SOCIAL INFLUENCE ON CONTINUATION OF ADOPTED AGRICULTURAL TECHNOLOGIES: A CASE OF HIMA PROJECT KILOLO DISTRICT

BY

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ABSTRACT

This study was set to investigate social influence on continuation of adopted agricultural technologies in Ukwega and Mtitu wards of Kilolo District, Iringa Region. Specifically the study aimed at identifying innovations currently used after HIMA project, determining whether social influence was responsible for continued use of agricultural technologies and assessing socio-economic characteristics of household influencing adoption and continued use of adopted agricultural technologies. A total of 120 respondents (84 males and 36 females) who were involved in HIMA project interventions were interviewed. Quantitative data were analyzed using Statistical Package for Social Science (SPSS) whereby content and structural functional analysis was used for qualitative data. The study revealed that HIMA project interventions that were extended to farmers included terraces, agroforestry; contour ploughing, crop rotation, use of improved seeds, multiple cropping system, mulching and tree planting on woodlots and boundaries. The average number of trees owned by households before HIMA has tremendously increased from 377 to 4155 after HIMA which was more than ten times. The finding from binary logistic regression revealed that of all the seven factors loaded into the model only three factors (farm size, farming experience and number of farms owned by the household) were statistically significant ($p<0.05$) in influencing continued use of adopted agricultural technologies. Farm size had highest Wald statistics of 6.286 implying that had big impact on influencing continuation of adopted technologies. This was followed by number of farms owned ($p=0.015$) with Wald statistics of 5.912 and farming experience ($p=0.021$) with Wald statistics of 5.337. Social influence had no effects towards influencing continuation of adopted agricultural technologies ($p<0.05$) and had very small Wald statistics of 0.150. The study thus concluded that the continuation of adopted agricultural technologies was not because of social influence but was because of other factors as pointed out above.

DECLARATION

I EDWIN NGAPOLA KILAVE, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work and that it has neither been submitted nor being concurrently submitted for degree award in any other institution.

Edwin Ngapola Kilave　　　　　　　　　　Date

(MARD - Candidate)

The above declaration is confirmed by

Dr. Mbwambo, J. S.　　　　　　　　　　Date

(Supervisor)

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It has been said that writing a dissertation is a long and lonely journey. However, I would agree that it is a long process and an individual work, but it is a journey accompanied by a lot of supports, help and encouragement. I could never have successfully completed this dissertation and my study without the assistance of many individuals and I want to express my deepest appreciation to them.

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DEDICATION

This dissertation is dedicated to my mother the late Lucia Mpagama, she who laid the foundation of my education and could not live to reap the fruit of her good work. May Almighty God rest her soul in peace Amen.

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LIST OF ABBREVIATIONS

CIMMITY	-	Centre International Mejoramients de Maize ye Trigo
DALDO	-	District Agricultural and Livestock Officer
DANIDA	-	Danish International Development Agency
DC	-	District Commissioner
DED	-	District Executive Director
DIT	-	Diffusion Innovation Theory
FAO	-	Food and Agricultural Organization
FoA	-	Faculty of Agriculture
GDP	-	Gross Domestic Product
HIMA	-	Hifadhi ya Mazingira
NDV	-	National Development Vision
NSGRP	-	National Strategy for Growth and Reduction of Poverty
PEU	-	Perceived Easy of Use
PU	-	Perceived Usefulness
SCPS	-	Social Capital and Poverty Survey
SNAL	-	Sokoine National Agricultural Library
SPSS	-	Statistical Package for Social Science
SUA	-	Sokoine University of Agriculture
TAM	-	Technology Acceptance Model
TPB	-	Theory of Planned Behaviour
TRA	-	Theory of Reasoned Action
URT	-	Unite Republic of Tanzania
EARO	-	Ethiopian Agricultural Research Organization.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Overview

This chapter comprise of six sections namely; background information which mainly describe the preliminary information's about the study; problem statement and justification which give an insight of the current problem and reasons necessary for correcting it; objectives of the study (overall and specific objectives), study questions and finally conceptual framework of the study which guided the study.

1.2 Background Information

The economic development of Tanzania depends mainly on agriculture sector. The sector contributes significantly in terms of aggregate growth, exports, employment and linkages with other sectors. Agriculture is the mainstay sector of the economy as enshrined in the National Development Vision (NDV) 2025 (URT, 1999) and National Strategy for Growth and Reduction of Poverty (NSGRP) (URT, 2005). It has been estimated that in Tanzania agricultural sector provides employment for 74% of the population staying in rural areas (URT, 2001). In 2006, it contributed about 75% of total employment and 26.5 percent of the Gross Domestic Product (GDP) (URT, 2008). Between 1999 and 2006 the crop and livestock sub-sectors contributed approximately 35% of foreign exchange earnings. This simply means that the rural population is central to the economic development of the country through development of agriculture and allied activities.

Discoveries and adoption of new proven agricultural technologies and management systems are accepted to be central factors for improving productivity and efficiency. The adoption of new agricultural technologies is an important route out of poverty for developing countries (Bandiera and Rasul 2005). However, the ability to adopt new technologies is a function of many factors that are both internal and external to any social system (Isham, 2000; Byakugila *et al.,* 2008). Sometimes agricultural technologies that would improve productivity are not adopted at all or cease to continue soon after donor period end (Doss, 2006; Byakugila *et al.,* 2008). According to Oladele (2005) agricultural innovations are often adopted slowly and some aspects of the adoption process remain poorly understood. Thus adoption and continual use of innovations/technologies remains the main challenge for agricultural productivity improvement.

The importance of farmers' adoption of new agricultural technology has long been of interest to agricultural extensionists and economists. According to Oladele (2005), several parameters have been identified as influencing the adoption behaviour of farmers from qualitative and quantitative models. In additional to that, social scientists investigating farmers' adoption behaviour have accumulated considerable evidence showing that demographic variables, technology characteristics, information sources, knowledge, awareness, attitude, and group influence affect adoption behaviour (Oladele, 2005; Byakugila *et al.*, 2008).

During the past decade, Iringa Region used to play a key role in agricultural production and natural resources productivity. Further more, Iringa Region was among the 4 major maize producing regions and other food crops such as beans, cowpeas, sorghum, millet, cassava sweet potatoes, round potatoes, groundnuts and sunflower in the country (Minja *et al*, 1996). With increasing human population, the once highly productive land has been reduced to nearly waste lands as a result of wantom clearance of all types of vegetation coupled with uncontrolled grazing of livestock (Mdoe and Mvena, 1995). Without a check on this environmental predicament, such unforeseen consequences to the environment could easily be replicated elsewhere in the region and finally in the whole country. In an attempt to curb the destruction of environment, an environmental conservation programme popularly known as Hifadhi ya Mazingira (HIMA) was commenced by Danish International Development Agency (DANIDA) in collaboration with Iringa Region. The project had objectives of improving the productivity and sustainability of agriculture and natural resource management; catchments protection and soil erosion reduction. To achieve those objectives HIMA had to introduce various interventions (technologies) such as agroforestry, contouring, terracing and the like.

The HIMA project ended in 2003. Nevertheless research carried out by Orbicon (2007) recognized that some of the technologies introduced by HIMA were highly accepted and were still used by farmers in the District. The research concentrated on other factors that resulted into adoption of those technologies but did not report anything on the social influence towards the continual use of those technologies. In that regard this study generally intended to explore social influence on continual use of various technologies adopted by farmers in Kilolo District.

1.3 Problem Statement and Justification

The adoption of innovations in agriculture has been studied intensively since early 1950's pioneering work on adoption of hybrid corn in the USA (Ghadim and Pannel, 1999). Adoption researches reveal contradicting results regarding the importance and influence of any given variable. This means that factors influencing adoption of agricultural technologies are different depending on farmers' characteristics, the nature of technology and a number of other social factors. Thus, it is not possible to extrapolate results from one location to another hence need for location specific studies (Wambura, 2004). Many adoption studies are based on an initial desire to gather basic information about the use of new technologies and to identify constraints to technology adoption and input use. According to Doss (2006) generating descriptive data about technology diffusion, can provide useful background information about farmers who are currently using a technology and those who are not (Doss, 2006). Technology adoption can dramatically improve the well-being of agricultural households, but many questions about the determinants of adoption remain unanswered (Besley and Case, 1993).

Empirical studies on agricultural technology adoption recognized that technology adoption is not a one-off static decision, rather it involves a dynamic process in which information gathering, learning and experience play pivotal roles (Jabbar, 2003; Uaiene *et al.*, 2009). More recently, an influential body of literature on technology adoption has focused on the effect of social learning on adoption decisions. The basic motivation behind this literature is the idea that a farmer in a village observes the behavior of neighbouring farmers, including their experimentation with new technology. Once a year's harvest is realized, the farmer then updates his priors concerning the technology which may increase his probability of adopting the new technology in the subsequent year (Uaiene *et al.*, 2009).

Previous studies in Tanzania on agricultural technology adoption have been carried out widely in four areas of inquiry: assessing the impact of agricultural research; priority setting for research; evaluating the distributional impacts of new technology, including the impact on poverty; and identifying and reducing constraints to adoption (Doss, 2003; Doss, 2006; Uaiene *et al.*, 2009). However, none of these studies was able to report on existence of social influence on continuation of adopted agricultural technologies. They ended up reporting on other factors like credit, education, extension services, inputs and the like. Likewise, HIMA project evaluation conducted by Orbicon and Goss Gilroy Ltd in 2007 revealed good adoption of various technologies after their introduction, as well as witnessed continual use of adopted agricultural technologies. However, it was not clear as to why farmers continued with those technologies after HIMA phased out. In additional, Orbicon evaluation study did not report any social influence on adoption and continued use of those technologies. Therefore this study intended to investigate social influence on continuation of adopted agricultural technologies introduced by HIMA project.

1.4 Objectives of the Study

1.4.1 Overall objective

The overall objective of this study was to determine social influence on continuation of adopted agricultural technologies introduced by HIMA.

1.4.2 Specific objectives

Specifically, the study intended to:

1. Identify agricultural technologies introduced by HIMA project in Kilolo District,

2. Identify agricultural innovations/technologies currently used after HIMA project,

3. Determine whether social influence is responsible for continued use of agricultural technology, and

4. Assess socio-economic characteristics of household influencing adoption and continuation of agricultural technologies.

