

**SOCIO-ECONOMIC FACTORS INFLUENCING ADOPTION OF
IMPROVED TECHNOLOGIES FOR MAIZE FARMING IN KARATU
DISTRICT, TANZANIA**

By

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of Master of Arts in Development Studies of the University of Dodoma

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CERTIFICATION

The Undersigned confirm that has read and hereby recommend for acceptance by the University of Dodoma a dissertation entitled “*Socio-economic Factors Influencing Adoption of Improved Technologies for Maize Farming in Karatu District, Tanzania*” in Partial Fulfillment of the Requirements for the Degree of Master of Arts in Development Studies of the University of Dodoma.

.....

Prof. Albino John Mkavindanda Tenge

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Date.....

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I, **Francis J. Shauri** declare that this dissertation is my own original work and that it has not been presented and will not be presented to any other University for a similar or any other degree award.

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DEDICATION

This dissertation is dedicated to my closely beloved wife Alice Ruhakwa for supporting me both materially and morally during my studies at the University of Dodoma. This dedication is also to my children Eliza and Hyasinta for being patient during my absence at home for studies.

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First and foremost would like to express my heartfelt thanks to Almighty God who has been keeping me alive during all time of conducting my studies.

A lot of people have played part to the accomplishment of this study in a number of ways. First of all, I would like to give many thanks to those who helped me during preparation of this dissertation. It would have been difficult if not their moral, guidance and advices. I would like to thank them all.

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ABSTRACT

This study attempted to assess socio-economic factors influencing adoption of improved technologies for maize farming in Karatu District. Specifically the study identified the types of maize production technologies used in Karatu District; analyzed socio-economic characteristics of maize farmers in Karatu District and identified socio-economic factors for adoption of maize production technologies in Karatu District. The study employed both probability and non-probability sampling methods to select a sample of 100 heads of households and 17 key informants as respondents. Data was collected using interviews, observations, Focused Group Discussion and secondary data reviews. Questionnaires and checklists were used as tools to collect data from the heads of households and key informants respectively. Data collected was descriptively analyzed using means and percentages with the help of Statistical Package for Social Sciences (SPSS) software. Results were cross tabulated to compare between and within the groups. Results indicate that the major types of technologies and proportion of users include improved seeds (87.6%), oxen plough (81.6%), insecticides (76.3%) and tractors (63.3%). Least used technologies are fertilizers (14.4%) and power tiller (18.4%). Results revealed that majority of maize farmers in Karatu district are male (63.0%), married (89.0%), with primary school education (50%) and age of 41-50 years. Socio-economic factors that influence adoption of improved technologies are educational level, marital status, age, sex and farm size. Other factors include location, place of birth, market situation, training and availability of extension services. Options to increase adoption included awareness creation on improved technology practices, provision of training and extension services. Finally the study concluded and recommend to the district authority to prepare incentive policies motivating farmers for adoption of improved

technologies such as subsidizing distribution of chemical fertilizer to farmers at village agricultural offices in every planting season.

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LIST OF ABBREVIATION

ADC	Agricultural Development Center
ASDP	Agricultural Sector Development Program
CIMMYT	International Maize and Wheat Improvement Center
FAO	Food and Agriculture Organization
FAOSTAT	Food and Agricultural Organization Statistical Data base
FIC	Farm International Concern
KDC	Karatu District Council
MAFC	Ministry of Agriculture Food Security and Cooperatives
NAIVS	National Agricultural Input Voucher Scheme
REPOA	Research on Poverty Alleviation
SWCM	Soil and Water Conservation Measures
UMADEP	Uluguru Mountains Agricultural Development Project
USAWA	A Union of Agricultural Savings and Credit Cooperatives

CHAPTER ONE

INTRODUCTION

1.1 Background Information

Maize is an annual crop that belongs to the family of grass, *Poaceae* (Owoyele *et al.*, 2010). It is an important source of food for human being because of its richness in energy (FAO, 2006). Maize is also a raw material for manufacturing of many industrial products such as corn starch, corn oil, corn syrup, alcohol, biofuel and stem fibers for manufacture of paper (Sanya and Owoyele *et al.*, 2010).

Globally, maize production is largely dominated by United States of America, China, Brazil, Mexico, France, and Argentina (Compass, 2014) where the production is high due to use of improved technologies. It is estimated that these countries produce 75% of the total world maize production.

