FACTORS CONTRIBUTING TO ADOPTION OF SUNFLOWER FARMING INNOVATIONS IN MLALI WARD, MVOMERO DISTRICT, MOROGORO REGION – TANZANIA

BY

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A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN AGRICULTURAL EDUCATION AND EXTENSION OF SOKOINE UNIVERSITY OF AGRICULTURE. MOROGORO, TANZANIA.

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ABSTRACT

Sunflower farming has been practiced for a long time in many parts of the world including Tanzania aiming at increasing oil production. Smallholder sunflower crop farming is an important sector that produces and nourishes rural as well as urban and peri-urban people with quality oil, which is free from cholesterol.

The aim of this study was to investigate factors that affected adoption of sunflower farming innovations at household level in Mlali ward. Data were collected by interviewing farmers using semi-structured questionnaires as a main tool, which comprised of closed and open ended questions. Descriptive and regression analyses using Statistical Package for Social Sciences were employed as a tool of analysis to determine factors influencing adoption of sunflower farming innovations. Results revealed that respondent's education level, family size, farming experience, availability of sunflower market, and frequency of contacting extension officer significantly influenced the adoption of sunflower farming innovations at $p \leq 0.05$. However, sex of respondent, respondent's age (years), respondent's marital status, and livestock ownership did not significantly influence the adoption of sunflower farming innovations at $p \leq 0.05$.

It was concluded that smallholder sunflower farming sector still has the potential to contribute to meet oil, animal feed and income requirements to the people in this study area. However small holder farmers will need a boost from productivity-improving technologies and support services because there is need to accelerate technology uptake to address declining farm production being experienced by smallholder farmers in Tanzania.

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DECLARATION

I, JUSTINE LIBERIO do hereby declare to the Senate of Sokoine University of Agriculture that this report is my own original work and that it has neither been submitted nor concurrently being submitted in any other institution.

.... 12/03/2012 ....

JUSTINE LIBERIO (MSc. Candidate) — Date

The above declaration is confirmed

.... 14/03/2012 ....

Dr. FLAVIANUS TILUSABA MAGAYANE (Supervisor) — Date

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LIST OF ABBREVIATIONS AND ACRONYMS

ATPS	Africa Technology Policy Studies
cm	centimetre
CIMMYT	International Maize and Wheat Improvement Centre
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
ha	hectare
IFAD	International Fund for Agricultural Development
NGOs	Non-Government Organizations
NSCA	National Sample Census of Agriculture
OECD	Organization for Economic Cooperation and Development
PADEP	Participatory Agricultural Development and Empowerment Project
PTD	Participatory Technology Development
SG 2000	Sasakawa Global 2000
SPSS	Statistical Package for Social Sciences
SSA	Sub Saharan Africa
SWMRG	Soil Water Management Research Group
UMADEP	Uluguru Mountains Agricultural Development Project
URT	United Republic of Tanzania
VIF	Variance Inflation Factor

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Over the last two decades, the level of produced food has decreased dramatically in Sub-Saharan Africa (SSA) resulting in general deterioration in the standard of living of the population. The challenge facing SSA agriculture is therefore to feed a population that is increasing at an annual rate of about 3%, and which will double in about 20 years (FAO, 1999). The problem of food shortage in developing countries could be overcome through use of modern agricultural technologies like improved seeds, fertilizers, fungicides, pesticides, agricultural machinery and proper spacing (Liberio, 2009).

Some of the benefits that can occur to farmers from use of improved agricultural technologies include reduced risks from pest and disease pressure thus leading to high harvest index (FAO, 1999). However, productivity of crops is directly linked to the genetic potential of the seed used and varies according to use of recommended complementary inputs and the observance of cultural practices (Mwanga, 2002).

Role of Agriculture in Tanzania

In Tanzania the agricultural sector is key to economic development (Majule, 2008). Agriculture is the foundation of the Tanzanian economy. It accounts for about half of the national income, three quarters of merchandise exports and is source of food in addition to provision of employment opportunities to about 80% of Tanzanians. Agriculture has linkages with the non-farm sector through forward linkages to agro-processing, consumption and export; provides raw materials to industries and a market for manufactured goods. Tanzania produces approximately 97% of its food requirement. Production of food crops varies from year to year according to the amount of rainfall received (PADEP, 2010). Agriculture contributes about 19.0% of GDP and grows at 4.1%. The rate is still less than the required 6 – 7% to have a significant impact on the lives of the poor (PADEP, 2010).

Agriculture in Tanzania

Agricultural GDP has grown at 3.3% per year since 1985 while the main food crops at 3.5% and export crops at 5.4% per year. Considering that the overall GDP growth target for halving abject poverty is in the range of 6 – 7%, this performance falls short of the needed growth (PADEP, 2010). It is estimated that about 70% of Tanzania's cultivated land is by use of hand hoe as a major tool to till the land, 20% of the cultivated land is by use of oxen and only 10% is by use of tractor. Inputs are not widely used in agricultural production (PADEP, 2010) and according to the World Bank (2001) only 15% of Tanzania farmers use chemical fertilizer, 27% use improved seeds and 18% use pesticides.

In Tanzania agriculture is faced with a number of challenges including ineffective extension services, inadequate use of improved seeds, fertilizers and unreliable rains which may result in low crop productivity. Furthermore, about 93% smallholder farmers in Tanzania cultivate less than 2 ha (World Bank, 1994; Keenja, 2001; URT, 2003a; Liberio, 2009). Liberio (2009) reported that some of the factors for low agricultural growth are; (i) low farm produce price compared to production costs and world market prices, (ii) inadequate agro-processing facilities to add value and shelf life to farm produce, (iii) weak cooperative unions which fail to organise farmers to form strong farming entity, (iv) absence of rural financial institutions to address farmers' credit needs on loan terms, (v) low utilization of appropriate technologies which leads to low agricultural productivity per given inputs and, (vi) weak research – extension – farmer linkage which reduces spread of new agricultural technologies and information/knowledge from research experts to farmers. In addition, poor rural transportation and infrastructure make many areas of product inaccessible to input and output market, thus contributing to late input delivery. Poor infrastructure and transportation also have made rural areas inaccessible to agricultural innovations including improved seeds, fertilizers, fungicides, pesticides, agricultural machinery and agricultural education.

Agricultural development has been in the domain of government/public funding for a long period of time. However macro-economic reforms have and continue to have had significant impact on the agriculture sector. The economic reforms have led to the opening up of the sector to private investment in production and processing, input importation and distribution and agricultural marketing. Most production, processing and marketing functions have been assigned to the private sector. The Government has retained regulatory and public support functions or facilitation role (PADEP, 2010).

Importance of Sunflower

Sunflower is thought to have originated in Mexico and Peru and it is one of the first plants to ever be cultivated in the United States. It has been used for more than 5,000 years by the Native Americans, who not only used the seeds as food and an oil source, but also used the flowers, roots and stems for a variety of purposes including a dye pigment.

The Spanish explorers introduced sunflower to Europe, and after being first grown in Spain, it was subsequently introduced to other neighbouring countries. Currently, sunflower oil is one of the most popular oils in the world. The leading commercial producers of sunflower seeds include Russia, Peru, Argentina, Spain, France and China (The George Mateljan Foundation, 2001-2010).

Sunflower seeds have very high oil content; they are one of the main sources of polyunsaturated oil. Sunflower seeds are an excellent source of vitamin E, the body's primary fat-soluble antioxidant. Vitamin E travels throughout the body neutralizing free radicals that would otherwise damage fat-containing structures and molecules such as cell membranes, brain cells, and cholesterol. By protecting these cellular and molecular components, vitamin E has significant anti-inflammatory effects that result in the reduction of symptoms in asthma, osteoarthritis and rheumatoid arthritis. Vitamin E has also been shown to reduce the risk of colon cancer, help decrease the severity and frequency of hot flashes in women going through menopause, and help reduce the development of diabetic complications (The George Mateljan Foundation, 2001-2010).

In addition, vitamin E plays an important role in the prevention of cardiovascular disease. Vitamin E is one of the main antioxidants found in cholesterol particles and helps prevent free radicals from oxidizing cholesterol. Only after it has been oxidized is cholesterol able to adhere to blood vessel walls and initiate the process of atherosclerosis, which can lead to blocked arteries, heart attack, or stroke. Getting plenty of vitamin E can significantly reduce the risk of developing atherosclerosis.

In fact, studies show that people who get a good amount of vitamin E are at a much lower risk of dying of a heart attack than people whose dietary intake of vitamin E is marginal or inadequate. Just a quarter-cup of sunflower seeds contains 90.5% of the daily value for vitamin E (The George Mateljan Foundation, 2001-2010).

Sunflower is an important industry in Tanzania. It ranks as one of the most important vegetable oil with high value and on international market, sunflower ranks fourth after soybean, oil palm and rapeseed. In Tanzania oil extracted from sunflower by local producers contribute 40% of the national cooking oil requirements. The development of this industry in Tanzania to a larger degree has been triggered by two main factors: (i) food value – basically sunflower is grown for its edible oil production and (ii) processing ability by farmers at farm level (Ugulumu, 2008). Farmers in Mlali Ward produce sunflower mainly for cooking oil, increasing household income and animal feeds (UMADEP, 2007).

Adoption of Agricultural Technologies in Tanzania

Due to recognition of the importance of new technologies in production, Tanzania's government created the Tanzania National Science Research Council in 1968. The council aimed at promoting scientific research of which agriculture was among the important areas to be researched on in order to generate improved agricultural technologies (Shao, 1994). Many reasons have been given for the less impact of improved agricultural technologies. Low adoption of the technologies coupled with abandonment of previously adopted agricultural technologies disseminated to farmers are among the reasons for low impact of improved technologies (Michelle, 2005).