1.5 Research Questions

i. What are the agricultural technologies introduced by HIMA project and are still used in the study area?

ii. What are the currently used agricultural technologies and the motive towards use after HIMA project?

iii. Does social influence has any contribution to continued use or cease of those technologies after HIMA project?

iv. What are the socio- economic factors which influenced villagers to adopt agricultural technologies in Kilolo district?

1.6 Conceptual Framework

Katani (1999) argued that without theoretical framework to bind facts together, knowledge is fragmented into discrete segments. Research performed without the guidance of theoretical framework is usually sterile for the reason that the researcher does not know quite well what data to collect and when to have them, and he or she put them to use (Kajembe, 1994). For the purpose of this study TAM by Davis, 1989 was modified to suit the study.

To understand the user's behaviour towards new innovation (technology), one must learn the technology adoption process (Rao, 1996). The technology acceptance model (TAM) consists of two beliefs, Perceived Usefulness (PU) which is operationally defined as "the degree to which the prospective adopter expects the new technology adopted to be free of effort regarding its transfer and utilization, which determine attitudes to adopt a new technology. The attitude towards adoption depicts the prospective adopter's positive or negative orientation/ behaviour about adopting a new technology (Rao, 1996). The other belief is Perceived Easy of Use (PEOU) is operationally defined as "the prospective adopter's subjective probability that applying the new technology from outside sources will be beneficial to his personal being". These benefits may consist of increases in productivity (Mauceri, 2004).

The TAM has been used to explain both short-term (acceptance and adoption) behaviours and long-term (usage) behaviours (Venkatesh *et al.,* 2003). The TAM has predominantly been used to explain technology acceptance and usage, where its validity is well established (Davis, 1989). An extensive literature describes and analyzes the determinants of agricultural technology adoption. The literature describes adoption theory and provides possible frameworks for variable definition. Models are employed to look at determinants of adoption, each with its own set of assumptions and emphasis on particular variables.

Adoption models are generally based on the theory that farmers make decisions in order to maximize their expected utility or profits (Mauceri, 2004). According to O'Reilly and Chatman (1986) and Malhotra and Galletta (1999) both pointed out how social influence process affect the person’s commitment to adoption and continual use of the introduced technology. Fig.1 presents the conceptual framework which is a modification of TAM developed by Davis, (1989). The model reflects the linkage of various variables and related factors used in this study. It was anticipated that variables like age, sex, education level, HH size, farm size, and farming experience (background variable) would have an effect on agricultural technologies (external variables) introduced by HIMA. Perceived usefulness (PU) and perceived easy of use (PEOU) will all have an effect on the attitude of the farmer towards the introduced technologies that will lead into behavioural intention towards adopting the introduced technology where some farmers expected to be influenced by others (social influence) to adopt and continue with the technology because of other farmers/neighbours who adopted the technology early.

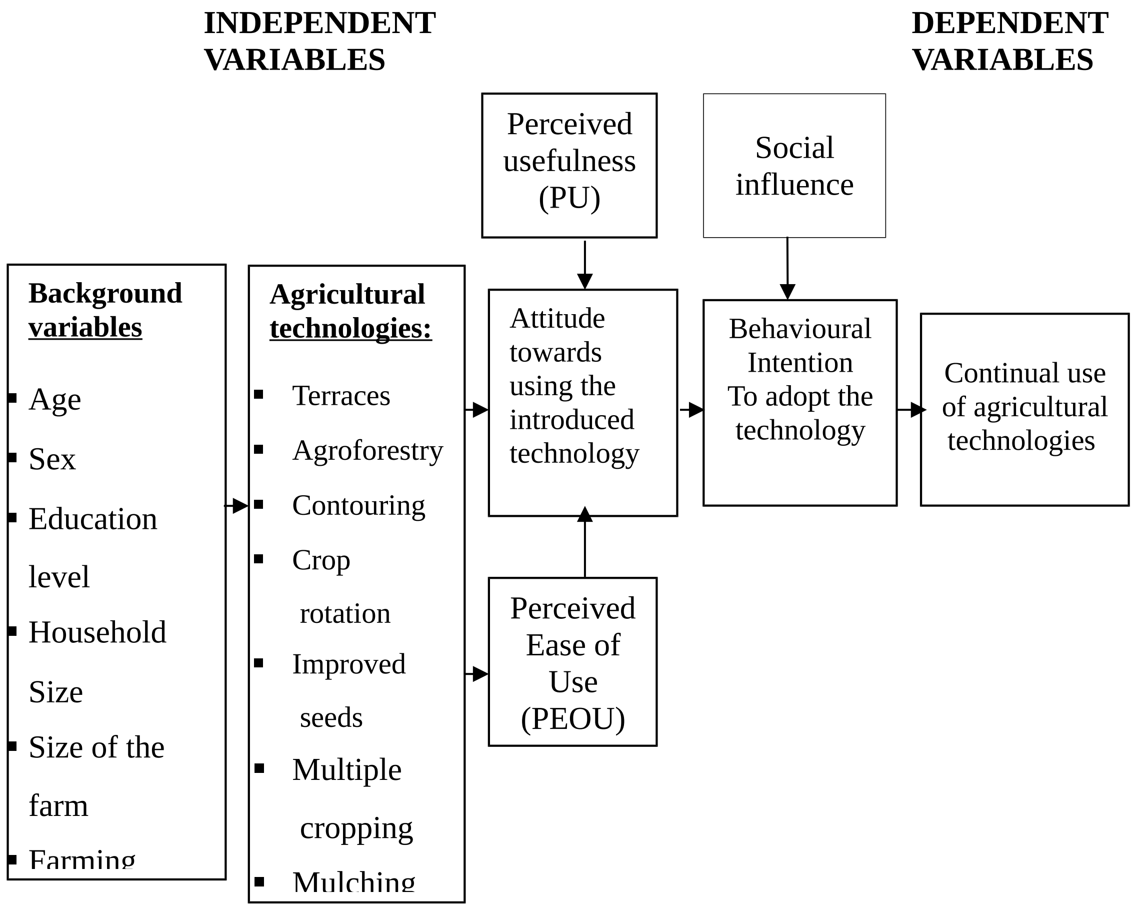

Figure 1: Conceptual framework (TAM)

(Modified from Davis, 1989)

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Overview

This chapter constitute of seven main sections which include: definition of key concepts, theoretical basis for the study, adoption diffusion and abandonment of technology, speed of technology adoption, categories of adopters, socio economic factors influencing adoption of agricultural technologies, factors influencing farmers to continue or cease using technology and status of research on continuation of adopted agricultural technologies. Each main section is divided into various subsections which are relevant to the main section.

2.2 Definition of Key Concepts

2.2.1 Technology

The word "technology" can also be used to refer to a collection of techniques. In this context, it is the current state of humanity's knowledge on how to combine resources to produce desired products, to solve problems, fulfill needs, or satisfy wants; it includes technical methods, skills, processes and techniques (Besley *et al.,* 1993). Mahajan and Peterson (1985) defined technology as any idea, object or practice that is perceived as new by the members of a social system. Innovations are classified into process and product innovation. A process innovation is an input to a production process, while product innovation is an end product for consumption (Mahajan and Peterson, 1985).

2.2.2 Agricultural technologies

Agricultural technologies focus on technological processes used in agriculture. Empirical studies on agricultural technology adoption generally divide a population into adopters and non adopters, and analyze the reasons for adoption or non adoption at a point in time (Jabbar, 2003). In reality, technology adoption is not a one-off static decision; rather it involves a dynamic process in information gathering, learning and experience which play pivotal roles, particularly in the early stage of adoption (Jabbar, 2003).

2.2.3 The concept of adoption of agricultural technologies

The use of agricultural innovations by farmers can be understood from the perspective of diffusion of innovations whereby innovations generated by agricultural research are passed to farmers through extension agents (TARP II SUA, 2005).Thus, in this process agricultural research is the source of innovation or change and farmers are its recipients. Moreover farmers’ rationality is conceived as being influenced by a stimulus response model of communication (Feder *et al*., 1985). The criterion used in judging farmers rationality is either adoption or rejection of innovations, which are seen as the outcome of an innovation-decision process. According to Rogers (1995) the innovation decision process can lead to either adoption, a decision to make full use of an innovation as a best course of action available, or rejection a decision not to adopt an innovation.

Technology adoption can dramatically improve the well-being of agricultural households, but many questions about the determinants of adoption remain unanswered (Besley and Case, 1993). In a review of early empirical and case study evidence on technology adoption, Feder *et al.* (1985) suggested that some adoption outcomes that can not be explained with traditional models or by standard household data may be the result of differing social, cultural and institutional environments. This conforms to the conclusions of myriad studies in rural sociology: “The heart of the diffusion process consists of interpersonal network exchanges between those individuals who have already adopted an innovation and those who are then influenced to do so” (Rogers, 1995).

2.2.4 Social Influence

Social influence occurs when an individual's thoughts or actions are affected by other people. The process of interpersonal influence that affects actors' attitudes and opinions is an important foundation of their socialization, identity, and decisions (Postmes *et al*., 2005). Social influence is an elementary aspect of human societies. People influence others and are influenced by friends, work colleagues, neighbours and even chance acquaintances (Mazman *et al.,* 2009). In this way, personal attitudes, the attitudes of groups and the attitudes of larger aggregates (like societies) are formed (Venkatesh *et al.,* 2003). This makes social influence a constitutive element of societies and one that must be taken into account. When we change what we believe, or how we behave, after observing the attitudes or actions of others, we are making this change because of social influence. It is a process of changing our attitudes, values and behaviours in response to the attitudes and behaviours of others (Mazman *et al.,* 2009).

Shen *et al*. (2006) called social influence as social factors and defined it as "the individual's internalization of the reference groups subjective culture and specific interpersonal agreements that the individual has made with others, in a specific social situation. Vankesh *et al.* (1996) defined social influence in their study as the degree to which an individual perceives that important others believe he/ she should use the new system. In a social system there have been different theories and models about factors that influence the process of adoption and usage of technologies (innovation) and being informed about an innovation. It is noticeable that social influence is taking place as an influential construct in the majority of these theories and models. Social influence has been called in different names as social factors, subjective norms or social norms in different theories (Mazman *et al.,* 2009).