Maize is among the most important crop in many African countries (Shiferaw *et al.*, 2011). It is used for both food and cash income hence important for food security and income generation. Despite its importance its yield with an average of 2 tones/ha is low compared to a potential yield of over 5 tones/ha (FAOSTAT, 2012). According to CIMMYT (1994) North Africa produces 6.1 t/h, West Africa 1.0 t/h, Central Africa 0.9 t/h, East Africa 1.2 t/h and Southern Africa 1.2 t/h. These yield gaps are mainly due to low use of improved technologies. For example, the use of fertilizer across Africa is 9 kg/ ha whereas in Asia is 96 kg/h (CIMMYT, 2010). This relatively low uses of fertilizer and other improved inputs is among the causes for low agricultural production and persistency of poverty in rural areas of Africa.

Production of maize in Tanzania is mainly practiced in 4 regions: Iringa, Mbeya, Ruvuma and Rukwa. Other regions include Kilimanjaro, Arusha and Manyara

(SAGCOT, 2010). According to MOAFSC (2012) the average maize yield in Tanzania is between 1.2 t/acre to 2.0 t/acre and the cultivation is mainly a rainfall dependent. Like in many other parts of Africa the use of improved technologies in Tanzania is low because most farmers rely on traditional farming methods (Nazir, et al., 2010). The study by Mugisha *et al.*, (2012) shows that formal education influence adoption because it enables to learn the new technologies. Tenge *et al.*, (2004) explained that location of farms influences adoption of improved soil and water conservation measures because farmers have to decide where to invest first, depending on walking distance and labor requirements. According to these studies, adoption varies from one location to another depending on socio-economic and biophysical factors. Therefore, this research intended to investigate factors influencing adoption of improved technologies for maize production in Karatu District, Tanzania.

1.2 Problem Statement

Maize is the main staple food and cash crop in many parts of Tanzania (Schroeder, 2013). It is grown in many parts of the country especially in Iringa, Mbeya, Ruvuma and Rukwa which accounts for 40% of the national maize production (ADC, 2011). Despite its importance, production of maize is dominated by small-holder farmers consisting 85% of the total production (Onyango *et al.*, 2013) but with low production due to limited improved technologies.

Government efforts to improve agriculture include initiation of several strategies, programs and projects (URT, 2003). Among the strategies, programs and projects include, Agricultural Sector Development Program (URT, 2010), Sasakawa Global 2000 extension project (Nkonya *et al.*, 1997), National Agricultural Input Voucher Scheme (NAIVS), Uluguru Mountains Agricultural Development Project

(UMADEP, 2007) and recently KILIMO KWANZA (Liberio, 2012). All these efforts were geared towards improvement of agricultural production through promotion of improved technology such as conservation agriculture, use of fertilizers, improved seed varieties and proper agronomic practices.

The government has also made efforts to ensure availability of agricultural extension services at village levels (Ngaizer, 2012). However, adoption of agricultural technologies among farmers is still low leading to low maize production. According to Mduma *et al.*, (2013), only 12% of farmers were estimated to use mineral fertilizers and improved seeds for maize production in Tanzania by 2005. A study by Lugando (2013), on adoption of improved technologies in Karatu District indicates the level of adoption of conservation agriculture to be low by 13%. Factors for adoption seem to vary from one place to another. For example, Lyamuya *et al.*, (1994) observed that maize farmers in Morogoro had not adopted fertility improvement measures because of their shifting cultivation characteristics. However, Tenge *et al.*, (2004) study in West Usambara highlands observed that farmers were reluctant to adopt soil and water conservation measures (SWC) because of fear that their small fields would be further reduced by these measures. Factors for adoption of technologies do differ from one place to another depending on socio- economic setting of the farming communities. Therefore, this research intended to analyze factors influencing adoption of improved technologies for maize production in Karatu District.

1.3 Research Objectives

1.3.1 General Objective

The general objective was to examine factors influencing adoption of maize production technologies in Karatu District.

1.3.2 Specific Objectives

- i. To identify types of maize production technologies used
- ii. To analyze socio-economic characteristics of maize farmers
- iii. To identify socio-economic factors for adoption of maize production technologies

1.4 Research Questions

- i. What are the types of maize production technologies used?
- ii. What are the socio-economic characteristics of maize farmers?
- iii. What are the socio-economic factors for adoption of improved technologies for maize production?