Technology adoption by agricultural producers is an essential prerequisite for economic prosperity in both developed and less developed countries. In many less developed countries, considerable resources have been devoted to providing technical assistance and education to agricultural producers. An extension project, Sasakawa Global 2000 (SG 2000) was initiated in Tanzania. The purpose of this project was to popularize use of scientific agricultural practices such as improved maize production technologies, especially improved maize seed and chemical fertilizer. Crop spacing, timeliness of farm operations, and seed dressing were additional management skills being advocated by SG 2000. The efficacies of such programmes depend on factors that influence technology adoption by targeted producers. Therefore, extension educators and technical assistants involved in agricultural development need to understand factors affecting technology adoption in order to target and deliver effective programmes (Nkonya *et al.,*1997).

Furthermore, irrigation technologies are being established in the country for the purpose of developing agricultural sector. For example, different micro irrigation and rainwater harvesting technologies are practiced in different parts of the country. The inventory of agricultural water technologies has revealed that there are at least fourteen technologies practiced in Tanzania. The technologies include money maker treadle pumps, drip irrigation, roof catchment with above ground tank, charco dam and *fanyajuu* terracing. Other technologies are ridging, mulching, minimum tillage (conservation agriculture), *ngoro* pits, *chololo* pits, silted sand valley and ladder terracing (Soil Water Management Research Group SWMRG, 2005).

1.1 Problem Statement

There is need for improving agricultural sector in Tanzania so that the sector increase food availability, reduce poverty, enable the country to increase markets for products, address pressing social needs, and eventually become self-sufficient in basic food requirements. Food production has been failing to meet demand and the country has been importing food and receiving food aid so as to meet the demand due to its production shortfalls (URT, 2002a; URT, 2003b).

Despite availability of many innovations and technological advances in recent decades, these innovations and technological advances pose novel and complex challenges for agriculture, which is under pressure to ensure food availability in ways that are environmentally and socially sustainable (National Research Council, 2010a), cited by Cooperative Actions for Water Security (2011).

According to the Ministry of Agriculture and Co-operatives (1997) and FAO (1999), agricultural development aimed at improving on-going food supplies in the country must emphasize adoption of improved agricultural technologies that will ensure availability of quality and locally appropriate seed varieties, fertilizers, agricultural mechanization, agricultural education, pesticides and fungicides to farmers in timely manner and at affordable prices.

Low adoption of improved technologies is one of the most important causes for low agricultural production in Tanzania. Low agricultural productivity results into low incomes and poor standard of living of people in rural areas particularly in villages.
For many years, reasons for the non or poor adoption of recommended practices in Tanzania have been associated with independent factors like farmers' characteristics, socio-economic, institutional and environmental factors (Lugeye, 1994).

Despite efforts such as emphasis on the use of terraces which control soil and fertility loss from field, optimum quantity of fertilizer application, construction of appropriate seed storage structures, and inter cropping, made by the Government and many NGOs like Uluguru Mountains Agricultural Development Project (UMADEP) to improve agricultural productivity in Mlali ward, agricultural innovations have been adopted at low level by smallholder farmers in the ward.

1.2 Justification of the Study

This study aims at understanding the specific factors leading to adoption of sunflower farming innovations in the study area. The information obtained from this study will generate useful knowledge to development planners, policy makers and practitioners in reducing poverty through increased agricultural productivity and strengthening sunflower farming and use.

This is in line with the national vision on KILIMO KWANZA, Activity 1.2 “Modernise and commercialise agriculture for peasant, small, medium and large scale producers under the 1st task of transforming peasant and small farmers to commercial farmers through emphasis on productivity and tradability”.

As well as to meet Millennium Development Goal 1 which is to eradicate extreme poverty and hunger with its 2 targets of halving between 1990 and 2015, the proportion of people whose income is less than one dollar a day (Target 1), and halve between 1990 and 2015, the proportion of people who suffer from hunger (Target 2).

1.4 Objectives of the Study

1.4.1 General objective

To investigate factors contributing to adoption of sunflower farming innovations by smallholder farmers at the household level in Mlali ward.

1.4.2 Specific objectives

1. To identify smallholder farmers who produce sunflower in the study area.
2. To measure adoption level of sunflower farming innovations.
3. To identify factors influencing the adoption of sunflower farming innovations.
4. To gauge socio-economic contributions of sunflower crop to smallholder farmers in the ward.

1.5 Research Questions

How many farmers are involved in sunflower farming in the ward?

What are the current farming practices adopted by farmers?

Which factors influence the adoption of sunflower farming innovations?

What social-economic benefits does smallholder farmer gain from sunflower farming?

1.6 Hypotheses

Null Hypothesis (H_0):

Adoption of sunflower farming innovations is not significantly influenced by economic factors, institutional factors, socio-psychological factors, and farmer characteristics.

Alternative Hypothesis (H_1):

Adoption of sunflower farming innovations is significantly influenced by economic factors, institutional factors, socio-psychological factors, and farmer characteristics.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Concepts of Innovation and Adoption

According to Dasgupta (1989), the term adoption is the continued use of a recommended idea or practice by individuals or groups over a reasonable long period. Archibugi *et al.* (1994) define innovation as successful creation, development, and marketing of new goods or successful application of new techniques or ways of working that improve the effectiveness of an individual and organization. OECD (1994) defines innovation as the transformation of an idea into a new or improved product introduced in the market, or a new or improved operational process used in industry and commerce, or into a new approach to a social service. Rogers (1995) defines an innovation as an idea, practice, or object that is perceived as new by an individual or any other unit of adoption.

Rogers and Shoemaker (1995) define adoption as a decision to make full use of new ideas as the best course of action available. The decision of whether or not to adopt a new technology hinges upon a careful evaluation of a large number of technical, economical and social factors. The authors further explained that adoption or rejection of an innovation is a decision to be made by an individual. Rogers (1995) defines adoption as the mental process through which an individual passes from first hearing about an innovation to final adoption. van den Ban and Hawkins (1996) also define technology adoption as a decision to apply an innovation and to continue to use it. Adoption is viewed as a variable representing behavioural changes that farmers undergo in accepting new ideas and innovations in agriculture.

The term behavioural change refers to desirable change in knowledge, understanding and ability to apply technological information, changes in feeling behaviour such as changes in interest, attitudes, aspirations, values and the like; and changes in overt abilities and skills (Ray, 2001).

Innovation decision process

The innovation decision process is a set of actions taken by an individual to accept or reject a new idea. According to Rogers (1995) the innovation decision process is characterised by five stages: knowledge, persuasion, decision, implementation and confirmation. Knowledge stage is when an individual is first exposed to an innovation but lacks information about the usefulness of the innovation. During this stage of the process the individual has not been inspired to find more information about the innovation. Persuasion is the stage when an individual gets interested in the innovation and actively seeks information/detail about the innovation. Decision stage is when an individual takes the concept of the innovation and weighs the advantages/disadvantages of using the innovation and decides whether to adopt or reject the innovation.

Due to the individualistic nature of the decision stage, Rogers (1995) notes that it is the most difficult stage to acquire empirical evidence. Implementation is when an individual employs the innovation to a varying degree depending on the situation. During this stage the individual knows/understands the usefulness of the innovation and may search for further information about it. Confirmation is the stage at which an individual finalizes his/her decision to continue using the innovation and may use the innovation to its fullest potential.

Individual innovativeness

Innovation theory states that an innovation will initially be adopted by a small group of innovative farmers and later diffuse to other farmers. It posits that innovations spread gradually over time and among people resulting in various adopter categories. The result is an adoption process that forms a normal S-shaped curve when plotted over time (Rogers 1995). Rogers attributes this distribution of adoption to the role of information, which reduces uncertainty among members in the diffusion process. Based on this argument the author has classified adopters into five categories: innovators, early adopters, early majority, late majority and laggards. Innovators are described as individuals who are venturesome, eager to try new ideas and willing to take risks. Early adopters are described as the local opinion leaders in the system who function as the role models and are quick to see the value of innovations. The early majority is formed by the largest category. These people only make a decision after they are convinced of the benefits. The late majority are cautious and sceptical persons who do not adopt until the large majority has done so. They are usually the relatively poor and are averse to risk. The last group of adopters is the laggards. They are suspicious of innovations and change agents. They are usually poor and seldom take risks.

2.2 Background of Adoption Study

Technology generation and development is an interactive process and the supply of technologies needs to be driven by demand from the users. As noted by Langyintuo and Mulugeta (2005), the importances of adoption study are: to quantify the number of technology users over time; to assess impacts or determine extension requirements; to provide information for technology reform and to provide a basis for measuring impact. Rural sociological research on the diffusion of agricultural innovations originated in the United States in 1920s when the United States Department of Agriculture decided to evaluate the process of their programme of introducing improved farming practices among farmers (Dasgupta, 1989).

van den Ban and Hawkins (1996) also state that adoption and diffusion of innovation research was high during the 1960s in less developing countries. This is because the ministries of agriculture saw the need for large numbers of farmers to use the result of scientific agriculture in order to prevent famine. The adoption of agricultural technologies during and after the Green Revolution is well documented (Gollin *et al*., 2005).

The importance of farmers' adoption of new agricultural technology has long been of interest to agricultural extensionists 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. 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.

2.3 Attributes of the Innovation and Farmers' Adoption Decision

Adoption is a decision-making process, in which an individual goes through a number of mental stages before making a final decision to adopt an innovation.

Decision-making is the process through which an individual passes from first knowledge of an innovation, to forming an attitude toward an innovation, to a decision to adopt or reject, to implementation of new idea, and to confirmation of the decision (Ray, 2001).

With regard to the relationship of technological attributes with farmers' adoption decision, Rogers (1995) identified five characteristics of agricultural innovations, which are important in adoption studies. These include 1) Relative advantage 2) Compatibility 3) Complexity 4) Trialability and 5) Observability. Rogers (1995) defines these characteristics as follows Relative advantage: Is the degree to which an innovation is perceived as better than the idea it supersedes. Compatibility: Is the degree to which the farmer perceives an innovation to be consistent with his/her cultural values and beliefs, traditional management objectives, the existing level of technology and stages of development. Complexity: Is the degree to which an innovation is perceived to be complex to understand and use by farmers. Trialability: Is the degree to which the innovation could easily be tried by farmer on his/her farm. Observability: Is the degree to which results of innovation are visible to farmers.