More recently, an influential body of literature on technology adoption has focused on the effect of social learning on adoption decisions. The basic motivation behind this literature is the idea that a farmer in a village observes the behavior of neighboring farmers, including their experimentation with new technology. Once a year's harvest is realized, the farmer then updates his priors concerning the technology which may increase his probability of adopting the new technology in the subsequent year (Uaiene *et al*., 2009).

Social-influence can be power and control in the form of explicit commands and orders or they can be norms, values, rewards, recognition, and approval. Such social-influence factors are regarded as subjective norms (Pryor, 1990). Subjective norms are defined as the perceptions of social pressure to perform or not to perform behaviour, and this social pressure is derived from the reference group with which the individual identifies him/herself.

2.2.5 Adoption and diffusion

Many researchers belonging to different disciplines have defined the two concepts (i.e. adoption and diffusion) in relation to their own fields (Doss, 2006). Adoption is a behavioural choice at a particular time and space while diffusion is the adoption pattern over time (Doss, 2006). Agricultural technology adoption has long been of interest to social scientist because of its importance in increasing productivity and efficiency (Becker *et al.,* 1995). Adoption refers to the decision to use a new technology or practice on a regular basis, while diffusion often refers to spatial and temporal spread of the new technology among different economic units. Oladele (2005) argued that, a wide range of economic, social, physical and technical aspect of farming influences adoption of agricultural production technology.

2.3 Theoretical Bases for the Study

There have been different studies that explain the role of social influence in the usage process of innovations which individuals meet in different fields (Malhotra and Galletta, 1999). In a social system there have been different theories and models about factors that influence the process of adoption and usage of an innovation (Becker *et al.,* 1995). It is noticeable that social influence is taking place as an influential construct in the majority of these theories and models; where social influence has been called in different names as social factors, subjective norms or social norms in different theories (Malhotra and Galletta, 1999). The model adopted in this study i.e. TAM pioneered by Davis (1989) advances the Theory of Reasoned Action (TRA) by postulating that perceived usefulness (PU) and perceived ease of use (PEU) are key determinants that inevitably lead to the actual usage of a particular technology or system. Davis (1989) defined Perceived usefulness as "the degree to which an individual believes that using a particular technology would enhance his or her productivity" while perceived ease of use is defined as "the degree an individual believes that using a particular technology would be free of effort". Between the two, perceived ease of use has a direct effect on both perceived usefulness and technology usage (Adams *et al.,* 1992; Davis, 1989). TAM theorizes that an individual's behavioural intention to adopt a technological system or innovation is determined by two beliefs, perceived usefulness and perceived ease of use (Dishaw and Strong, 1999). Davis (1989) also found that there is a relationship between users' beliefs about a technology's usefulness and the attitude and the intention to use the technology. However, perceived usefulness exhibited a stronger and more consistent relationship with usage than did other variables reported in the literature. In addition, an individual may adopt a technology if he or she perceives it as convenient, useful and socially important even though they do not enjoy using the technology (Saga and Zmud, 1994). Thus, there might be a possibility of a direct relationship between beliefs and intentions. Furthermore, it is suggested that there are external variables that affect both perceived ease of use and perceived usefulness (Davis, 1989).

2.4 Adoption, Diffusion and Abandonment of New Technology

Adoption and diffusion of technologies are two interrelated concepts describing the decision to use or not use and the spread of a given technology among economic units over a period of time. Adoption of any innovation is not a one step process as it takes time for adoption to complete. The duration of adoption of a technology vary among economic units, regions and attributes of the technology itself (Ghadim and Pannel, 1999).

Further more Rogers (1995) defined the diffusion process as the human interaction in which a person communicates a new idea to another person, group of individuals, or an organization. This process is conducted over time and at different degrees of interest and understanding by the individuals involved in the process (Conley and Udry, 2002). According to Rodgers (1995) a social system is a group of individuals who may be functionally different but who are involved in similar problem-solving behavior. The term over time is described as the length of time required for an individual to pass through the adoption process. Rogers (1995) also defined adoption as the continued use of the innovation in the future.

The introduction of a new technology consists of two phases. In the first phase, the new technology is introduced to farmers through for instance, demonstration plots or other means and the new technology will be adopted when found beneficial. The second phase is characterized by declining use of the new technology over time until abandonment. Abandonment (discontinue use) of a new technology is a reflection of either a loss of profitability due to increasing costs of inputs, falling yields or the result of a switch to a more profitable technology (Kotu *et al.*, 2000).

2.5 Speed of Technology Adoption

Many adoption studies indicated that there is a great variation in the speed of technology diffusion. It has been argued that potential adopters' and perceptions of the attributes of the new technology affect the speed with which that technology is adopted (Alene *et al.*, 2000). A study by Rogers (1995) identified five characteristics of innovations that have an impact on the speed of adoption. Those characteristics included: relative advantages, compatibility, complexity, divisibility, and observability. Another study by Supe (1983), added two more attributes that affect the rate of adoption: variation in the cost of adoption and group action requirement of the technology. Foster and Rosenzweig (1995) found that initially farmers may not adopt a new technology because of imperfect knowledge about management of the new technology; however, adoption eventually occurs due to own experience and neighbours' experience. Similarly, Conley and Udry (2002), looking at pineapple cultivation in Ghana, analyzed whether an individual farmer's fertilizer use responds to changes in information about the fertilizer productivity of his neighbour. They found that a farmer increases or decreases his fertilizer use when a neighbour experienced higher than expected profits using more or less fertilizer than he did, indicating the importance of social learning/social influence.

2.6 Categories of Adopters

Adoption studies identified and described five categories of adopters in a social system. The categories included innovators, early adopters, early majority, late majority, and laggards (Mosler *et al.*, 2001; Rogers 1995). Further more, Rogers pointed out that majority of early adopters are expected to be younger, more educated venturesome and willing to take risk. In contrary to this group the late adopters are expected to be older, less educated, conservative and not willing to take risks. However, a study by Rundquist (1984) cited by (Kotu *et al.*, 2000) noted that the practical aspect of the classification of adopters into five categories is relevant to deliberate or planned introduction of innovation.

2.7 Social Economic Factors Influencing Adoption of Agricultural Technologies

Different factors influence adoption differently. Kessy and O'Kting'ati (1994) found that the extent of tree planting and fodder grass cultivation was positively correlated with size of farm holdings and size of household.

2.7.1 Institutional characteristics

These are derived from publicly operated systems for providing research and extension services to farmers. Publicly operated systems providing research and extension of new innovations sometimes get out of touch with the needs of the recipients they serve (Lionberger and Gwin, 1991). Kauzeni (1988) argued that slow rate of adoption is frequently an indictment of project methodology rather than unwillingness of farmers to adopt the technology.

2.7.2 Land tenure system

Kihiyo (1996) argued that the way land is distributed and owned in a society has always been a problem in many developing countries. All land in Tanzania will continue to be publicly owned and vested in the state. But the maintenance and improvement of the quality of the land will depend significantly on land user (Ministry of Agriculture and Cooperative, 1997). But in practice most agricultural land is held under either customary or communal systems (Mlambiti, 1994), to which its use could be dictated by norms and social settings prevailing in a given area.

2.8 Factors Influencing Farmers to Continue or Cease Using Technologies

2.8.1 Farmers' characteristics

Different farmers' characteristics have been used to analyze adoption of technologies (CIMMYT, 1993). Differences in socio-economic characteristics such as wealth, land holding and education can be used to explain the difference between those who continue with and those who reject innovations/technologies. Subsistence farmers do not have large margins of error and they are more likely to sustain systems, techniques which seem familiar. They frequently favour one component of a crop association at expense of others (Mead and Willey, 1980). Failure by farmers to adopt an innovation could also be due to the socio-cultural outskirts of beliefs, values and traditional practices (Mvena and Mattee, 1988). However, it has been recognized that there are alternative explanations such as characteristics of individual farmers that can be used as explanatory variables in understanding the model, these factors may include age, sex, education, land size that may predispose a farmer to take an interest in an innovation (Nkonoki, 1994).

2.8.2 Formal education

Farmers' education background is a potential factor in determining the readiness to accept and use an innovation (Okuthe *et al.*, 2008). In Tanzania; most farmers' have low formal education and rely on traditional farming practices. Therefore the more complex the technology the more likely it is that education will play a role (CIMMYT, 1993). Education makes a farmer more open minded to advice from extension agents or more able to deal with technical innovations.

2.8.3 Farm size

Depending on the characteristics of innovation and situational setting, farm size can have an effect on the rate of adoption. The relationship of farm size to adoption depends on factors such as labour requirements, tenure arrangements, and fixed adoption costs (Feder *et al.*, 1985). However in other situations farmers with small farms may adopt soil conservation measures to control soil erosion from reducing the farm demand for increased subsistence production (Anim, 1999).

2.8.4 Age

Younger and energetic farmers have proved to be active and ready to try new innovations (Nanai, 1993). CIMMYT (1993) argued that older farmers may have more experience, resources or authority that would give them more possibilities for trying new innovations. However, John (1995) found that though older people have more experience, their receptivity to new ideas and technologies decreases with age. Hella (1992) found that age of the respondents was one of the factors that influenced the adoption of hybrid maize seed in Iringa region.

2.8.5 Income

Wealthier farmers have better access to extension services and information and stand better chance to use their resources to try new technologies (CIMMYT, 1993). Many times it is farmers with more resources in terms of capital, land and labour that are to take advantage of new technologies and practices. The extension systems also tend to favour certain categories of farmers. Wambura (2004) found that young, richer and better educated farmers had higher extension contacts than poorer older and less educated farmers.

2.8.6 Household size

Household size may have positive or negative influence on adoption of technologies. For labour intensive technologies family size positively influences adoption. This is because for smallholder farmers, household labour is the most dependable source of labour.

Consequently household with more labour supply are expected to adopt labour intensive technologies. Instead of total household size, Caveness and Kurtz (1993) and Kalineza *et al.* (1999) emphasizes on number of adults in the households who are able to work as a major factor influencing adoption of technologies while Senkondo *et al.* (1998) observed that number of family members working in the farm field are associated with adoption of technologies.