1.5 Significance of the Study

This research generated new knowledge on factors influencing adoption of improved technologies in maize production. This knowledge will be useful to the Ministry of Agriculture and policy makers as they make policies to promote adoption of improved technologies for maize production.

CHAPTER TWO

LITERATURE REVIEW

2.1 Definition of Key Terms

2.1.1 Technology

Technology is broadly defined as an application of scientific knowledge, organizations, procedures, machinery, equipment and human skills in production of the desirable products (REPOA, 2000). Therefore technology with regards to this study means the use of scientific knowledge, methods, tools, and human skills in maize production.

2.1.2 Adoption of Technology

According to Gollin *et al.*, (2005) adoption of technology refers to the act of beginning to use a new technology. Therefore, adoption of maize production technologies at the farm level means farmers' decisions to use a new technology in farming practices (Hall and Khan, 2002).

2.2 Theoretical Literature Review

There are several theories that can explain adoption of new technologies. These theories include diffusion of innovation theory (Behavioral change model) and Modeling diffusion theory (Boston, 2013).

2.2.1 Diffusion of Innovation (DOI) Theory

The theory states that, "Adoption of a new idea, behavior or product does not happen simultaneously in a social system; rather it is a process whereby some people are more suitable to adopt the innovation than others" (Boston, 2013). This theory was developed by Rogers in 1962, and it is one of the major social science theories. It originated in communication to explain how, over time, a new technology gains momentum and diffuses (or spreads) through a specific population or social system.

According to the theory with time all individuals will adopt the technologies. The key to adoption is that the person must perceive the idea, behavior or product as new or innovative.

Rogers (2003) classifies adopters into five categories namely innovators, early adopters, early majority, late majority, and laggards. These categories are important because they can help the pursuing of new visions for a new product, assist in developing marketing strategies to penetrate the various adopter categories, and assist in foreseeing the continued acceptance or rejection of a new product (Mahajan *et al.*, 1990).

The strength of this theory is that it helps to understand categories of adopters who are expected to appear in the process of adoption (Boston, 2013). The major weakness of the theory is that it does not explain factors that influence the adoption of new technology to take place (Boston, 2013). Also it assumes that with time all individuals will adopt the technologies and does not consider the dropouts.

2.2.2 Modeling Diffusion Theory

Modeling diffusion theory states that, “It is natural to imagine adoption proceeding slowly at first, accelerating as it spreads throughout the potential adopters, and then slowing down as the relevant population becomes saturated” (Hall and Khan, 2002). Based on this theory, there are two models to explain the theory. The models are Adopter Heterogeneity Model (AHM) and Adopter Learning (Epidemic) Model. Each model is here under explained.

2.2.2.1 The Adopter Heterogeneity Model

The model assumes that different individuals place different values on the improved technology and adopt when the valuation they have for the technology is greater than the cost of the technology. According to the model it means that less costly and

achievable technology will result into less expensive product and is more likely to be adopted than expensive one (Hall and Khan, 2002).

2.2.2.2 Adopter Learning (Epidemic) Model

This model assumes that, people learn about a technology from one another and as time passes, more and more adopt the technology during any period, hence leading to an increasing rate of adoption. Eventually the market becomes saturated and the rate decreases again (Hall and Khan, 2002).

2.2.2.3 Strength and Weaknesses of the Modeling and Diffusion of Innovation Theories

One of the strength of these theories is that they have indicated some factors that influence the adoption of a new technology. For instance, Adopter Heterogeneity model (theory) has pointed out cost of technology while Adopter Learning Model has mentioned time as some of the factors for adoption of the new technology (Hall and Khan, 2002). One of the weaknesses of these theories is that they identify time and cost of technology as the only factors influencing adoption of technology. Therefore, the theories have been too limited to time and cost of technology as only the factors influencing adoption of new technology

2.2.2.4 Application of the Modeling Diffusion and Diffusion of Innovation Theories in the Study

In this research both Modeling Diffusion and Diffusion of Innovation theories were used to guide understanding categories of adoption and some factors influencing adoption of new technology.