The conventional adoption framework simplifies the analysis of the adoption decision by its implicit assumption of an individual "decision-maker." Within the farm household, the ability to make decisions regarding resource use and technology varies according to age, sex and other categories. Nkonoki (1994) found that resources such as land size and animal ownership may make easier for a farmer to alter practices.

Also Jamison and Lawrence (1982) discovered a significant relationship between farm size and adoption of an innovation and that there was a positive correlation between farm size and adoption of new technologies. Actual decisions can depend on a complex bargaining process among household members. Beyond the household, group processes and the ability to harness them can also play a crucial role in adoption decisions, particularly on conservation practices. Moreover, decisions about new technology are frequently prompted by an intervention in the form of a project (Cramb, 2003).

The study of Doss *et al*. (2003) on adoption of maize and wheat technology in Eastern Africa report that farmers cited several reasons for not adopting improved technologies. The first was simply being unaware of the technologies or that they could provide benefits; this may include misconceptions about the related costs and benefits. The second reason was that the technologies were not profitable, given the complex sets of decisions that farmers make about how to allocate land and labour across agricultural and non-agricultural activities. This may be due to the fact that appropriate varieties for farmers' agro ecological conditions were not available or that farmers preferred characteristics found only in local varieties. It may also be due to institutional factors, such as the policy environment, which affect the availability of inputs (land, labour, seeds, and fertilizer) and markets for credit and outputs. These institutional factors also affect input prices. It may also be that use of improved technologies may increase production risks: if crops fail, the financial losses would be higher. Finally, technologies were not adopted because they were simply not available.

Ehui *et al*. (2004) explain that a new technology introduced to smallholder farmers by itself alone does not guarantee for wide spread adoption and efficient use. For efficient utilization of the technology, fulfilment of specific economic, technical and institutional conditions are required. From the farmers' perspective, the new technology should be economically more profitable. The new technology should also be technically easily manageable by smallholders and adaptable to the surrounding socio-cultural situations. Similarly, the availability of the new technology and all other necessary inputs to smallholders at the right time and place and in the right quantity and quality should be ensured. The rate of adoption is influenced by the farmers' perception of the characteristics of the innovation, the changes this innovation requires in farm management and the roles of the farm family (van den Ban and Hawkins, 1996). The authors further stated that innovations usually are adopted rapidly when they have a high relative advantage for the farmers; compatible with the farmers' values, experiences and needs; are not complex; can be tried first on small scale and easy to observe the results. However, technology adoption incorporates two essential elements, the embracement of the technology by individuals and its embedment in society (Baron *et al.,* 2006), cited by Deligiannaki and Ali (2011).

Moreover, data on the adoption and use of technology such as computers have shown that a number of factors, such as education, socioeconomic status, attitudes toward the technology, the perceived benefits of technology, and access to technology, influence technology adoption (Czaja *et al.,* 2006). Individuals possess some information about the innovation being considered, and this information is dynamic; the tendency of the potential adopters to adopt the innovation is influenced by this information and their minimal expectations (i.e. adoption threshold) from such an innovation (Yücel and Daalen, 2011).

Adoption of improved maize seed, and to some extent chemical fertilizer in Tanzania, is affected both by characteristics of household heads and the resources they own.

Farm size significantly affects improved maize seed adoption. Those with larger farms are likely to be better informed, be able to take larger risks associated with early adoption, and have more opportunity to experiment. Agricultural technologies are more likely to be adopted by farmers with larger farms. In terms of equitability this implies the need for research, extension and planning agencies to be sensitive to the needs of smaller farmers through developing and disseminating/implementing technologies and strategies that are relevant to their needs (Nkonya *et al.,* 1997).

Farmers' characteristics have an influence on the adoption of farming innovations, these factors include age, gender, culture, and education that may predispose a farmer to take an interest on an innovation, and resources such as income, land size and number of animals owned that may make it easier for a farmer to alter practices (Nkonoki, 1994).

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

With regard to the issue of sex, CIMMYT (1993) contended that because women play a key role in most of the agricultural systems, it is important that adoption studies consider the degree to which a new technology reaches female farmers. Similarly, most of the food producers in Africa are women and yet most technologies are promoted for men. Stephens (1992) argued that though most technologies are considered gender neutral, they are often gender biased during their introduction and use by societies.

According to Swamson *et al.* (1984) the farmers' educational background is a potential factor in determining the readiness to accept and properly use an innovation. In Tanzania, most farmers have primary education and rely on traditional farming practices. Therefore, the more complex the technology the more likely it is that education will play a major role (CIMMYT, 1993).

In terms of resources, wealthier farmers have better access to extension information and stand a better chance to use their own resources to experiment with new innovations (CIMMYT, 1993). Many times it is farmers with more resources in terms of capital, land and labour that are able to take advantage of new technologies and practices (Liberio, 2009).

In Tanzania there is positive correlation between cattle stall-feeding and availability of male children in the household because children helped in stall-feeding cattle. The age of the household head may be relevant if the technology is long term. A short term technology like the dairy technologies renders age irrelevant. If the technology needs a lot of information, then the experience one has had with the technology, and not just general farming experience becomes more relevant (Kaliba *et al.*, 1997).

Culturally, in many cases innovations are faced by barriers before their establishment and the reason is not only that an innovation can be "good or bad" there is a system of norms and rules written or not that "trap or release" an innovation. While the promise of change is what drives adoption, such explanations neglect the social embeddedness of the process by which innovations are introduced to and accepted by the public (Lounsbury and Glynn, 2000), cited by Deligiannaki and Ali (2011).

2.4 Participation of Rural Farmers in Agricultural Innovation Programmes

In many instances in developing countries local people are not involved in the early stages of agricultural innovation programmes development like seed production, sowing, spacing, application of fertilizer and pesticides. They are usually mobilized to implement agricultural innovation programmes that are decided at district, regional or national level. The need for involving people in agricultural innovation programmes is essential because; (i) participation is the key to learning process in agricultural production programme, (ii) participation empowers farmers in agricultural production programme, (iii) participation supports the progress and sustainability of agricultural production programme, (iv) participation promotes sense of agricultural production programme ownership to the farmers (v) participation promotes self-reliance to the farmers in agricultural production programme (Liberio, 2009).

2.5 Agricultural Extension with Participatory Approach

The central elements in participatory approach are active participation and involvement of smallholder farmers in the three crucial stages namely; assessment, analysis and action (Due, 1996). Participatory approach promotes shared understanding and empowerment, which lead to joint decision making. The approach usually starts with consultation and moves to negotiation, problems, solution and approaches and ends with decision making and action (IFAD, 2001).

The significance of the approach is that many poor rural people are hardly able to define and articulate their problems, hence the use of non-formal educational methods which depend on and encourage dialogue has proved to be very effective in enabling them to participate in development project and programme. However, the role of extension agents as facilitators is important since it helps the farmers deliberate information by joining with them in translating information and in selecting the best alternative.

The major role of extension in many countries in the past was seen to be transfer of new technologies from researcher to the farmers. Now it is seen more as a process of helping farmers to make their own decisions by increasing the range of options from which they can choose, and by helping them to develop insight into the consequences of each option (van den Ban and Hawkins, 1996). Extension plays a great role in popularizing farm technologies. Currently, everyone is found in competitive globalized world. Hence, to make farmer competent, it is expected from the extension to work closely with farmers than any other times.

As noted by Hagmann *et al*. (2003) the role of extension includes:

1. Building the capacity of farmers and farmer organizations to pursue their development goals by articulating high quality demand for services.

This can be effected by offering need-based practical training and close follow up which enable them to examine their farming environment comparing with other farming situation. This, in turn, develops farmers' aspiration for change through adopting different farm technologies that is suitable to their farming system.

2. Linking farmers and farmer organizations to other support agencies including markets and input supply systems, creating platforms for their interaction and facilitating negotiation between the different stakeholders.

3. Helping farmers search for new knowledge and technologies as well as creating partnerships that enhance application of the knowledge and technologies.

4. Facilitate farmers for collective and individual learning about innovations to enhance community's capacity to innovate. Collective action helps to find appropriate solution. Hence, participating different actors in learning and experimenting together and sharing experiences that enhance them to understand more about the technology. Enhancing technology dissemination and adoption is part of an innovation system that starts with the technology development process itself.

Concepts of participatory technology development (PTD) and now integrated agricultural research for development indicates a shift from supply driven to more collaborative ways of generating and disseminating relevant agricultural technologies. This therefore, means that the responsibility to promote technologies cannot be left to extension agencies alone but rather a collective responsibility of researchers, extension agents, farmers and other service providers. Engaging in such collective responsibility demands new skills for integration and working together in partnership with key stakeholders. Skill for doing so has to be clearly identified and deliberately built in the system (Abebe, 2007).

2.6 Conceptual Framework of the Study

The importance of farmers' adoption of new agricultural technology has long been of interest to agricultural extensionists 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. 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 (Rogers, 2003).

As noted by Degnet and Belay (2001) the reasons for adoption or non-adoption at farm level vary over space and time. Factors influencing adoption are neither exclusively economic nor purely non-economic. Both economic and non-economic reasons are essential motives for shaping the farmers attitude towards the new technology and its final adoption.

The following conceptual model (Figure 1) serves the study as its framework.