2.8.7 Socio-cultural

In most sub-Saharan Africa, involvement of people in agricultural activities is influenced by the prevailing cultural background which includes beliefs, attitude, behavior and traditional practices of people in a given area. According to Malhotra and Galletta (1999), a person's attitude towards an object is based on his or her salient beliefs about that object and will influence one's intentions to perform certain behaviours. Attitude is an individual's disposition to react towards an object. Kilolo District is occupied by the Wahehe and Wabena tribes; the cultural background favour men in terms of access to resources and decision making which could limit active participation in some new technologies. According to Boserup (1983) culture determines the type of activities in which women can choose to take part.

2.9 Status of Research on Continuation of Adopted Agricultural Technology

2.9.1 In Africa

Recent adoption studies in Europe, Asia and Africa have identified farm and technology specific factors, institutional, policy variables, and environmental factors to explain the patterns and intensity of adoption. Rao (1996) found a positive and significant association between age, farming experience, training received, and socio-economic status, cropping intensity, aspiration, economic motivation, innovativeness, information source utilization, agent credibility and adoption. Also Agbamu (1993) found only knowledge of a practice to be significantly related to its adoption. Ikpi *et al.* (1992) showed that where farmers have to adopt a new technology that shifts time from their farming to the home production activity sector, the probability and rate of adoption of such technology are higher. Also, as family time is shifted away from the farming sector to home production sector, the economic impact index increases. Arene (1994) reported a positive and significant relationship between family size and adoption. On the other hand Voh (1982) established that household size is not significantly related to adoption. (Abdul *et al.*, 1993) reported a significant relationship between landholdings (farm size) and adoption as cited by Oladele, (2005).

Further, an influential body of literature on technology adoption has focused on the effect of social learning on adoption decisions. The basic motivation behind this literature is the idea that a farmer in a village observes the behaviour of neighbouring farmers, including their experimentation with new technology. Once a year's harvest is realized, the farmer then updates his priors concerning the technology which may increase his probability of adopting the new technology in the subsequent year. Bandiera and Rasul (2005) looked at social networks and technology adoption in Northern Mozambique and found that the probability of adoption is higher amongst farmers who reported discussing agriculture with others. Besley and Case (1993) used a model of learning where the profitability of adoption is uncertain and exogenous. Looking at a village in India, they found that once farmers discover the true profitability of adopting the new technology, they are more likely to adopt.

2.9.2 In Tanzania

Several studies have reported issues related to adoption of technologies and factors that influence adoption of technologies. Nkonya (2003) reported that the rate of adoption for farmers using chemical fertilizer in Northern zone of Tanzania was 64% and 44% on moderate rainfall zone and low rainfall zone respectively. The reasons for different rate of adoption were associated with income differences in the zones (Nkonya, 2003). Data that is available from the recent Social Capital and Poverty Survey (SCPS) in Tanzania suggest three characteristics of social structures as far as adoption is concerned; village homogeneity, leadership heterogeneity, and decision-making norms all these have promoted more rapid diffusion of innovations among agricultural households (Isham, 2000).

According to Oladele (2005), the importance of farmers' adoption of new agricultural technology has long been of interest to agricultural extensionist and economists. Several parameters have been identified as influencing the adoption behaviour of farmers from qualitative and quantitative models for the exploration of the subject (Feder and Umali, 1993). Social scientist investigating farmers adoption behaviour has accumulated considerable evidence showing that demographic varibhhhhhccxdsw4es, technology characteristi6cs, information sources, knowledge, awareness, attitude and group influence affects adoption behaviour (Oladele, 2005).

Further more Negatua and Parikhb (1999) also pointed out that Farmers' decisions to adopt a new agricultural technology in preference to other alternative (old technologies) depend on complex factors. One of the factors is farmers' perception of the characteristics of the new technology vis-à-vis that of the existing (old) technology. Other factors which influence farmers' adoption are the conventional traditional ones: resource endowments;

socio-economic status; demographic characteristics; and access to institutional services (extension, input supply, markets, etc.). Studies on the effect of the conventional factors on adoption are extensive and numerous (Feder *et al.*, 1985; Feder and Umali, 1993).

Senkondo *et al*. (1998) and Kalineza *et al.* (1999) empirically suggested that farmers who are knowledgeable in a technology are expected to adopt the techniques compared with those who are not knowledgeable. According to Laparh and Pandey (1999) adoption of soil conservation in Philippine could be hypothesized as positively correlated with farmers' education level. Conversely, Kalineza *et al.* (1999) reported that education was not significant determinant of adoption of soil conservation in Tanzania.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Overview

This chapter comprise of five main sections which further divided into various sub sections that are relevant to the main sections. These include: description of the study area, research design, sampling procedure, methods of data collection and data processing. Generally the chapter highlights where and how the study was done, who were the respondents and how information was obtained. and analyzed.

3.2 Description of the Study Area

3.2.1 Location of the study area

This study was carried out in Kilolo District. Kilolo District is among the seven Districts in Iringa Region. The District is located in Southern highlands zone extending between 7°-8.3° latitudes South and longitudes 34°- 37° East. It borders Mpwapwa District to the North, Kilosa District to the Northeast and Kilombero District to the East, Mufindi District to the South and Iringa District to the West (Kilolo District Council, 2008). Administratively the District is divided into three divisions namely Kilolo, Mazombe and Mahenge. The District was selected because is among the Districts in Iringa Region whose farmers benefited from HIMA project interventions.

3.2.2 Climate

Topographically the District varies significantly. Rainfall is fairly typical of the tropical region and is largely bi-modal. Short rains in certain parts, normally in the months of September to October and ‘long rains’ in November to May, with a peak in March and dry period extends from June to August. The District has a mean annual rainfall of

500-2700mm and a mean annual temperature ranging between 15^0C - 30^0C in lowlands (Kilolo District Council, 2008).

3.2.3 Population size, density and ethnicity

According to population projection of 2008, Kilolo District had a total population of about 222 530 people of whom 111 917 were females and 110 613 males (Kilolo District Council, 2008). The population of females is slightly higher than that of males. The population density is 6804 people per square kilometer (URT, 2003). The indigenous people of Kilolo District are of Bantu origin. The dominant tribes are Wahehe and Wabena who dominates the District population. Others include Wakinga and Wasagara.

3.2.4 Economic activities

Majority of people in the District are predominantly smallholder farmers. Most of the population lives in rural area relying on farming and livestock keeping as their main economic activities. Some people were also engaged is timber production which contributed significantly to the wellbeing of Kilolo community. Others dealt with forestry, mining and trading (Kilolo District Council, 2008). The major crops included maize, round potatoes, sunflower and a variety of fruits, vegetables and small production of cash crops like tea, pyrethrum and tobacco. The 2009 livestock population projections showed that there were 42 124 cattle, 25 123 goats 363 040 poultry and 6118 sheep, 1229 donkeys and 22 065 pigs (Kilolo District Council, 2008). These animals were indigenously reared; however their contribution to the District economy cannot be ignored.

3.3 Research Design

The study adopted a cross sectional research design which allows data collection to be done at a single point in time (Bailey, 1995). The design was adopted because of time limitation and resources. For this case data was collected in two phases. The first phase of data collection was interview using a structured questionnaire which formed the major part of the study. The second phase was devoted for Focused Group Discussion (FGD) and interview of key informants.

3.4 Sampling Procedures

Purposive sampling was done to select one division out of three divisions whereby Kilolo division was selected based on easy of accessibility. Thereafter simple random sampling was used to select two wards out of five wards of Kilolo division, two villages in each ward making a total of 4 villages. Kising'a and Isele villages from Ukwega ward and Lulanzi and Utengule villages from Mtitu ward were selected. Purposive sampling was used in selection of divisions in order to ensure that a division where HIMA project interventions were successfully adopted and continued to be used was selected. Selection of wards and villages was done randomly bearing in mind that all the villages and wards in the selected division benefitted with HIMA interventions. All five wards were listed and each assigned a number, then those numbers were written on small piece of paper and put on a basket and shaken vigorously. Three WEOs were requested to pick one piece of paper from the basket then each number corresponded to a ward which was included for the study. Similarly was done for selection of villages.

Finally using the existing village household lists of each selected village (sampling frame) households were selected randomly to constitute a sub sample from each village (Table 1). In due course this made sample size totaling to 120 households. This procedure was adopted from Kajembe and Luoga (1996), who argued that significant population representation is achieved when a random sample of at least five percent of the total population is taken for the study.

Table 1: Proportions of the sampled population per village

Division	Ward	Village	Household	Sample	Percent (%)
Kilolo	Ukwega	Isele	520	43	8.0
Kilolo	Ukwega	Kising'a	470	34	7.0
Kilolo	Mtitu	Lulanzi	410	29	7.0
Kilolo	Mtitu	Utengule	266	14	5.0

3.5 Methods of Data Collection

To address objective number one which aimed to know which technologies were introduced by HIMA project; interview was the main data collection method. Using structured questionnaire with open and closed ended questions, respondents were asked to mention various agricultural technologies that were introduced by HIMA project in their area. The questionnaire was administered to the respondent by the researcher himself assisted by one enumerator.

To address objective number two on currently used technologies after HIMA project; interview method was also adopted. Respondent were requested to mention which of the introduced technologies were still used after HIMA project phase-out. Respondents were asked questions that were set to collect information on innovations currently used after HIMA project. Responses were recorded for subsequent processes.

The same interview method was adopted as main method for collection of information to address objective three, where respondent were asked questions related to objective three which was to determine whether social influence was responsible for continued use of agricultural technology.

Through interview using structured questionnaire with open and closed ended questions; information on social economic characteristics of household were collected and recorded for further processing this aimed to address objective number four which was socio economic characteristics of household influencing adoption and continuation of adopted agricultural technologies. In order to supplement information collected through interview other methods were employed to address the four objectives; the methods included FGD, observations and using available information.

3.6 Primary Data Collection

The process involved two phases. The first phase of data collection formed the major part of the study. A structured questionnaire (Appendix 1) with open and closed ended questions was designed to obtain information as per specific objectives of the study. Questionnaire was chosen as the main data-gathering instrument because of the advantages it provides over other types of instruments, as it is contended by Tripath, (1999) that questionnaire considered to be relatively inexpensive, permits anonymity and may result in more honest responses. Questionnaire results in uniform responses from all respondents because each respondent receives identical questions.

Prior data collection, an enumerator was trained on how to administer the tool and pretesting of questionnaire was carried out in Kising'a and Utengule villages whereby 14 households randomly selected were interviewed. This was done so as to test the questionnaire validity and necessary adjustment was made for a final instrument.

