement	Strongly Disagree (1)	Disagree (2)	Undecided (3)	Agree (4)	Strongly Agree (5)
1. This is one of the areas where soil is being lost through rainfall					
2. Soil loss in my plots is of much concern					
3. At old age it is of no use to implement terracing					
4. It is rational to excavate terraces on a hired land					
5. The necessary technical know-how for terracing is well known by you					
6. Labour to undertake terracing is sufficiently available					
7. It is more important to engage myself in off farm activities than terracing					
8. Terracing will certainly promote yields					
9. Terracing is too difficult to implement					
10. Hardly can terracing realize amount of revenue that is commensurate with investment					
11. Terracing is necessary for my field condition					

C. Incentives for adoption of SWC

37. Have you participated in any irrigation improvement program? (e.g. training, visits by extension officers, being instructed by fellow farmer, demonstrations…)
    1. Yes ( ) Explain……..
    2. No ( )

38. Do you know of any high value crop which was introduced in the area by UMADEP?
    1. Yes ( ) Mention/Explain……..
    2. No ( )

39. Would you say there is an improvement in crop markets nowadays?
    1. Yes ( ) Mention/Explain……..
    2. No ( )

40. I would like to know your opinion on the extent to which the following statements apply to you. Please tick in the appropriate cells according to the scale (1) Strongly Disagree (2) Disagree (3) Undecided (4) Agree (5) Strongly Agree.

Statement	**Strongly Disagree (1)**	**Disagree (2)**	**Undecided (3)**	**Agree (4)**	**Strongly Agree (5)**
1. On steep slope high value crops can not be profitably grown without terracing					
2. High value crops are necessary for adoption of terracing					
3. Terracing does not increase yields from high value crops					
4. Availability of high value crops is a motivation for farmers to invest in terracing					
5. Farmers would do terracing even without high value crops					
6. It is irrational to grow high value crops in non conserved steep slope land					

For ADOPTERS of SWC measures

41. Please explain the way you acquired soil and water conservation skills
    1. Training from extension officers ( )
    2. Knowledge gained from fellow farmers ( )
    3. Local knowledge (gained from elders or own innovativeness) ( )
    4. 1 and 2 above ( )
    5. Other (specify) ( )…….

42. Did each of the following factors motivate you to invest in SWC measures? Please show the extent to which each of the factors influenced your decision to invest in SWC by indicating accordingly (1) Not at all (2) No (3) A little (4) Much (5) Very much

Incentive	**Not at all (1)**	**No (2)**	**A little (3)**	**Much (4)**	**Very much (5)**
1. Suitability for growing high value crops					
2. Improved irrigation skills/knowledge					
3. Extension efforts					
4. Availability of credit from SACCOS					
5. Market development					
6. Working as a group (mutual labour sharing)					
7. SWC programs (training, visits by extension officers, demonstrations…)					
8. Food for work					
9. Cash payment					
10. Reward and prizes					
11. Supplied farm implements, seeds, fertilizers…					
12. Land security					
13. Expected increase in livestock fodder production					
14. Agricultural sustainability					
15. Others (specify)…					

For NON-ADOPTERS of SWC measures

43. Do you know how to excavate terraces?
    1. Yes ( )
    2. No ( ) (GO TO #45)
44. If yes, how did you know about it?
    1. Training/visit from extension officers ( )
    2. Knowledge gained from fellow farmers ( )
    3. Local knowledge (gained from elders or own innovativeness) ( )
    4. 1 and 2 above ( )

5. Other (specify) ( )……

45. Have you tried to seek the terracing knowledge? Please explain…….

46. Are you aware of anybody who can help you with terracing knowledge? Explain……..

47. What would motivate you to invest in SWC?
……
……
……

48. Would the following factors motivate you to invest in SWC measures? Please show the extent to which each of the factors would influence your decision to invest in SWC by indicating accordingly (1) Not at all (2) No (3) A little (4) Much (5) Very much

Incentive	**Not at all (1)**	**No (2)**	**A little (3)**	**Much (4)**	**Very much (5)**
1. Do you think suitability for growing high value crops is a motivating factor for conservation					
2. Improved irrigation skills/knowledge					
3. Extension efforts					
4. Availability of credit from SACCOS					
5. Market development					
6. Working as a group (mutual labour sharing)					
7. SWC programs (training, visits by extension officers, demonstrations…)					
8. Food for work					
9. Cash payment					
10. Reward and prizes					
11. Supplied farm implements, seeds, fertilizers…					
12. Land security					
13. Expected increase in livestock fodder production					
14. Agricultural sustainability					
15. Others (specify)…					

Thank you for your cooperation

Appendix 2: Checklist of questions for key informants

Interviewer Id……

Date of interview……

1. What are the reasons for Mgeta people to invest in SWC?.....
2. What are the reasons for some Mgeta people to dislike SWC?.....
3. Considering the extension service in your area would you say it influences investment in SWC? Please explain……
4. Would you say establishment of SACCOS served as an incentive to conservation? Please explain……
5. Is there any link between formation of farmers' organizations and implementation of SWC? Explain…….
6. Did improvement of irrigation systems motivate farmers to implement SWC? Explain
7. Is it realistic to say that enhanced market access has triggered investment in SWC? Explain……
8. Was the introduction of high value crops an incentive for SWC? Explain……
9. Please rank the existing SWC practices in Mgeta. Give explanation for the highest and least ranked measure (why you prefer it most or least)……
10. Which crops do you consider as high value? Rank and give reasons……
11. Which crops do you consider as low value? Rank and give reasons……

Thank you for your cooperation