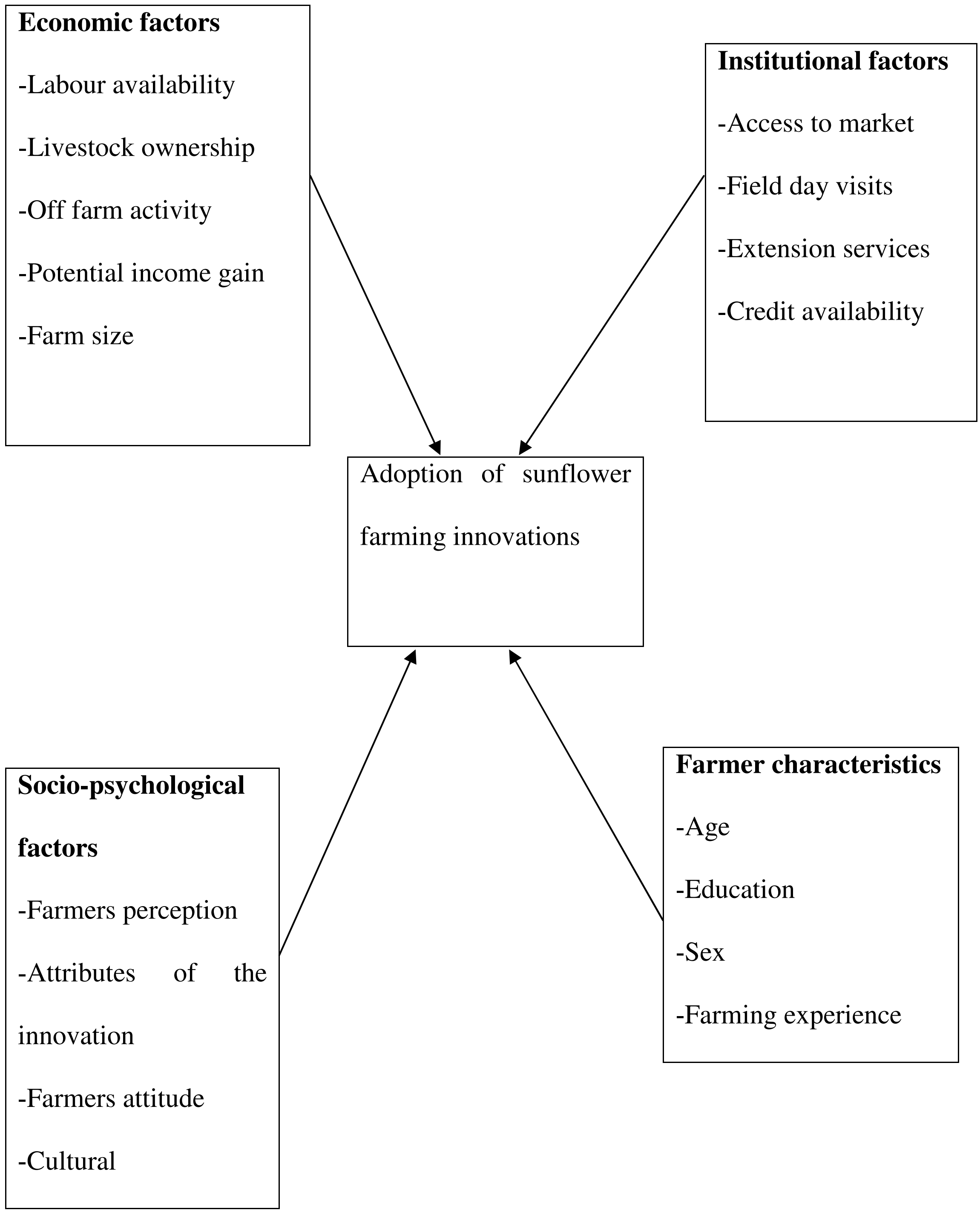

Figure 1: Factors affecting adoption of sunflower farming innovations

CHAPTER THREE

3.0 METHODOLOGY

3.1 Location and Geographical Description of the Study Area

The study was conducted in Mlali ward, which is among the four wards of Mlali division located in Mvomero district in Morogoro region. It is found on the Southern part of Mvomero district bordering Morogoro urban to the south and Morogoro rural to the East. Kilosa district borders the study area to the West. The ward is 30 km to the West of Morogoro Municipality. Mlali ward is on the lowlands adjacent to the UluguruMountain. The climate in the area is semi-arid with annual rainfall ranging from 500 – 800 mm.

3.2 Research Design

The research design for this study was a cross-sectional survey where data were collected at a single point in time. Data collected were used for simple description purposes as well as determining relationships between variables.

3.3 Study Population

Five villages of Mlali ward where sunflower is produced ie. Mlali, Kipera, Manza, Homboza, and Pekomisegese were included in the study. All smallholder farming households in Mlali ward who produced sunflower constituted the study population and totalled 134.

3.4 Sample Size Determination and Sampling Procedure

A simple random sampling was used to obtain a sample size of 100 farmers from these villages to represent the total population at confidence level of 95% and level of precision of 5%, as derived from Yamane (1967) formula.

$$n = \frac{N}{1+N(e^2)} \quad \text{(Equation 1)}$$

Where; n is the sample size

N is the population size = 134

e is the level of precision (Sampling error) = 5% or 0.05

$$n = \frac{134}{1+134(0.05^2)}$$

$$n = \frac{134}{1+134(0.0025)}$$

n = 100

In addition to the sample of 100 farmers, 14 key informants were also interviewed during the study. They included 10 experienced sunflower farmers, two ward extension officers, and two UMADEP workers.

3.5 Data Collection

Data collection is the process of gathering and measuring information on variables of interest, in an established systematic fashion that enables one to answer stated research questions, test hypotheses, and evaluate outcomes (Dodge, 2003). For this study both primary and secondary data were collected. In order to address the objective of the study, both qualitative and quantitative data were collected.

3.5.1 Primary data

Primary data are the data observed or collected directly from first-hand experience (Dodge, 2003). In this study primary data collected included socio-economic characteristics of respondents as well as production practices and attitude towards sunflower farming.

3.5.2 Secondary data

Secondary data are the data that were collected by someone else or for a purpose other than the current one (Dodge, 2003). In this study secondary data such as past records on adoption of agricultural innovations were collected through reviewing literatures from various sources such as journals, books, reports from UMADEP offices, internet and research publications from Libraries.

3.5.3 Qualitative data

Qualitative data are the data which describe items in terms of some quality or categorization (Dodge, 2003). The following qualitative data were involved in the study; farm irrigation, availability of sunflower market, production of farm seeds, type of farm seeds produced, reasons for not producing farm seeds, knowing other farmers, producing farm seeds, terms of selling seed, use of improved seeds, areas of getting seeds, reasons for not buying inputs, easiness of getting land, soil suitability for sunflower farming, livestock ownership, types of livestock kept, tools used in farming, farm weeding, frequency of weeding, use of recommended spacing, use of pesticides, types of pesticides used, access to sunflower processing machine, contact with village extension officer, benefits of sunflower production, respondent's suggestion on sunflower farming, respondent's opinions about sunflower farming innovations.

3.5.4 Quantitative data

Quantitative data are the data in which items are described in terms of quantity and in which a range numerical values are used without implying that a particular numerical value refers to a particular distinct category (Dodge, 2003). The following quantitative data were involved in the study; respondent's age (years), sex of respondent, respondent's education level, family size, access to land, mode of land acquisition, farm size, total area cultivated per season, farming experience, fertilizer application, buying of agricultural inputs, types of inputs bought, number of livestock kept, having source of fund, respondents source of fund, major source of labour, frequency of contacting extension officer, strand of sunflower farming.

3.6 Data Collection Instruments

In-depth interviews and discussions were used to collect the qualitative data. Semi-structured questionnaire of closed ended and open ended questions was used to collect the quantitative data. In-depth interviews involved key informants while focus group discussions involved five groups. 14 key informants including 10 experienced sunflower farmers, two ward extension officers and two UMADEP workers were purposively selected and involved in in-depth interviews. Five groups of 10 farmers each were formed for focus group discussions. Semi-structured questionnaire was used to collect data from 100 sunflower farmers who were randomly sampled.

3.7 Validity and Reliability

Questionnaire was read by some academic staff members of the Department of Agricultural Education and Extension at Sokoine University of Agriculture, comments of the experts were used to modify the questionnaire before pre-testing in order to suit the objectives of the study, and were pre-tested to 15 sunflower smallholder farmers in Mlali ward, 3 smallholder farmers from each village of the study to include all quantitative data pertaining to the study.

3.8 Data Analysis

Data analysis is the process of evaluating data using analytical and logical reasoning to examine each component of the data provided (Dodge, 2003). For this study Descriptive and regression analyses were used to analyse collected data.

3.8.1 Descriptive analysis

Descriptive statistics were used whereby qualitative and quantitative data collected from farmers were summarized, coded, and entered in the software programme of Statistical Package for Social Sciences (SPSS) version 16 spread sheets for analysis to give the quantitative description of information, frequencies and percentages were obtained and used to present results.

3.8.2 Regression analysis

Multiple linear regression model was run to quantify the combined effect of the factors contributing to adoption of sunflower farming innovations as independent variables as well as gauge the role of each variable in explaining the variances in the dependent variable.

The factors used as predictors included sex of respondent, respondent's age (years), respondent's education level, respondent's marital status, family size, farming experience, availability of sunflower market, livestock ownership, and frequency of contacting extension officer. The dependent variable was adoption of sunflower farming technologies.

A rating scale of one to three was used to measure perception of three technology attributes (availability of sunflower market, livestock ownership, and frequency of contacting extension officer). In addition to these factors, the following farmers' characteristics; sex, age, education level, marital status, family size, and farming experience were included as explanatory variables in the model. The individual ratings of innovation attributes were pooled in order to obtain a composite measure of attributes on adoption. Farmer's characteristics were incorporated to test whether perception variables influence adoption decision.

3.8.2.1 Model specification

$$Y= a + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \ldots \beta_nX_n + e_t$$

……………………………………………………………………………… (Equation 2)

Where:

Y= f{Sex of respondent (X_1) + Respondent's age (X_2) + Respondent's education level (X_3) + Respondent's marital status (X_4) + Family size (X_5) + Farming experience (X_6)+ Availability of sunflower market (X_7) + Livestock ownership (X_8) + Frequency of contacting extension officer (X_9)}.