In this phase, demographic and socio economic factors were collected from the respondents. Other aspects collected included type of agricultural technologies, innovations currently used by farmers; trend of trees planted and farm factors. Data collected were used for simple description purposes also used for determining relationship between variables

The second phase was devoted to Focused Group Discussion (FGD) and interview of key informants. In each village, one FGD comprising male and female respondents was conducted. Selection of respondents was done randomly but with great care to include respondents with various age including young age, middle age and old age for both male and female respondents. The FGD comprised of an average of 12 individuals (males and females) who benefited from HIMA interventions. The FGDs were convened in order to get in-depth information from various respondents on concepts, perceptions and ideas of a group about agricultural technologies introduced by HIMA project, and if there was any social influence in the continued use of adopted agricultural technologies. In this phase FGDs were held to augment data gathered through questionnaire and to take advantage of the synergistic effects of focused discussions. Thus information received was recorded and used to supplement answers from individual questionnaires. The FGD was guided by a checklist of questions (Appendix 2).

Key informants participated in the second phase of the study included Village Agricultural Extension Officers, Ward/village leaders and influential farmers. Key issues discussed with key informants included, existing agricultural technologies introduced by HIMA project, reasons and extent of adoption and continued use of adopted agricultural technologies.

3.7 Secondary Data Collection

Review of various documents at the District and Region i.e. HIMA reports and other documents related to the project was thoroughly done to collect and ascertain information collected from the field. Some information was reviewed from various books, proceedings and other written documents obtained from Sokoine National Agricultural Library (SNAL) and internet.

3.8 Data Processing and Analysis

3.8.1 Technologies introduced by HIMA project in Kilolo District

The collected data were quantified, summarized, coded and entered as nominal or ordinal into the Statistical Package for Social Science version 16 (SPSS V16) computer software. Descriptive statistics particularly frequencies, cross-tabulations, percentages and graphs were the main data analysis methods used for objective number one.

3.8.2 Innovations currently used after HIMA project

Information/data related to innovations currently used after HIMA project were summarized, coded and analyzed using SPSS V16; where descriptive statistics were used especially frequencies, percentages means, minimum, maximum standard deviation and cross tabulation to present results.

3.8.3 Social influence and continued use of agricultural technology

Content and structural functional analysis was used for the analysis of qualitative data collected through FGDs. In content analysis the recorded discussion was broken into units of information to obtain useful information for the study. Structural functional analysis took care social factors; such factors related to economic gain, prestige and social influence/ farmers altitude in relation to continual use of adopted agricultural technologies within their society and physical environment (like farm or household location). Further logistic regression was done to ascertain whether there existed any social influence towards continuation of adopted agricultural technologies.

3.8.4 Socio-economic characteristics of household influencing adoption and continuation of agricultural technologies

Logistic regression analysis was employed to address specific objectives number three and four (social influence on continued use of adopted agricultural technologies and socio-economic characteristics of household influencing adoption of agricultural technologies).

The logistic model/equation used for this analysis was summarized as follows:

$$\text{Logit}(p) = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \dots\dots\dots + \beta_kX_k$$

Where:

p	=	The dependent variable
β_0	=	Constant of the equation
β_1 to β_k	=	Regression coefficients,
$(X_1 - X_k)$	=	Explanatory variables (age, education level, farm size, farming experience, number of farms owned, household income, and social influence).

The dependent variable in the logistic regression for this study was the continuation of adopted agricultural technologies while independent variables consisted of socio-economic factors and farm factors. Table 2 presents a brief description of these variables.

Table 2: Variable definition for logistic regression analysis

Variable	Definition	Measurement
Age	Age of household head (years)	Ratio
Education level	Education level of household head (years)	Ratio
Household size	Number of people in the household	Ratio
Farm size	Farm size of the household (acreage)	Ratio
Farming	Number of years involved in farming	Ratio
Farms owned	Number of farms owned by household	Ratio
plot owned	Number plots owned by household	Ratio
Household	Average annual income of the household (Tshs)	Ratio
Social influence	Whether respondent belongs to farmers group	Ratio

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Overview

Mainly this chapter present and discuss the findings of the study. The chapter is organized into section which include; socio-economic and demographic features of respondents, agricultural technologies introduced by HIMA, current technologies used by farmers after HIMA, factors influencing continuation of adopted agricultural technologies and summary of major findings. Generally each section is divided into subsections that are relevant to the main section.

4.2 Socio-economic and Demographic Features of Respondents

Majority of respondents in Isele (56%) and Kising'a (53%) their age ranged from 26-46 years, which is considered to be strong and energetic group while Lulanzi and Utengule majority (55% and 57%) respectively were in age of 47 -67 which is considered to be old age though can still work. Very few respondent only 2% from Isele were above 68 years age and there were no respondent above that age in Kising'a, Lulanzi and Utengule (Table 3). According to CIMMYT, 1993 and Nanai, 1993 it is revealed that age has considerable influence on either use or no use of any new technology introduced in particular area. John (1995) further argued that older people have more experience however their receptivity to new ideas and technology decrease with age. Age of farmers have an impact on experience, wealth and decision making all of which affect the rate and extent of adoption of new technology.

The study found that majority of respondent in each village were males (Table 3); Isele (81%), Kising'a (65%), Lulanzi (68%) and Utengule (50%) respectively which means there were more men users of agricultural technologies than women. This was probably because men were the one who owned land in this society.

Results in Table 3 further indicate that majority of respondents in Isele (88%), Kising’a (88%), Lulanzi (89%) and Utengule (64%) were married while very few were widow, separated and divorced (Table 3). The high percentage of marriage i.e. more than three quarters of the respondent being married implies that most of the respondents had permanent resident and had household responsibilities it was a stable society. The married household had advantages over others (single, divorced and windowed) on sharing managerial skills within the family and provision of labour force. Eighty four percent of the respondents were male headed households i.e. Isele (91%), Kising’a (85%), Lulanzi (83%) and Utengule (64%) respectively.

In terms of education background, about 76.7% of the respondents had primary education (Isele 74%, Kising’a 85%, Lulanzi 65% and Utengule 86%) followed by non formal education (15.8%) and adult education 7.5%. There were no respondent with post primary education (Table 3).

Majority (65%) of respondent had farm size below ten acres i.e. Isele (51%), Kising’a (71%), Lulanzi (79%) and Utengule (64%) had farms/plot size equal or less than ten acres. Table 3 further indicates that majority of respondents in the four villages owned several plots (less than five) as follows Isele (95%), Kising’a (97%), Lulanzi (93%) and Utengule (100%).

Most of respondent, Isele 81%, Kising’a 85%, Lulanzi 86% and Utengule 86% respectively acquired land through inheritance from their ancestors where the rest acquired through buying from other villagers (Table 3). Since most people own land through inheritance from their ancestors it meant that the community had strong traditions that were respected within the society.

Majority of respondent in the area depended on labour from within the household; where Kising'a 79%, Lulanzi 62%, Utengule 57% and Isele 51% derived labour within the family. However 11% of the respondent used hired labour alone and 6% engaged both hired and household labour. Starkey (1996) argued that household labour availability has influence on utilization of technologies. This study suggests that since majority of farmers depended on family labour probably this could be one of the influences towards continual use of adopted agricultural technologies.

Table 3: Distribution of respondent by socio-economic and demographic features

Characteristics	Village				
	Isele (n=43)	Kising'a (n=34)	Lulanzi (n=29)	Utengule (n=14)	Total (N=120)
Age of household head					
≤25	0	3	0	0	3
26-46	24 (56)	18 (53)	13 (45)	6 (43)	61 (51)
47-67	18 (42)	13 (38)	16 (55)	8(57)	55 (46)
≥ 68	1.0	0	0	0	1
Mean	45.8	42.6	48	47.6	
Maximum	70	60	67	61	
Minimum	29	25	30	38	
Sex					
Male	35(81)	22(65)	20(68)	7(50)	84(70)
Female	8	12	9	7	36(30)
Marital status					
Single	1	0	1	0	2
Married	38(88)	30(88)	26(89)	9(64)	103(86)
Widow	2	3	1	3	9
Separated	2	1	0	1	4
Divorced	0	0	1	1	2
Household head					
Male	39(91)	29(85)	24(83)	9(64)	101(84)
Female	4	5	5	5	19
Education level					
Standard VII	32(74)	29(85)	19(65)	12(86)	92(77)
Adult education	3	2	4	0	9
No formal education	8	3	6	2	19(16)
Farm size(acres)					
≤10	22(51)	24(71)	23(79)	9(64)	78(65)
11-21	15(35)	8	5	5	33(26)
22-32	4	0	1	0	5
33-43	0	2	0	0	2
≥44	2	0	0	0	2
Mean	16.7	26.1	8.0	10.0	
Maximum	50	40	28	20	
Minimum	3	3	3	5	
Number of Farms owned					
≤5	41(95)	33(97)	27(93)	14(100)	41(34)
6-11	2	0	2	0	2
12-17	0	1	0	0	0
Mean	2.9	2.79	2.51	1.92	
Maximum	6	21	6	3	
Minimum	1	1	1	1	
Land acquisition					
Inherited from ancestors	35(81)	29(85)	25(86)	12(86)	35(29)
Bought from other people	3	5	3	0	3
Inherited and bought	5	0	1	2	5
Source of labour					
H/H labour	22(51)	27(79)	18(62)	8(57)	22(18)
Hired Labour	14	6	1	0	14
H/H and Hired labour	7	1	10	6	7

*Figures in parenthesis denote percentages and those outside indicate frequencies

4.3 Agricultural Technologies Introduced by HIMA

When respondent were requested to mention technologies that were introduced by HIMA project in Kilolo District, they were able to identify various agricultural technologies which included terraces, agroforestry, contour ploughing, crop rotation, use of improved seeds, multiple cropping mulching and tree planting (Table 4).