Y= The dependent variable representing the level of adoption of sunflower farming technologies.

a= Intercept (constant) term.

X_1 to X_n=Independent variables.

e_t= Random error term.

$\beta_1$toβ_n=Standardized partial regression coefficients for independent variables.

The assumptions of the multiple regression model were;

1. There was no linear relationship existing between two or more of the independent variables.

2. The error term had an expected value and constant variance for all observations.

3. The error term was normally distributed, that is $e \sim N(0,\delta^2)$

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Characteristics of Smallholder Head of Households

The distribution of respondents by villages is presented in Table 1 where it shows that 20 (20%) farmers were coming from Kipera village, 20 (20%) from Mlali village, 20 (20%) from Manza village, 20 (20%) from Homboza village, and 20 (20%) from Pekomisegese.

Table 1: Village names and number of respondents (n=100)

Village name	Number	Percent
Mlali	20	20.0
Kipera	20	20.0
Manza	20	20.0
Homboza	20	20.0
Pekomisegese	20	20.0
Total	100	100.0

Table 2 depicts respondents' age categories. From the Table, it shows that 47 (47%) farmers were aged between 41 and 50 years, 27 (27%) between 31 and 40 years, 21 (21%) between 51 and 60 years, four (4%) between 20 and 30 years, and only one (1%) was aged between 61 and 70 years.

Table 2: Age of respondents (n=100)

Age category in years	Number	Percent
20-30	4	4.0
31-40	27	27.0
41-50	47	47.0
51-60	21	21.0
61-70	1	1.0
Total	100	100.0

Findings in Table 3 show that 73 (73%) farmers were males and the remaining 27 (27%) were females. According to these results, males dominated sunflower production in the ward. These findings comply with that of Stephens (1992) who argued that though most technologies are considered gender neutral, they are often gender biased during their introduction and use by societies.

Table 3: Sex of respondents (n=100)

Sex	Number	Percent
Male	73	73.0
Female	27	27.0
Total	100	100.0

Results in Table 4 present the education level of respondents whereby 77 (77%) farmers had primary education, 12 (12%) had no formal education, seven (7%) had post-secondary education, and four (4%) had secondary education. These results indicate that majority (77%) of the smallholder sunflower producers had primary education. The results are in agreement with that of CIMMYT (1993) where it was reported that in Tanzania, most farmers have primary education and rely on traditional farming practices.

Table 4: Respondents' education level (n=100)

Education level	Number	Percent
No formal education	12	12.0
Primary education	77	77.0
Secondary education	4	4.0
Post-secondary education	7	7.0
Total	100	100.0

Findings in Table 5 show respondents' occupations whereby 87 (87%) were practicing farming as their only occupation, eight (8%) and five (5%) were teachers and business persons respectively apart from farming. These results indicate that 87 (87%) farmers in the ward had no other means of sustaining their livelihoods apart from farming. These findings comply with that of PADEP (2010) which states that agriculture is the source of food and provides employment opportunities to about 80% of Tanzanians.

Table 5: Respondents' occupation (n=100)

Occupation	Number	Percent
Farming only	87	87.0
Teaching	8	8.0
Doing business	5	5.0
Total	100	100.0

Findings in Table 6 show that 88 (88%) farmers were married and living together with their partners in the same house, eight (8%) were widowed, two (2%) were divorced/separated, and two (2%) were single. These results indicate that majority of farmers 88 (88%) were married.

Table 6: Respondents' marital status (n=100)

Marital status	Number	Percent
Single	2	2.0
Married	88	88.0
Divorced/Separated	2	2.0
Widowed	8	8.0
Total	100	100.0

Results in Table 7 show that the largest family was having 12 members and smallest family was having one member. These findings reveal that families had more than three members with an exception of one family, this enabled farmers to engage more in agricultural production because of the labour force available in the household, many times it is farmers with more labour that are able to take advantage of high production in agriculture.

Table 7: Respondents' family size (n=100)

Family members	Number	Percent
1	1	1.0
3	4	4.0
4	11	11.0
5	15	15.0
6	25	25.0
7	14	14.0
8	12	12.0
9	10	10.0
10	6	6.0
12	2	2.0
Total	100	100.0

4.2 Description of Farming Situation and Practices Done by Smallholder Farmers in the Ward

Results in Table 8 show that all 100 (100%) smallholder sunflower farmers in the ward had access to land. Also, 66 (66%) farmers purchased the land, 28 (28%) inherited the land and six (6%) rented the land for sunflower farming. These findings show that many farmers 66 (66%) in the ward purchased land for sunflower farming.

Table 8: Farmers' access to land and mode of land acquisition for sunflower farming (n=100)

Whether one has access to land	Number	Percent
No	0	0
Yes	100	100.0
Total	100	100.0

Mode of land acquisition	Number	Percent
Purchased	66	66.0
rented	6	6.0
inherited	28	28.0
Total	100	100.0

Findings in Table 9 show that it was difficult for 63 (63%) farmers to get land because they had no money to buy land, and very difficult for 25 (25%) to get land. On the other hand 11 (11%) said it was easy for them to get land because they either inherited from parents or were given free by relatives, and only one (1%) said it was very easy for him/ her to get land because he/she got it as a gift from his/her friend. These findings indicate that, lack of money was a problem to many farmers 63 (63%) in getting land.

Table 9: Easiness of accessing land (n=100)

Level of easiness	Number	Percent
Very easy	1	1.0
Easy	11	11.0
Difficult	63	63.0
Very difficult	25	25.0
Total	100	100.0

Results in Table 10 show that minimum land owned by farmers in the ward was 0.4 ha while maximum land owned by farmers was 14.6 ha. Mean farm size owned was 3.2 ha and farm owned ranged from o.4 ha to 14.6 ha. These findings show that smallest land owned by farmers was 0.4 ha and the largest land owned by farmers was 14.6 ha. Farmers with larger farms are likely to be better informed, be able to take larger risks associated with early adoption, and have more opportunity to experiment. Agricultural technologies are more likely to be adopted by farmers with larger farms. Nkonoki (1994) found that resource such as land size may make easier for a farmer to alter practices. Also Jamison and Lawrence (1982) discovered a significant relationship between farm size and adoption of an innovation and that there was a positive correlation between farm size and adoption of new technologies.

Table 10: Size of the farm owned by smallholder farmers (n=100)

Farm size (ha)	Number	Percent
0.4	2	2.0
0.8	23	23.0
1.2	31	31.0
1.6	18	18.0
2.0	13	13.0
2.4	6	6.0
2.8	1	5.0
3.6	2	1.0
4.5	1	2.0
6.1	1	1.0
6.5	1	1.0
14.6	1	1.0
Total	100	100.0

Mean farm size owned = 3.2 ha, Range = 0.4 ha to 14.6 ha

Table 11 presents the total area cultivated with sunflower by farmers whereby, maximum land cultivated was 3.6 ha and minimum was 0.2 ha, the mean farm cultivated was 1.5 ha, farm cultivated ranged from 0.2 ha to 3.6 ha. However, 34 (34%) farmers cultivated 0.4 ha, and one (1%) cultivated 3.6 ha. According to these findings farmers in the ward produced sunflower crop at small scale level and used part of their total land area for farming sunflower.

Table 11: Total area cultivated with sunflower by farmers per season (n=100)

Area cultivated (ha)	Number	Percent
0.2	9	9.0
0.4	34	34.0
0.6	13	13.0
0.8	26	26.0
1.0	4	4.0
1.2	4	4.0
1.6	5	5.0
2.0	3	3.0
3.2	1	1.0
3.6	1	1.0
Total	100	100.0

Mean area cultivated = 1.5 ha, Range = 0.2 ha to 3.6 ha

Findings in Table 12 show the perception of farmers on soil suitability for sunflower farming whereby 73 (73%) farmers said their farms had moderate fertile soil for sunflower farming, 19 (19) had farms with unfertile soil for sunflower farming and eight (8%) had farms with very fertile soil for sunflower farming. From these results the large number of farmers in the ward 73 (73%) had farms with moderate fertile soil for sunflower farming.

Table 12: Soil suitability for sunflower farming (n=100)

Soil status	Number	Percent
Very fertile	8	8.0
Moderate fertile	73	73.0
Not fertile	19	19.0
Total	100	100.0

Table 13 presents fertilizer application whereby 44 (66.7%) farmers in the ward applied inorganic fertilizer, and the rest 22 (33.3%) applied organic fertilizer. These results indicate that many farmers in the ward 44 (66.7%) adopted inorganic fertilizer in order to make soil suitable for farming sunflower. According to the findings use of inorganic fertilizer has increased when compared to that of World Bank (2001) which found that 15% of Tanzania farmers use chemical fertilizer. However 22 (33.3%) farmers used organic fertilizer.

Table 13: Fertilizer application (n=66)

Type of fertilizer applied	Number	Percent
Organic fertilizer	22	33.3
Inorganic fertilizer	44	66.7
Total	66	100.0

Results in Table 14 show that majority (97%) of farmers in the ward bought agricultural inputs, and only few of them three (3%) did not buy agricultural inputs because they were expensive to them. Results further show that 55 (56.7%) farmers bought improved seeds, 40 (41.3%) bought inorganic fertilizers, one (1%) bought pesticides, and one (1%) bought spraying pump. These findings show that improved seeds and inorganic fertilizers were bought in large amount compared to pesticides and spraying pumps, this may be due to the reason that improved seeds and inorganic fertilizers were affordable to them. Affordability influenced adoption of improved sunflower seeds and inorganic fertilizers by farmers in the ward. These results comply with Nkonya *et al.* (1997) who argued that adoption of improved seed, and to some extent chemical fertilizer in Tanzania, is affected both by characteristics of household heads and the resources they own.

Table 14: Buying of agricultural inputs (n=100) and types of inputs bought (n=97)

Whether buying agricultural inputs	Number	Percent
No	3	3.0
Yes	97	97.0
Total	100	100

Types of inputs bought	Number	Percent
Improved farm seeds	55	56.7
Inorganic fertilizers	40	41.3
Pesticides	1	1.0
Spraying pump	1	1.0
Total	97	100.0

Findings in Table 15 show that 89 (89%) farmers had access to sources of fund for their farming activities as follows; 43 (48%) got fund from Savings and Credit Associations, 34 (38.2%) sold agricultural products to get fund for farming activities, seven (7.9%) used their salaries for farming activities, four (4.5%) sold livestock to get fund for farming activities and only one (1.1%) got loan from Bank for farming activities, whereby 11 (11%) did not have access to any source of fund for their farming activities. These results imply that majority of farmers in the ward 89 (89%) were able to access fund from various sources which influenced them to adopt farming innovations such as inorganic fertilizers and improved seeds. These results are supported by CIMMYT (1993) where it was reported that farmers with better access to extension information stand a better chance to use their own resources to experiment with new innovations. Also, CIMMYT (1993), Nkonoki (1994), Degnet and Belay (2001) and Liberio (2009) found that many times it is farmers with more resources in terms of capital, land and labour that are able to take advantage of new technologies and practices.

Table 15: Having source of fund (n=100) and respondents' source of fund (n=89)

Whether having source fund	Number	Percent
No	11	11.0
Yes	89	89.0
Total	100	100.0

Respondents' source of fund	Number	Percent
Loan from bank	1	1.1
Savings and credit association	43	48.3
Selling agricultural products	34	38.2
Salary	7	7.9
Selling livestock	4	4.5
Total	89	100.0

Findings in Table 16 show that 50 (50%) farmers used families as their source of labour in farm activities, 43 (43%) used both family labour and hired labour in farm activities, and seven (7%) used hired labour in farm activities.

Table 16: Major source of labour (n=100)

Type of labour	Number	Percent
Family labour only	50	50.0
Hired labour only	7	7.0
Family labour and hired labour	43	43.0
Total	100	100.0

Results in Table 17 show that farmers 83 (83%) in the ward did not use irrigation as source of water to their farms, 17 (17%) irrigated their farms. These results show that majority of farmers (83) did not practice irrigation.

Table 17: Farm irrigation (n=100)

Whether irrigating	Number	Percent
No	83	83.0
Yes	17	17.0
Total	100	100.0

Table 18 presents variety of sunflower seeds produced and reasons for not producing sunflower seeds. From the Table it is shown that 93 (93%) farmers did not produce sunflower seeds and seven (7%) produced sunflower seeds. These results indicate that there was small number of farmers (seven) in the ward who produced their own seeds and the rest of farmers (93) depended on seeds from various sources such as agro-shops and extension agents for farming activities.

Farmers were asked to indicate reasons for not producing sunflower seeds whereby 60 (64.5%) farmers in the ward did not produce seeds because they lacked education on production of seeds hence they would not produce quality seeds, 13 (14%) did not produce seeds because of destructive birds, and five (5.4%) did not produce seeds because of unfavourable weather condition which was unsuitable for production of quality seeds. These results are supported by Degnet and Belay (2001) who stated that the reasons for adoption or non-adoption at farm level vary over space and time. Factors influencing adoption are neither exclusively economic nor purely non-economic. Both economic and non-economic reasons are essential motives for shaping the farmers attitude towards the new technology and its final adoption.

Table 18: Variety of sunflower seeds produced (n=7) and reasons for not producing seeds (n=93)

Whether producing seeds	Number	Percent
No	93	93.00
Yes	7	7.00
Total	100	100.0

Variety of seed produced	Number	Percent
Record	7	100.0
Total	7	100.0

Reasons for not producing seeds	Number	Percent
Dry weather condition	5	5.4
Small farm size	5	5.4
Lack of irrigating machine	1	1.1
Lack of education	60	64.5
Destructive birds	13	14.0
High costs	9	9.7
Total	93	100.0

Results in Table 19 show that 68 (68%) farmers did not know seed producing farmers. This could be a reason for them not adopting sunflower seeds production due to lack of awareness, 32 (32%) knew farmers who produced sunflower seeds and that seeds produced were sold on cash.

Table 19: Knowing other farmers producing sunflower seeds (n=100) and terms of selling seeds (n=32)

Whether knowing farmers producing seeds	Number	Percent
No	68	68.0
Yes	32	32.0
Total	100	100.0

Terms of selling seed	Number	Percent
On cash	32	32.0
Total	32	100.0

Table 20 presents results on use and sources of improved seeds. Results show that 97 (97%) farmers used improved seeds in sunflower farming, and only three (3%) did not use improved seeds. These results indicate that majority of farmers (97) adopted improved sunflower seeds.

Fifty six (56%) got improved seeds from projects like Uluguru Mountains Agricultural Development Project (UMADEP), 20 (20%) got improved seeds from extension officers, and 16 (16%) got improved seeds from seed dealers/ agro-shops. These results imply that project contributed to the adoption of improved sunflower seeds because they made seeds available to 56% of farmers. These results comply with that of Cramb (2003) who found that decisions about new technology are frequently prompted by an intervention in the form of a project.

Table 20: Use of improved seeds (n=100) and sources of seeds (n=97)

Whether using improved seeds	Number	Percent
No	3	3.0
Yes	97	97.0
Total	100	100.0

Sources of getting seeds	Number	Percent
Seed producers	3	3.0
Relatives	2	2.0
Extension officer	20	20.0
Seed dealers/shops	16	16.0
Projects/organization	56	56.0
Total	97	100.0

Findings in Table 21 show types of livestock kept and number of livestock kept whereby 27 (50%) farmers kept chicken, 22 (40.7%) kept goats, three (5.6%) kept pigs, and two (3.7%) kept cows. The findings further show that mean livestock kept was 22 and number of livestock kept ranged from four livestock to 72 livestock. However, maximum number of livestock kept was 76 and minimum was four.

Table 21: Types of livestock kept and number of livestock kept (n=54)

Livestock kept	Number	Percent
Chicken	27	50.0
Goats	22	40.7
Cows	2	3.7
Pigs	3	5.6
Total	54	100.0

Number of Livestock	Number	Percent
1-10	9	16.67
11-20	23	42.59
21-30	8	14.81
31-40	9	16.67
41-50	4	7.41
51-60	0	0.0
61-70	0	0.0
71-80	1	1.85
Total	54	100.0

Mean livestock kept = 22, Range = 4 livestock to 76 livestock

Results in Table 22 show that all (100) farmers interviewed weeded their farms whereby 79 (79%) weeded twice per season while 21 (21%) weeded once per season. These results reveal that all farmers in the ward adopted weeding in farming sunflower to reduce competition of nutrients between sunflower and weeds which increased production of sunflower.

Table 22: Farm weeding and number of weeding per season (n=100)

Whether weeding	Number	Percent
No	0	0.0
Yes	100	100.0
Total	100	100.0

Number of weeding per season	Number	Percent
1	79	79.0
2	21	21.0
Total	100	100.0

Results in Table 23 show that all (100) farmers interviewed used double strand in farming sunflower. This reveals that all farmers adopted double strand which is recommended by extension agents in order to get high yield of sunflower. Sixty five farmers in the ward (65%) adopted recommended spacing (60 cm by 45 cm to single strand and 75 cm by 60 cm to double strand) in farming sunflower while 35 (35%) did not adopt recommended spacing in farming sunflower.

Table 23: Strand of sunflower farming and use of recommended spacing (n=100)

Whether practicing double strand/single strand	Number	Percent
Single strand	0	0.0
Double strand	100	100.0
Total	100	100.0

Use of recommended spacing	Number	Percent
No	35	35.0
Yes	65	65.0
Total	100	100.0

Findings in Table 24 show that 95 (95%) farmers did not use pesticides and only five (5%) used pesticides. Pesticides used by farmers were those from industries (chemical pesticides). These results imply that, majority of farmers (95) had not adopted use of chemical pesticides. These findings differ with that of the World Bank (2001) which found that 18% of Tanzania farmers use pesticides.

Table 24: Use of pesticides (n=100) and types of pesticides used (n=5)

Whether using pesticides	Number	Percent
No	95	95.0
Yes	5	5.0
Total	100	100.0

Types of pesticides used	Number	Percent
From industries	5	100.0
Total	5	100.0

Findings in Table 25 show that 65 (65%) farmers did not have access to sunflower processing machine in their villages, and 35 (35%) had access to sunflower processing machine in their village. This study found that all farmers in the ward depended on one sunflower processing machine which was brought in the ward by UMADEP. Presence of this machine in the ward helped farmers to process sunflower and adding value for produced goods such as cooking oil and animal feeds.

Table 25: Access to sunflower processing machine (n=100)

Whether accessing machine	Number	Percent
No	65	65.0
Yes	35	35.0
Total	100	100.0

Findings in Table 26 show that 97 (97%) farmers had contact with village extension officer, and only three (3%) had no contact with village extension officer. Farmers got agricultural advice from extensionists which prompted them to adopt agricultural innovations such as use of improved seeds, spacing, double strand, harvesting methods, and storage techniques.

These results are supported by van den Ban and Hawkins (1996) who stated that, extension plays a great role in popularizing farm technologies. Hence, to make farmer competent, it is expected from the extension agent to work closely with farmers.

Table 26: Contact with village extension officer (n=100)

Contact	Number	Percent
No	3	3.0
Yes	97	97.0
Total	100	100.0

4.3 Results of the Multiple Regression Model for Selected Predictors

Multiple regression analysis represents a logical extension of two variables regression analysis. Instead of a single independent variable, two or more independent variables are used to estimate the values of a dependent variable (Gupta, 1990).

Collinearity/multicollinearity diagnostics were tested in order to detect whether there is correlation among the independent (X) variables. According to Lin (2007) when there is a perfect linear relationship among the predictors, the estimates for a regression model cannot be uniquely computed. The term collinearity implies that two variables are near perfect linear combinations of one another. When more than two variables are involved it is often called multicollinearity, although the two terms are often used interchangeably.