Table 4: Various technologies introduced in Kilolo District

Agricultural technology	Introduced by:
Terraces	HIMA
Agroforestry	HIMA
Contour ploughing	HIMA
Crop rotation	HIMA
Use of improved seeds	HIMA
Use of multiple cropping	HIMA
Mulching	HIMA
Tree planting	HIMA

4.3.1 Tree planting for conservation

The most common type of tree species planted by farmers in the study area included pines, grevillea, cypress, eucalyptus and wattle trees. Pines, cypress, eucalyptus and grevillea were mainly aimed for timber production, while wattle trees were for building poles. These forestry products (timber and poles) were either locally used or transported to Iringa municipality, Morogoro Dar-es- Salaam, as well as other to east African countries, far and middle east countries (Kilolo District Council, 2008).

Moreover, the findings from direct observation and focus group discussions depicted that the increase in tree population in Kilolo District was one of the success of the HIMA project. It was noted that HIMA project trained farmers on various agricultural and environmental technologies, thus majority of farmers had adequate knowledge and skills on tree nursery establishment and management, transplanting, thinning, tree management and the like. Senkondo *et al*. (1998) and Kalineza *et al.* (1999) recognized that farmers who are knowledgeable in technology are expected to adopt the techniques compared with those who are not knowledgeable.

The results further revealed that majority of respondents (85%) had their own tree nursery while 15% did not. The respondents were able to tell how they prepare their tree seedlings for planting each season and at times they generated income through selling of the seedlings to their fellow farmers who had no tree nursery. Seedling rising in the study area had become one of important income source at household level. Though this was not quantified it was observed during field survey. It was further noted that Kilolo community had gained knowledge on row planting, improved drying and timber storage.

4.3.2 Livestock and agroforestry practices

The study revealed that commonly kept livestock were chicken, cows, ducks, pigs, sheep and goats. Farmers kept one type or a mixture of livestock. The study revealed that those farmers who kept only chicken, goat and cow were 67%, 5%, 8% respectively and those who kept a mixture of chicken and cow; chicken, goat and cow; chicken, pigs and sheep; sheep, ducks and goat was 5%, 6%, 3% and 6% respectively (Fig. 2). Almost all (100%) of respondent who kept animals pointed out that the main reason for keeping livestock are for meat, eggs, milk, manure and at times used for rituals and dowry payments. Livestock were also a source of cash particularly when cash was immediately needed. The common type of agroforestry practices in the area comprised of tree home gardens, wind breaks, shelterbelts, shade trees in cropland, scattered trees in cropland, live fences, alley cropping, and wood strips. According to Glean (2002) and Ajay (2006) this type of agroforestry system offers many benefits and opportunities including the production of crops, livestock, soil fertility and water availability improvement. They also allow diversification of household revenue sources through production of timber and non timber forestry products and thus enhance landscape by promoting biodiversity and carbon sequaration (Rao and Kwesiga, 2003).

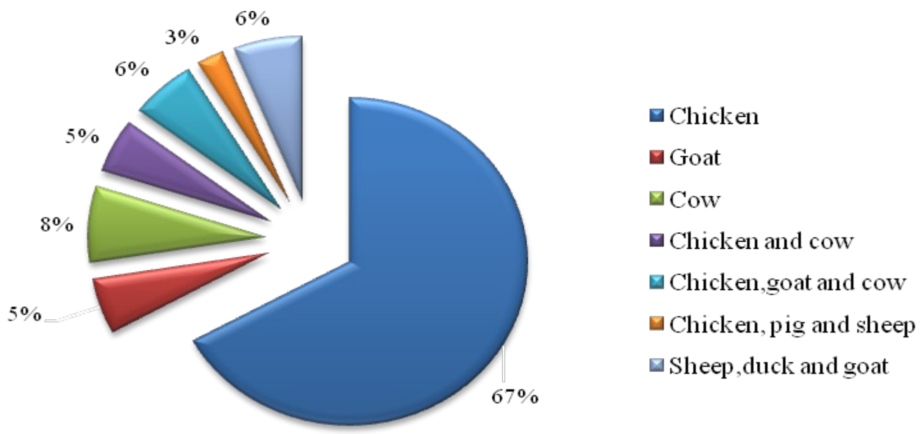

Figure 2: Distribution of livestock commonly kept in the study area

4.3.3 Number of farmers involved in technologies use in the District

Respondents were asked whether they used any agricultural technology in their farms and it was found that all (100%) used more than one agricultural technology (Table 5). The technologies used included agroforestry, contour ploughing, use of improved seeds, multiple cropping, tree planting, crop rotation and mulching. However there was no agricultural technology that was used alone rather farmers used more than one technology in their field.

Table 5: Agricultural technology use

Category	Frequency	Percent (%)
YES	120	100.0

Category	Frequency	Percent (%)
NO	0	0.0
Total	120	100.0

4.4 Current Technologies Used by Farmers after HIMA

When currently used technologies were reviewed it was found that contours, tree planting and terraces were the common technologies used by farmers in Kilolo District. Results from Table 6 show that majority (70%) of farmers used the mentioned technologies (i.e. contours, tree planting, and terraces), followed by improved seeds, and agroforestry 26.66%. However, crop rotation was the least used technology in the area. Probably this was because it involves plan, either drawn or written on paper hence without a plan, it is difficult to remember which crop is to follow and also it can be tricky to decide which rotation to follow when inter-planting is also used.

Table 6: Current technologies used by farmers after HIMA

Technology/Innovation	Frequency	Percent (%)
Contours, tree planting and terraces	84	70.00
Improved seeds and Agroforestry	32	26.66
Crop rotation	4	3.34
Total	120	100.00

HIMA project introduced more than eight agricultural technologies however during the study it was found that farmers managed to continue with six technologies i.e. contours, tree planting, terraces, improved seeds, agroforestry and crop rotation (Table 6). Mulching and multiple cropping were not commonly used that is were abandoned.

4.4.1 Technologies most preferred

Results from Table 7 shows that majority of farmers (70%) preferred contours, tree planting and terraces this probably was because of the location of their farms whereby 80% of farmers in the District had their farms located on gentle slopes, followed by those on flat land (16.7%) and others on steep slope (3.3%). This implies that their farms required some measures to control soil erosion and restore soil fertility. This therefore justifies the high proportional of farmers who utilized contours, tree planting and terraces (Table 7). The findings also revealed fair increase in use of improved seeds. This was because some farmers in the study area were still using local seeds which were associated with high cost of improved seeds that poor rural farmers cannot afford. FAO (2009) contended that in many developing countries, farmers' access to quality seed of a diverse range of adapted varieties has been impeded by financial constraints such as lack of access to credit for inputs.

Table 7: Technologies preference and farms/plots location

Technology/Innovation	Frequency	Percent (%)	Preference
Contours, tree planting and terraces	84	70.00	Most preferred
Improved seeds and Agroforestry	32	26.66	Moderate
Crop rotation	4	3.34	Less preferred
Total	120	100.00	
Distribution of farmers by location of their farms/plots			
Location of farms/plots			
On gentle slope	96	80.0	
On flat land	20	16.7	
On steep slope	4	3.3	
Total	120	100.0	

4.4.2 Current status of tree planting

Average number of trees planted before HIMA project was 377 trees per household that was involved in the study; however after HIMA the average number of trees rose to 4155 trees (Table 8). Further more, results from the same table show that 48.3% of respondents had number of trees above fifty but less than 1000 trees before HIMA interventions where as majority of respondents (70%) had number of trees above 350 but less than 5000 trees after HIMA project and very few 9.1% of respondent had trees above 10 000. This finding revealed that after HIMA project which operated for more than 15 years the number of trees owned by households has tremendously increased (Table 8).

Table 8: Distribution of farmers by tree planted before and after HIMA (n=120)

Tree Planted before HIMA	Frequency	Percent (%)	Average/Mean	Std deviation
≤ 50 trees	51	42.5		
51 - 1000 trees	58	48.3		
1001- 2000 trees	8	6.7		
≥ 2001 trees	3	2.5		
Total	120	100.0	376.96	657.626
Tree planted after HIMA				
≤350 trees	4	3.3		
351 – 5000 trees	84	70.1		
5001-10000 trees	21	17.5		
≥10 001 trees	11	9.1		
Total	120	100.0	4155.28	4090.756

4.4.3 Current status of livestock keeping

Results from Table 9 indicate that majority of farmers (67%) kept chicken alone, followed by those who kept a combination of more than one livestock category; goat and cattle 12.55%, chicken, goat and cattle 6.4% and chicken and cattle 5.8%. When secondary data was reviewed from Iringa region economic profile it was also found that chicken number was higher compared to other livestock type which agree with the high percentage of farmers keeping chicken (Table 9).

Table 9: Current distribution of livestock kept (n=120)

Livestock	Frequency	Percent (%)
Chicken	80	67.00
Goat and cattle	15	12.50
Chicken and cattle	7	5.80
Chicken goat and cattle	8	6.40
Chicken, pig and sheep	3	2.50
Sheep, goat and donkey	7	5.80
Total	120	100.00

Number of livestock kept in Kilolo District as of 2009

Cattle	Goats	Sheep	Donkeys	Pigs	Poultry
42,124	25,123	6,118	1,229	22,065	363,040

Source: Kilolo District council

4.5 Factors Influencing Continuation of Adopted Agricultural Technologies

Logistic regression model was adopted to analyse factors influencing continuation of adopted agricultural technologies Factors that were loaded into regression model for analysis included farm size, number of plots, age of respondent, education level, farming experience, household income and social influence. Prior analysis omnibus test of model coefficients was performed to test the capability of all independent variable (predictors) in the model jointly to predict the response (dependent) variable (Table 10). Results of significance implied that there was adequate fit of data to the model and that at least one of the predictors was significantly related to the dependent variable (Garson, 2008; Wuensch, 2008). According to this explanation and by looking at the results in Table 10, there was significance at 0.001 hence data entered into the model adequately fitted the model and at least one of the predictors is significantly related to the response variable.

Table 10: Omnibus tests of model coefficients

		Chi-square	df	Sig.
Step 1	Step	25.381	7	.001
	Block	25.381	7	.001

Model	25.381	7	.001

In logistic regression another vital outputs was the wald statistic test which was test the significance of individual logistic regression coefficients for each independent variable. Wald statistics corresponds to significant testing of β coefficients associated with individual independent variables this help to realize the relative importance of each independent variable. In other words Wald coefficient is a measure of the unique contribution of each independent variable in the context of the other independent variables and holding constant other independent variables; bigger Wald statistic implies that the independent variable associated with it has a high contribution to the occurrence of the dependent variable.

4.5.1 Farm size

Results from Table 11 revealed that, farm size was significant at p=0.012 with highest wald statistics of 6.286 implying that had big impact on influencing continuation of adopted agricultural technologies. It is frequently argued that farmers with larger farms are more likely to adopt an improved technology compared to those with small farms, as they can afford to devote part of their fields to try out improved technology (Alene *et al.*, 2000). Descriptive statistics indicated that the mean size of land owned by household was 11.5 acres per household this probably gave room for likely continuation of adopted agricultural technologies. Therefore the size of the farm owned by households was significant determinant of continual use of adopted agricultural technologies in Kilolo District. This finding concur with CIMMYT (1993) who contended that the size of the family farm is a factor that is often argued as important in affecting adoption decisions.

4.5.2 Number of plots

Number of plots owned by household had positive effects on continued use of adopted agricultural technologies. The number of plots owned were statistically significant at (p=0.015) with wald statistics of 5.912 on influencing continued use of adopted agricultural technologies (Table 11). On other hand it was observed that average number of plots per household was 2.67 plots and more than three quarter (78%) of the farmers had 2-5 plots per households (Table 12). Probably this might be the reasons for them to continue with the technologies as it is easy for a farmer to subject one plot under trial while the other plots are grown traditionally until the new technology proved successful.

4.5.3 Age of farmers

Results from logistic regression (Table 11 and Fig 3) revealed that respondent age was statistically not significant factor towards continuation of adopted agricultural technologies with wald statistic coefficient of 0.00 and p=0.992 which is higher than 0.500 (P>0.05). This scenario is contrary to CIMMYT (1993) and Nanai, (1993) who both argued that age has considerable influence on either use or no use of any new technology introduced in particular area. The maximum, mean and minimum age was 70 years, 45.7 years and 25 years respectively. The maximum age varied from the mean by 24.3 years above the mean, while the minimum varied from the mean by 20.7 years below the mean.

4.5.4 Education level

Table 11 indicate that education was statistically not significant factor towards continual use of adopted agricultural technologies at wald statistic 0.114 and p=0.735 (P>0.500). However it was also noted that majority (76.7%) of respondents had completed standard seven, 15.8% no formal education, 7.5% adult education and there were no respondent with post primary education. The insignificance towards continual use of technologies may have been attributed by the respondents having almost similar level of education. Since there was very minimal variation in farmers' education level, therefore education level was not a determining factor towards continuation of adopted agricultural technologies. Similarly Kalineza *et al.* (1999) reported that education was not significant determinant of adoption of soil conservation in Tanzania. However, it is frequently argued that high level of education enhances the understanding or awareness and practice of agricultural technologies.

4.5.5 Farming experience

Farming experience was estimated using number of years that the respondent had worked in farming and livestock keeping. The regression model results (Table 11 and Fig.3) shows that farming experience was statistically significant (p=0.021 with wald statistics of 5.337) though had less impact on influencing continual use of adopted agricultural technologies when compared with farm size and number of plots (Fig. 3). Thus this result suggests that the more experienced the farmer the more likely to continue with adopted agricultural technologies and vice versa.

4.5.6 Household income

Results from logistic regression (Table 11 and Fig. 3) revealed that household income was not significant at wald statistic 0.020 and p=0.888 (p>0.05) thus household income didn't have influence towards continuation of adopted agricultural technologies. However, this result is contrary to the previous study by Hella (1992) who debated that income of the respondents was one of key factor that influenced the adoption and continued use of hybrid maize seed in Iringa region.

4.5.7 Social influence

Social influence had no effects towards influencing farmers to continue with adopted agricultural technologies as it was statistically insignificant at $p>0.05$ and had very small wald statistics of 0.150 (Table 11). Also Fig.4 indicates that social influence had big significance value meaning that there was no correlation with dependent variable i.e. continual use of adopted agricultural technologies. Conversely, this finding is contrary to the study by Dogbe (2006) who argued that social influence in the adoption process and continual use of technology is essential since farmers need to see and learn from what others have done and are doing also believe and have evidence. However, Dogbe (2006) and Mazman *et al.* (2009) commended that the final decision to adopt or continue use of technologies is made by the farmer who must be provided with useful information including what others are doing.

Table 11: Variables in the equation (Logistic regression)

Independent variables	B	S.E.	Wald	df	Sig.	Exp(β)
Age of respondent	0.004	0.375	0.000	1	0.992	1.004
Education level	0.132	0.390	0.114	1	0.735	1.141
Size of the farm	-0.770	0.307	6.286	1	0.012	0.463
Farming experience	-0.843	0.365	5.337	1	0.021	0.431
Number of plots owned	0.763	0.314	5.912	1	0.015	2.144
Household income	0.042	0.299	0.020	1	0.888	1.043
Social influence	-0.120	0.311	0.150	1	0.698	0.887
Constant	0.099	0.478	0.043	1	0.836	1.104

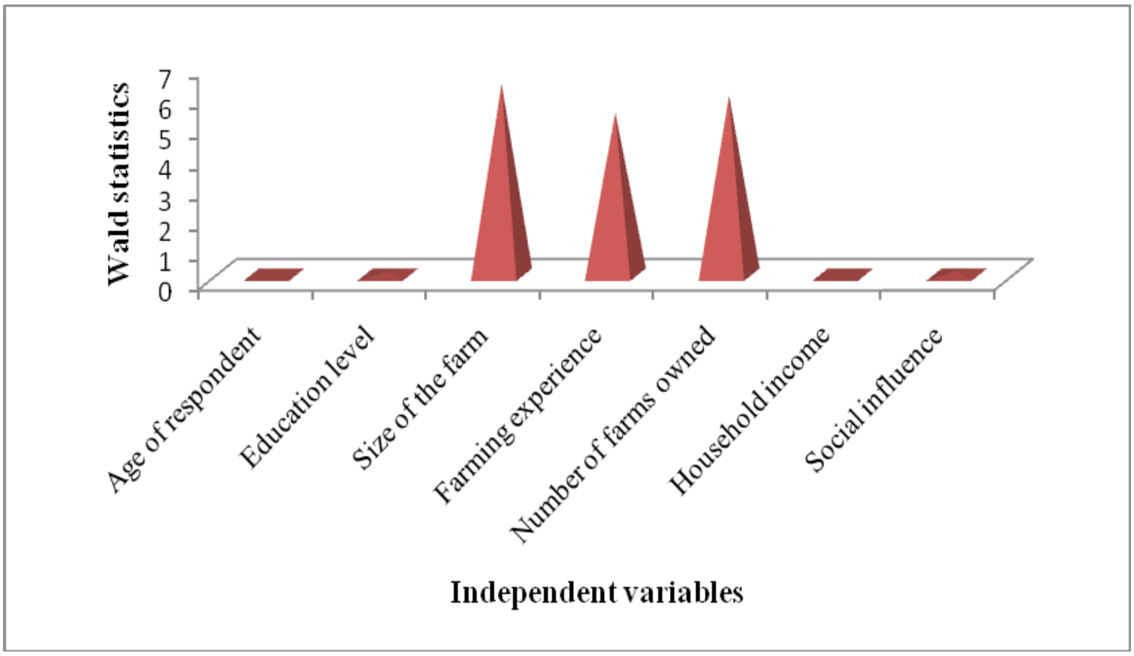

Figure 3: Contribution of independent variables in continuation of technologies

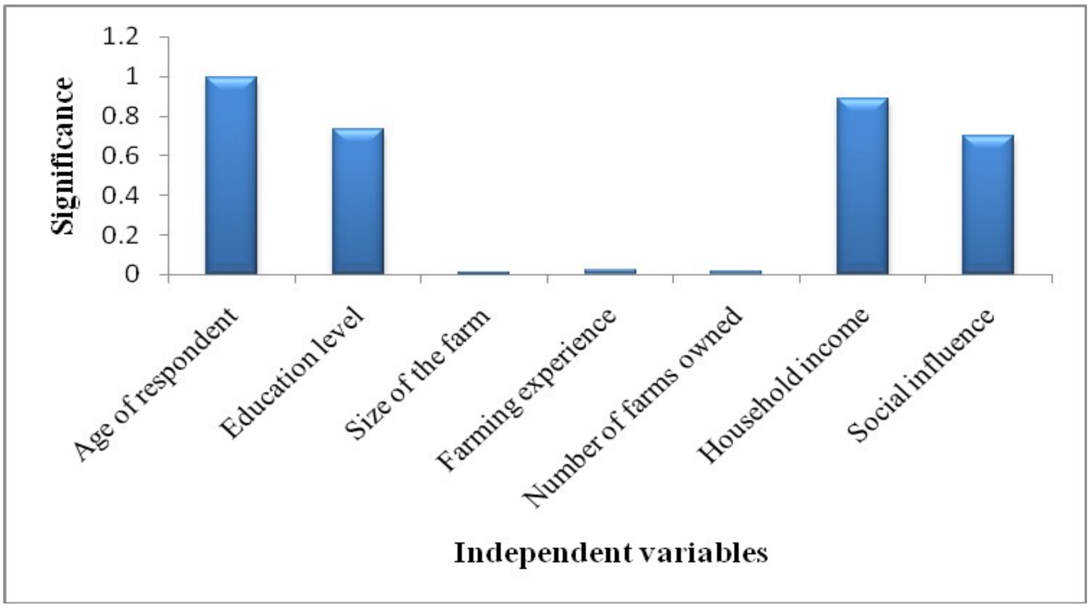

Figure 4: Contribution for each factor towards continuation of adopted agricultural technologies

4.6 Other Factors

4.6.1 Household labour

Availability of household labour is important in adoption and continued use of technology. Results shows that 62.5% of the respondents said family labour was the main source of labour for farming activities; other 20% depended on both hired and family labour where as 17.5% depended solely on the hired labour (Table 12). Starkey (1996) in his study on networking for sustainable agriculture found that labour availability has influence on utilization of technologies. This study suggests that since majority of farmers depended on family labour probably this could be one of the influences towards continual use of adopted agricultural technologies.