Results show Variance Inflation Factors (VIF) which measure how much the variance of the estimated coefficients are increased over the case of no correlation among the X variables. If no two X variables are correlated, then all the VIFs will be less than five

(Table 27). If VIF for one of the variables is around or greater than five, there is collinearity associated with that variable, this was not observed in the results of Table 27 which implies that no linear relationship existing between and among two or more of the independent variables.

Table 27 presents predictors influencing the adoption of sunflower farming innovations whereby regression was significant ($p \leq 0.05$) and the nine independent variables account for 55% (Adjusted $R^2 = 0.551$) of variation in adoption. Also, findings show that six of the nine independent variables included in the analysis have significant ($p \leq 0.05$) regression coefficients.

Table 27: Predictors influencing the adoption of sunflower farming innovations

Independent variables (X)	Std. Error (e_t)	Standardized Coefficients Beta (β)	t	Sig.	Collinearity Statistics Tolerance	VIF
Constant	.055		8.408	.000		
Respondent's age (years)	.001	-.065	-1.070	.286	.528	1.892
Sex of respondent	.015	-.065	-1.259	.209	.725	1.380
Respondent's education level	.012	.125	2.086	.038*	.543	1.842
Respondent's marital status	.012	-.059	-1.084	.279	.654	1.528
Family size	.004	-.209	-3.289	.001*	.478	2.090
Farming experience	.006	.447	7.543	.001*	.552	1.811
Availability of sunflower market	.029	.157	3.208	.001*	.812	1.232
Livestock ownership	.013	.084	1.735	.084	.828	1.208
Frequency of contacting extension officer	.008	.357	6.042	.001*	.554	1.806

R Square (R^2) = .572
Adjusted R Square (R^2) = .551
F-statistics (for R^2) = .048*
* = significant at .05 level
Dependent Variable: Adoption level of sunflower farming technologies

Farming experience was the highest predictor of adoption of sunflower farming innovations (standardized regression coefficient of 0.447, significant at $p \leq 0.05$). The positive regression coefficient implies that farming experience and adoption of sunflower farming innovations are positively related. Increase in farming experience leads to adoption of sunflower farming innovations. A change of farming experience by 1 unit translates into a change in variance for adoption by 0.447.

Frequency of contacting extension officer had a standardized regression coefficient of 0.357, significant at ($p \leq 0.05$). The positive regression coefficient implies that frequency of contacting extension officer and adoption of sunflower farming innovations are positively related. Increase in frequency of contacting extension officer increases adoption of sunflower farming innovations.

Family size had a standardized regression coefficient of - 0.209, significant at ($p \leq 0.05$). The negative regression coefficient implies that family size and adoption of sunflower farming innovations are negatively related. Increase in family size leads to low adoption of sunflower farming innovations. This is unexpected relationship because the larger family size should lead to high adoption of sunflower farming innovations due to availability of human labour. This may be due to the fact that not all family members were involved in the farming activities because of either division of labour or were not in the productive age (aged above 65 years or aged below 15 years), the mean family size was seven members.

Availability of sunflower market had a standardized regression coefficient of 0.157, significant at ($p \leq 0.05$). The positive regression coefficient implies that availability of sunflower market and adoption of sunflower farming innovations are positively related. Increase in availability of sunflower market increases adoption of sunflower farming innovations.

Respondent's education level had a standardized regression coefficient of 0.125, significant at ($p \leq 0.05$). The positive regression coefficient implies that respondent's education level and adoption of sunflower farming innovations are positively related. Increase in respondent's education level increases adoption of sunflower farming innovations.

Results of respondent education level comply with that of Swamson *et al.* (1984) the farmers' educational background is a potential factor in determining the readiness to accept and properly use an innovation. CIMMYT (1993) found that in Tanzania, most farmers have primary education and rely on traditional farming practices. Therefore, the more complex the technology the more likely it is that education will play a major role. In terms of experience, CIMMYT (1993) stated that older farmers may have more experience, resources or authority that would give them more possibilities for trying new innovations. However, John (1995) argued that though older people have more experience, their receptivity to new ideas and technologies typically decreases with age. In terms of resources, wealthier farmers have better access to extension information and stand a better chance to use their own resources to experiment with new innovations (CIMMYT, 1993). Many times it is farmers with more resources in terms of capital, land and labour that are able to take advantage of new technologies and practices (Liberio, 2009).

Hagmann *et al*. (2003) argued that extension services facilitate farmers for collective and individual learning about innovations to enhance community's capacity to innovate.

However, sex of respondent, respondent's age (years), respondent's marital status, livestock ownership, and tools used in farming did not significantly influence the adoption of sunflower farming innovations at $p \leq 0.05$ (Table 27). Results of sex of respondent, respondent's age (years), respondent's marital status, livestock ownership, and tools used in farming contradict with Stephens (1992) who argued that though most technologies are considered gender neutral, they are often gender biased during their introduction and use by societies. In terms of age, Hella (1992) found that age of respondents was one of the factors that influenced the adoption of hybrid seed in Iringa region, Tanzania. Nanai (1993) argued that younger and energetic farmers have proved to be active and ready to try new innovations.

4.4 Contributions of Sunflower to Socio-economic Attributes of Smallholder Farmers in the Ward

Results in Table 28 show that 51 (51%) farmers got cooking oil which is one of the main sources of polyunsaturated oil. Sunflower oil is an excellent source of vitamin E, the body's primary fat-soluble antioxidant. Forty seven farmers (47%) increased household income which helped them to pay school fees for their children, buying foods which are not produced by them, buying agricultural inputs such as fertilizers and improved seeds, paying for health services, buying clothes, building house, and two (2%) got animal feed.

Table 28: Benefits of sunflower production (n=100)

Benefits	Number	Percent
Animal feed	2	2.0
Cooking oil	51	5151
Increasing household income	47	47.0
Total	100	100.0

Ugulumu (2008) noted that Sunflower is an important industry in Tanzania. It ranks as one of the most important vegetable oil with high value and on international market, sunflower ranks fourth after soybean, oil palm and rapeseed. In Tanzania oil extracted from sunflower by local producers contributes 40% of the national cooking oil requirements. The development of this industry in Tanzania to a larger degree has been triggered by two main factors; food value – basically sunflower is grown for its edible oil production and secondly, processing ability by farmers at farm level.

Findings in Table 29 present report by farmers on sunflower farming whereby 32 (32%) farmers reported that sunflower farming is good for income generation, 18 (18%) reported that farmers should produce more sunflower in the ward for poverty reduction, 14 (14%) farmers reported that agricultural education should be provided to farmers in order to improve sunflower farming in the ward, and nine (9%) reported that government and other stakeholders should increase market for sunflower in order to motivate farmers to produce more.

Table 29: Respondents' suggestions on sunflower farming (n=100)

Suggestions	Number	Percent
It is good for income generation	32	32.0
Cheap to produce sunflower	18	18.0
Farmers to produce more	18	18.0
Provision of agricultural education	14	14.0
Increasing market for sunflower	9	9.0
Availability of record seeds at affordable Price	6	6.0
Availability of irrigating machines at affordable price	3	3.0
Total	100	100.0

Results in Table 30 show that 40 (40%) farmers interviewed said agricultural technologies should be sold at affordable prices in order to enable farmers produce more sunflower in the ward, 27 (27%) said government should increase agricultural subsidies to help farmers adopt new technologies in order to improve sunflower farming in the ward, 13 (13%) said government and other stakeholders should make sure that irrigating machines including pumps are available at affordable price to stimulate irrigation farming in the ward, 11 (11%) said agricultural education should be provided to farmers to help them understand application and advantages of using new agricultural technologies in order to improve sunflower farming in the ward, five (5%) interviewed specified that tractors should be sold at affordable prices in order to enable farmers to cultivate large areas for the purpose of producing more sunflower in the ward, two (2%) said government and other stakeholders should increase market for sunflower in order to encourage farmers to produce more, two (2%) said conditions for bank loan should be reduced in order to allow many farmers access fund for agricultural activities.

Table 30: Respondent's opinions about sunflower farming innovations (n=100)

Opinions	Number	Percent
Affordable technologies	40	40.0
Increasing agricultural subsidies	27	27.0
Availability of irrigating machines at affordable price	13	13.0
Provision of agricultural education	11	11.0
Tractors should be sold at affordable price	5	5.0
Increasing market for sunflower	2	2.0
Reducing conditions for bank loan	2	2.0
Total	100	100.0

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

Most of the farmers were aware of the sunflower farming innovations and preferred to adopt them in order to improve their farming practices to increase farm produce. However, on the basis of this study the following conclusions and recommendations can be drawn to assist development planners, change agencies, policy makers and practitioners and farmers with regard to the adoption of farming innovations for modern and profitable agriculture.

5.2 Conclusions

Farmers adopted some innovations like application of inorganic fertilizer, use of improved seeds, use of double strand and recommended spacing in sunflower farming. Factors such as farming experience, frequency of contacting extension officer, family size, availability of sunflower market, and respondent’s education level significantly influenced the adoption of sunflower farming innovations. The remaining factors which included sex of respondent, respondent's age (years), respondent's marital status, livestock ownership, and tools used in farming did not significantly influence the adoption of sunflower farming innovations.

It is evident that sunflower contribute to socio-economy of smallholder farmers, sunflower farming from smallholder farmers in rural areas like Mlali Ward is important in contributing substantial portion of oil which is of high quality, since it has no cholesterol which causes heart failure to human beings, sunflower contributes to animal feed which is either used directly by the smallholder or sold to earn cash for household use. It is therefore a potential industry that needs a boost in productivity by improving agricultural technologies and support from favourable socio-economic policy environment, as well as efficient institutional support services because there is need to accelerate technology uptake to address declining farm production being experienced by smallholder farmers.

5.3 Recommendations

In correspondence to the findings and conclusions the following were recommended

- Farming Technologies produced should be affordable to farmers based on farmers scarce resources, so as to enhance technology transferring with the available extension and research supports and are sustainable over the long term.