Table 12: Distribution of farmers by source of labour (n=120)

Source of labour	Frequency	Percent (%)
Family members	75	62.5
Hired labour	21	17.5
Family & hired labour	24	20.0
Total	120	100.0

4.6.2 Nature of land acquisition

Majority (84.1%) of respondent acquired land through inheritance from their ancestors and few (9.2%) owned land through buying from their fellow farmers. The remaining (6.7%) of respondents had acquired land through both; inheritance from their fore fathers and through buying from other villagers (Table 13). The high percentage of land inheritance concurs with Blarel *et al.* (1992) who argued that in most African societies land acquisition is through inheritance, some by rental arrangements or purchased. Farmers might therefore operate one or more inherited plots, one or more purchased plots and the like. The high inheritance form of land acquisition suggests a strong traditional ties and systems that exist in the area which is an indication of social cohesion which may have attributed adoption and continual use of adopted agricultural technologies.

Table 13: Distribution of farmers by nature of land acquisition (n=120)

Nature of land acquisition	Frequency	Percent
Inherited from ancestors	101	84.1
Bought from other people	11	9.2
Inherited and bought	8	6.7
Total	120	100.0

4.7 Summary of Major Findings as Per Objectives

4.7.1 Technologies introduced by HIMA project in Kilolo District

Farmers were asked to mention which technologies are available in their area and were able to mention about nine agricultural innovations/technologies. The technologies included; terraces, agroforestry, contour ploughing, crop rotation, use of improved seeds, use of multiple cropping, mulching and tree planting. When further requested to tell who introduced those technologies all farmers identified HIMA project.

4.7.2 Innovations/technologies currently used after HIMA project

All technologies introduced by HIMA i.e. terraces, agroforestry, contour ploughing, use of improved seeds ,use of multiple cropping, tree planting and mulching was the technologies that farmers mentioned to continue with after HIMA project. Farmers used one or more than one technology in their farms, however farmers preferred most three technologies which include; contour ploughing, terraces and tree planting.

4.7.3 Social influence and continued use of agricultural technologies

When social influence was loaded into logit model with other factors it was found that; social influence was not statistically significant factor towards continuation of adopted agricultural technologies in the study area, therefore social influence didn't have role to play in continuation of adopted agricultural technologies meaning that farmers continued because of other factors.

4.7.4 Socio-economic factors influencing adoption of technologies

In this objective it was found that there were those factors which didn't have influence on continuation of adopted agricultural technologies and others which had influence on the continuation of adopted agricultural technologies. Those factors which didn't have influence included farmer's age, education level and household income. On the other hand those factors which played significant role in the continuation of adopted agricultural technologies included farm/plot size, number of farms/plots owned, farming experience and household labour.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATION

5.1 Conclusion

Based on the findings from the study the following conclusions are made:

(i) Farmers in the District continued with the adopted agricultural technologies from HIMA because of other factors and not because of social influence. Therefore there was no social influence towards continuation of adopted agricultural technologies in Kilolo District. Factors that were noted by the study to influence continuation of adopted agricultural technologies included; size of farm/plot, number of farms/plots owned by the farmer and farming experience of the farmer. All these factors were significant contributors towards adoption and continuation of adopted agricultural technologies in the District.

(ii) It can also be concluded that despite of all the innovations/technologies that were introduced by HIMA project in the District, most farmers preferred four technologies which include contour ploughing, terraces, improved seeds and tree planting. Farmers preferred most contours, terraces and tree planting because majority of their farms are located on gentle slopes.

(iii) Despite of HIMA project having phased out several years ago, Kilolo community still continue with the technologies adopted from HIMA project and were able tell the advantages of the adopted technologies and what would happen in absence of those technologies introduced by HIMA project.

5.2 Recommendation

(i) Since HIMA project managed to improve community livelihoods through the interventions introduced in Kilolo District, it is important to ensure that there is a mechanism to pass lessons learnt from HIMA project to the young generation.

(ii) It is also recommended that success stories about the innovations introduced by the project are being made available at village level so that could be easily traced back and experience shared to other new incoming projects in the future.

(iii) Strengthening of by laws towards fire outbreaks should be done. It was very commonly noted during focus group discussion that if no stringent measure to stop uncontrolled burning taken it may result into big loss economically and environmentally as fire is disastrous to environment and personal properties.

5.3 Further Research Areas

While the study has provided useful information's with regard to social influence on continuation of adopted agricultural technologies, yet future research is needed to track the extent of youth's involvement and adoption of those agricultural technologies from their elders.

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APPENDICES

Appendix 1: Interview schedule for respondent

TITTLE: SOCIAL INFLUENCE ON CONTINUATION OF ADOPTED AGRICULTURAL TECHNOLOGIES: A CASE STUDY OF HIMA PROJECT KILOLO DISTRICT

Good morning/ afternoon. My name is .... from Sokoine University of Agriculture (SUA), Morogoro. I am undertaking a study in the district to assess the social influence on continuation of adopted Agricultural technologies introduced by HIMA. As members of local community, you have been randomly selected among others from which information will be collected. Your participation is highly respected and the responses will be treated confidentially.

Respondent number………………………………

Ward…………………Village……………………..

A: SOCIO DEMOGRAPHIC INFORMATIONS

1. Age of the respondent.................... (years)

2. Sex. 1. Male [ ] (TICK)
   2. Female [ ]

3. Head of the household
   1. Male [ ]
   2. Female [ ]

4. Marital status
   1. Single [ ]
   2 Married [ ]
   3. Widowed [ ]
   4. Separated [ ]
   5. Divorced [ ]
   6. Other, specify…………………………

5. Type of marriage (if married)

1. Monogamy [ ]
2. Polygamy [ ]

6. For the case of polygamy, how many wives [ ]

7. Household composition:

Age group	Male	Female	Total	Relationship with HHH
< 5 years				
6-15 years				
16-25 years				
26-45 years				
46-60 years				
> 60 years				

8. What is the level of education of the household head in years?

1. No formal education [ ]
2. Adult education [ ]
3. Primary education [ ]
4. Secondary education [ ]
5. Others, specify………………………..

9. What is your main economic activity? …………………………..

B. GENERAL INFORMATION ON ADOPTED AGRICULTURAL TECHNOLOGIES

10. For how long have you involved in farming activities?...................... (Years)

11. Do you own land?

1. YES [ ] 2. NO [ ]

12. If answered YES in 11 above, what is the total size of your farm? [……] (Acreage)

13. How many farms do you own? ....

14. How did you acquire your land?

1. Inherited from ancestors [ ]
2. Bought from other people [ ]

15. Where is your farm/plot situated?

1. On flat land [ ]
2. On gentle slope [ ]
3. On steep slope [ ]

4. Others, specify………………..

16. What types of crops are growing in you plot?..

17. What is the source of your labour?

1. Household labour [ ]
2. Hired labour [ ]

18. Do you use any agricultural technology on your farm?

1. YES [ ] 2.NO [ ]

19. If answered YES in item 18 above which are those technologies?

1………………
2………………
3……………….

20. Who introduced those technologies?

1. HIMA [ ]
2. TASAF [ ]
3.MEMA [ ]
4. Others specify………..

21. Which of the introduced technologies are you using currently?

1……………..
2……………..
3……………..

22. Do you plant any tree?

1. YES [ ] 2.NO [ ]

23. If answered YES in item 22, who introduced them?

1. TASAF [ ]
2. HIMA [ ]
3. CONCERN [ ]
4. Others; specify……………

24. How many trees do you own?

Before HIMA intervention.............
After HIMA intervention…………

25. What types of trees are in your farm?

1. Natural trees [ ] 2.Exotic trees [ ]

26. Who introduced those kinds of trees?

    1. HIMA [ ]
    2. TASAF [ ]
    3. MEMA [ ]
    4. Others; specify……………..

27. Why you adopted agroforestry in your farm?

    1. Influenced by my neighbours [ ]
    2. Economic reasons [ ]
    3. Prestige [ ]
    4. Other reasons; specify…………………..

28. How much income do you get from farming?.................... (Tsh. per annum)

29. Do you have other sources of income apart from farming?

    1. YES [ ] 2. NO [ ]

30. If answered YES in item 29 above name them:

    ……………………………………………………

C. FACTORS LEADING TO ADOPTION AND CONTNUATION OF AGRICULTURAL TECHNOLOGIES

31. What factors made to adopt technologies you are using?

    1. Income [ ]
    2. Influenced by others [ ]
    3. Prestige [ ]
    4 Others, specify………………………

32. Are you still using the technologies adopted from HIMA?

    1. YES [ ] 2.NO [ ]

33. If answered YES from item 32 above what made you continue using those technologies?

    1. Income [ ]
    2. Influenced by others [ ]
    3 Easy to use [ ]
    4. Others specify………………

34. If answered NO in item 32 above/dropped the technology what made you discontinue?

    1. Influenced by others [ ]
    2. Difficult to use [ ]
    3. Expensive [ ]

35. Did you receive any type of training on HIMA technologies?

1. YES [ ] 2. NO [ ]

36. If answered YES in item 35 above, what kind of training did you receive?

1. Agroforestry [ ]
2. Use of animal power [ ]
3. Contour farming [ ]
4. Use of improved seeds [ ]

37. Did your training incorporate packages on continuation after HIMA?

1. YES [ ] 2. NO [ ]

38. If answered NO in item 37 above, what influenced you to continue with the adopted technologies?

1. Influenced by my neghbours [ ]
2. Income [ ]
3. Others specify……………..

39. Do you receive any advice from outside?

1. YES [ ] 2. NO [ ]

40. If answered YES in item 39 above, where do you get those advices?

1. Other fellow farmers [ ]
2. Extension officers [ ]
3. Village Agricultural Facilitators [ ]
4. Others specify………………

41. Are there any cultural/ beliefs or taboos hindering technology adoption?

1. YES [ ] 2. NO [ ]

42. If answered YES, in item 33 above, name them

THANK YOU FOR YOUR COOPERATION

Appendix 2: Checklist for focused group discussion

1. When was HIMA introduced in Kilolo District/Iringa?
2. What were its objectives?
3. Identify different technologies that was introduced by HIMA
4. What were the criteria to be included in HIMA Project?
5. Which of the identified technologies did you adopt?
6. What was the main reason for you to adopt those technologies?
7. What influence you to continue with those technologies?
8. When did HIMA phase-out?
9. Which of the introduced technologies are you still practicing after HIMA project?
10. What are the reasons that make you continue with those technologies
11. What was the forestry situation before HIMA and after HIMA
12. What was the average number of trees per household before and after HIMA
13. What are the main economic activities in this area?