- Extension services should be properly linked with farmers especially those smallholder sunflower producers by involving them in experimentation of innovations such as how to produce new variety seeds, application of pesticides, means of storing and processing sunflower and dissemination of those innovations to their fellow farmers which will motivate them to adopt these scientific achievements.

- Farmers should be encouraged to form an association of sunflower producers which will help them to find market for their products at profitable rate.

- Effective introduction of on-farm seed production should be enhanced to enable farmers produce on-farm seeds within their community in order to alleviate seed shortage.

- Government should make sure rural transportation and infrastructures are improved to make them passable in all seasons in order to make many producing areas accessible to input and output market and contribute to timely input delivery.

- Establishment of rural financial institutions to address farmers' credit needs on loan terms with low interest rate.

- Popularization of adaptive, high yielding, and disease and insect resistant crop varieties.

- Land should be well distributed in the ward to make sure that all people have an access to land for agricultural practices especially sunflower farming.

- Establishment of irrigation scheme which will help farmers to produce sunflower in all periods of the season.

- Strengthening the farmers' knowledge on quality seed production, management and marketing systems.

- Government and other development agencies should make sure smallholder farmers get agricultural technologies such as tractors and irrigating machines at affordable prices as well as increasing agricultural subsidies such as fertilizers.

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APPENDICES

Appendix 1: Questionnaire for Smallholder Farmers Producing Sunflower

Name of the interviewer -------------------------------------

Date of interview --

Name of respondent --

Name of village --

Name of ward --

1. What is your age? ------------------------------- (years)

2. Sex of the farmer (tick)

   a) Female ( ) b) Male ( )

3. Educational level of the farmer (Tick one)

   (a) No formal schooling ( )

   (b) Standard 1 – IV ( )

   (c)Standard 1 – VII ( )

   (d) Secondary School ( )

   (e) Post Secondary School ( )

4. What is your occupation apart from being a farmer? (Tick appropriate)

(a) Farming only ( )

(b) Teaching ( )

(c) Nursing ( )

(d) Doing business ( )

(e) Any other, specify…………………………..

5. Marital status of the farmer (Tick one)

(a) Single ( )

(b) Married ( )

(c) divorced/separated ( )

(d) Widowed ( )

6. What is your family size? (Write numbers)Adults ------------------------------

Children ----------------------------

7. Do you have access to land for sunflower farming? (Tick one)

(a) Yes ( ) (b) No ( )

8. Have you purchased, rented or inherited the land for sunflower farming?

(a) Purchased ( ) (b) rented ( ) (c) inherited ( )

9. How big is your land area? --------------------- (acres)

10. How big is your farm (cultivated area with sunflower) in season 2009/2010?

11. How easy is to get land in the village? (Tick one)

(a) Very easy (no conditions to get the land) ( )

(b) Easy (few conditions to get land) ( )

(c) Difficult (strong conditions to get the land) ( )

(d) Very difficult (very strong conditions to get the land) ( )

12. Is the soil in your farm land suitable for sunflower crop production? (Tick one)

(a) Yes, very fertile ( )

(b) Yes, moderate fertile ( )

(c) No, not fertile ( )

13. What fertilizers do you apply (if any) in your farm? (Tick appropriate) (a) Organic fertilizers ( ) (b) Inorganic fertilizers ( )

14. Do you buy any agricultural inputs? (Tick one)

(a) Yes ( ) (b) No ( )

15. If Yes to question 14, what are the agricultural inputs do you buy? (Mention)

……………………………………………………………………………….

16. If No to question 14, what are the reasons for not buying agricultural input? (Tick appropriate)

(a) It is expensive ( )

(b) It is unavailable ( )

(c) It is not profitable ( )

(d) Its utilization is complex ( )

(e) Culturally not accepted ( )

(f) Any other (mention) …………………………………………

17. Do you have any source of fund? (Tick one) (a) Yes ( ) (b) No ( )

18. If Yes to question 17, what is your source of fund? (Tick appropriate)

(a) Loan from Bank ( ) (b) Savings and Credit Association ( ) (c) Any other (specify) ……………….. …………………………..

19. What is the major source of labour in farming activities? (Tick appropriate) (a) Family only ( ) (b) Hired labour only ( ) (c) Family labour and hired labour ( )

20. Do you use irrigation in sunflower farming? (Tick one)

(a) Yes ( ) (b) No ( )

21. For how long (years) have you been farming sunflower? ………………………

22. Do you have market of sunflower in your area? (a) Yes ( ) (b) No ( )

23. Do you produce seed for your farm? (Tick one)

(a) Yes ( ) (b) No ( )

24. If Yes to question 23, what type of seed do you produce?

----

25. If No to question 23, why? (Give a reason)

(a) Dry weather condition ( ) (b) Small farm size ( ) (c) Lack of irrigating machine ( )

(d) Lack of education ( ) (e) Destructive birds ( ) (f) High costs ( )

26. Apart from yourself, do you know any farmer who produces seed in this ward? (Tick one)

(a) Yes ( )

(b) No ( )

27. If Yes to question 26, under what terms does he/she sell those seeds? (Tick appropriate)

(a) In kind ( )

(b) On credit ( )

(c) On cash ( )

(d) As gifts ( )

(e) Through barter system ( )

(f) Other terms (name) ……………………..

28. Do you use improved seed in farming sunflower? (Tick one) (a) Yes ( ) (b) No ( )

29. If Yes to question 28, where do you get improved seeds? (Tick appropriate)

(a) Seed producers ( )

(b) Relative/neighbours ( )

(c) Extensionists ( )

(d) Seed dealers/shop ( )

(e) Project/organization ( )

(f) Other (name) ------------------------------

30. Do you own livestock? (Tick one) (a) Yes ( ) (b) No ( )

31. If yes to question 30, what is the number of Livestock do you own currently? ……………..

32. What tools do you use in doing farm activities? (Tick appropriate)

(a) Hand hoes ( )

(b) Animal power ( )

(c) Motorized tools ( )

33. Do you weed your farm? (Tick one) (a) Yes ( ) (b) No ( )

34. If Yes to question 33, how many times do you weed your farm per season?..............................

35. Which strand do you use in farming sunflower? (Tick one)

(a) Single strand ( ) (b) Double strand ( )

36. Do you use recommended spacing in farming sunflower ie. 60cm by 45cm to the single strand and 75cm by 60cm to the double strand? (Tick one) (a) Yes ( ) (b) No ( )

37. Do you use fungicides/pesticides for preventing pests and diseases? (Tick one) (a) Yes ( ) (b) No ( )

38. If Yes to question 37, what type of fungicides/pesticides do you use? (Tick one)

(a) Locally made ( ) (b) From industries ( )

39. Do you have an access to the sunflower processing machine? (Tick one) (a)Yes ( ) (b) No ( )

40. Do you have contacts with a village extension officer? (Tick one) (a) Yes ( ) (b) No ( )

41. If Yes to question 40, how many times do you contact per month?

42. What do you think is/are the attributes of adoption of farming innovations?

Variables	Scores (1, 2, 3)
Availability of sunflower market	
Livestock ownership	
Frequency of contacting extension officer	

43. What benefit have you gained by producing sunflower? (Tick one)

(a) Animal feed ( ) (b) Cooking oil ( ) (c) Increasing household income ( )

44. What is your suggestion about sunflower farming? (Tick one)

(a) Availability of irrigating machines at affordable price ( )

(b) Availability of record seeds at affordable price ( )

(c) Cheap to produce sunflower ( )

(d) Farmers to produce more ( )

(e) Increasing market for sunflower ( )

(f) It is good for income generation ( )

(g) Provision of agricultural education ( )

45. What is your opinion about sunflower farming innovations? (Give one opinion)

THANK YOU FOR YOUR COOPERATION

Appendix 2: Checklist for Smallholder Farmers Producing Sunflower

1. How big is your farm (cultivated area with sunflower) in season 2009/2010?

2. What fertilizers do you apply (if any) in your farm?..

3. What is the major source of labour in farming activities?..................................

4. For how long (years) have you been farming sunflower? ………………………

5. Do you have market of sunflower in your area?...

6. What variety of seeds do you use in farming sunflower?......................................

7. What tools do you use in doing farm activities? ………………………………..

8. How many times do you weed your farm per season?............................. ………

9. Which strand do you use in farming sunflower?...

10. Do you use recommended spacing in farming sunflower ie. 60cm by 45cm to single strand and 75cm by 60cm to double strand? ……………………………..

11. Do you use fungicides/pesticides for preventing pests and diseases?

12. What type of fungicides/pesticides do you use?………………………………….

13. Do you have contacts with a village extension officer? ………………………….

14. How many times do you contact with extension officer per month? ……………..

15. What do you think is/are the attributes of adoption of farming innovations?

16. What benefits have you gained by producing sunflower? ……………………..

17. What are your suggestions about sunflower farming? ……………………………

Appendix 3: Checklist for extension officers and UMADEP workers

1. What fertilizers do farmers apply (if any) in their farms?..

2. What is the major source of labour farmers use in farming activities?....................

3. For how long (years) have you been serving farmers? ……….

4. Is there any market for sunflower in your area?...

5. What variety of seeds do farmers use in farming sunflower?..................................

6. What tools do farmers you use in doing farm activities? ………………………….

7. How many times do farmers weed their farms per season?.............................. ….

8. Which strand do farmers use in farming sunflower?....................................

9. Do farmers use recommended spacing in farming sunflower ie. 60cm by 45cm to single strand and 75cm by 60cm to double strand? …………………………..

10. Do farmers use fungicides/pesticides for preventing pests and diseases?................

11. What type of fungicides/pesticides do farmers use?……………………………..

12. Do you have contacts with sunflower farmers? ………………………………….

13. How many times do you contact with farmers per month? ……………..

14. What do you think is/are the attributes of adoption of farming innovations?

15. What benefits do farmers gain by producing sunflower? ……………………..

16. What are your suggestions about sunflower farming? ……………………………