2.3 Empirical Literature Review

2.3.1 Factors Influencing Adoption of Improved Technologies

There are several studies on factors which influence adoption of improved technologies. Results from these studies indicate that factors vary from one place to another as here under explained.

2.3.1.1 Personal Factors

Adoption of improved maize seed and to some extent chemical fertilizer in Tanzania is affected by both characteristics of household heads and the resources they own. For example, farm size significantly affects improved maize seed adoption (Nkonya *et al.*, 1997). This may be due to the fact that farmers with larger farms have opportunity to experiment and to take larger risks than those with smaller farms. As a result small scale farmers fear trying improved technologies (Ouma *et al.*, 2006; Omolehin *et al.*, 2007).

Farmers' personal characteristics such as age, culture, and education may influence adoption of improved technology (Nkonoki, 1994). According to Hella (1992) age of respondents is one of the factors that influence the adoption of hybrid maize seed in Iringa region, Tanzania. This is because older farmers tend to stick to their old production techniques and are usually less willing to accept change.

Culturally, in many circumstances innovations are faced by barriers before they can be adopted because they may not be compatible with norms and customs of local people (Deligiannaki and Ali, 2011). Likewise some farmers doubt use fertilizers, because of unavailability or unaffordable prices. The study by Doss *et al.*, (2003) on adoption of maize and wheat technology in Eastern Africa identified several factors for not adopting the technologies. They include being unaware of the technologies and the profitability of the technologies.

2.3.1.2 Resource Factors

Resource factors that may influence adoption of technologies include capital, land ownership, labor and high yield availability. Wealthier farmers have better chance to be up-to-date with new technology because are able to take larger risks related to early adoption, and have opportunity to conduct experiment of using improved technology than non-wealthier farmers (Nkonya *et al.*, 1997). For instance wealthier farmers may be the first to try to buy and use improved seeds in farming or buy chemical fertilizer than non-wealthier farmers.

Yield levels: Technology that will result into high yield is likely to be more adopted than low yielding one. This is because high yield is expected to increase income and food security. Ojiako *et al.*, (2007) in the study of adoption in Nigeria found that high yield variable was positive and significant in influencing adoption at 5% level of probability.

Ownership of farm assets: Studies by Carletto *et al.*, (1999); Neill and Lee (2001); Oladele (2005); Aklilu and Graaf (2007) and An (2008) about adoption of improved technologies in Ethiopia show that ownership of farm assets, can explain the decision of using agricultural technologies. This is because it determines the farmer's financial capacity to pay for the technology.

2.3.1.3 Institutional factors

Adoption of agricultural technologies can also be influence by institutional factors, such as the policy environment, which affect the availability of inputs (land, labor, seeds, and fertilizer) and markets for 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 (Doss *et al.*, 2003).

Kathage (2012) in his study about hybrid maize production and its impacts on smallholder farmers in Tanzania found that high prices and vulnerability of improved maize seed as among the most important factors leading farmers not to adopt the improved maize variety. Farmers with low income failed to purchase costly seeds. Variety of maize that is too susceptible to pests and diseases will not attract farmers to use. Low income farmers may purchase high priced improved variety if they are given credits or subsidized by government.

2.4 Knowledge Gap

Even though government and NGOs have made efforts to promote the use of improved technologies in maize farming, yet there is low adoption of these technologies in Tanzania. Results from previous studies indicate that factors influencing adoption of maize production technologies differ from place to place, due to socio-economic situation of the farming communities. Following that situation there is a need to undertake a study on factors influencing adoption of maize production technologies for each major socio-economic setting of farmers.

2.5 Conceptual Frame Work

This study conceptualizes that, in order to have adoption of improved technologies in maize production, there should be an interaction between several factors. These include personal factors (education, sex, marital status, experience, education, age and culture) resource factors (farm ownership, farm sizes, labor, income, and economic activities available), biophysical factors (soil fertility and rainfall) and institutional factors (extension services, training, access to market, policy, rules and regulations, credit facilities).

Personal factors like education enhance adoption since it makes educated people more accessible to the information about a new technology and decides to use it in

maize farming. Resource factors such as land and income, fosters adoption because they determine farmer's ability to afford the technology. Also, this research conceptualizes that to have adoption of new technology there should be government support through extension services, credit facilities, and policy. Adoption of new technology also depends on the type of technology. Adoption of the technology will result into high yield of maize, increased income, and food security.

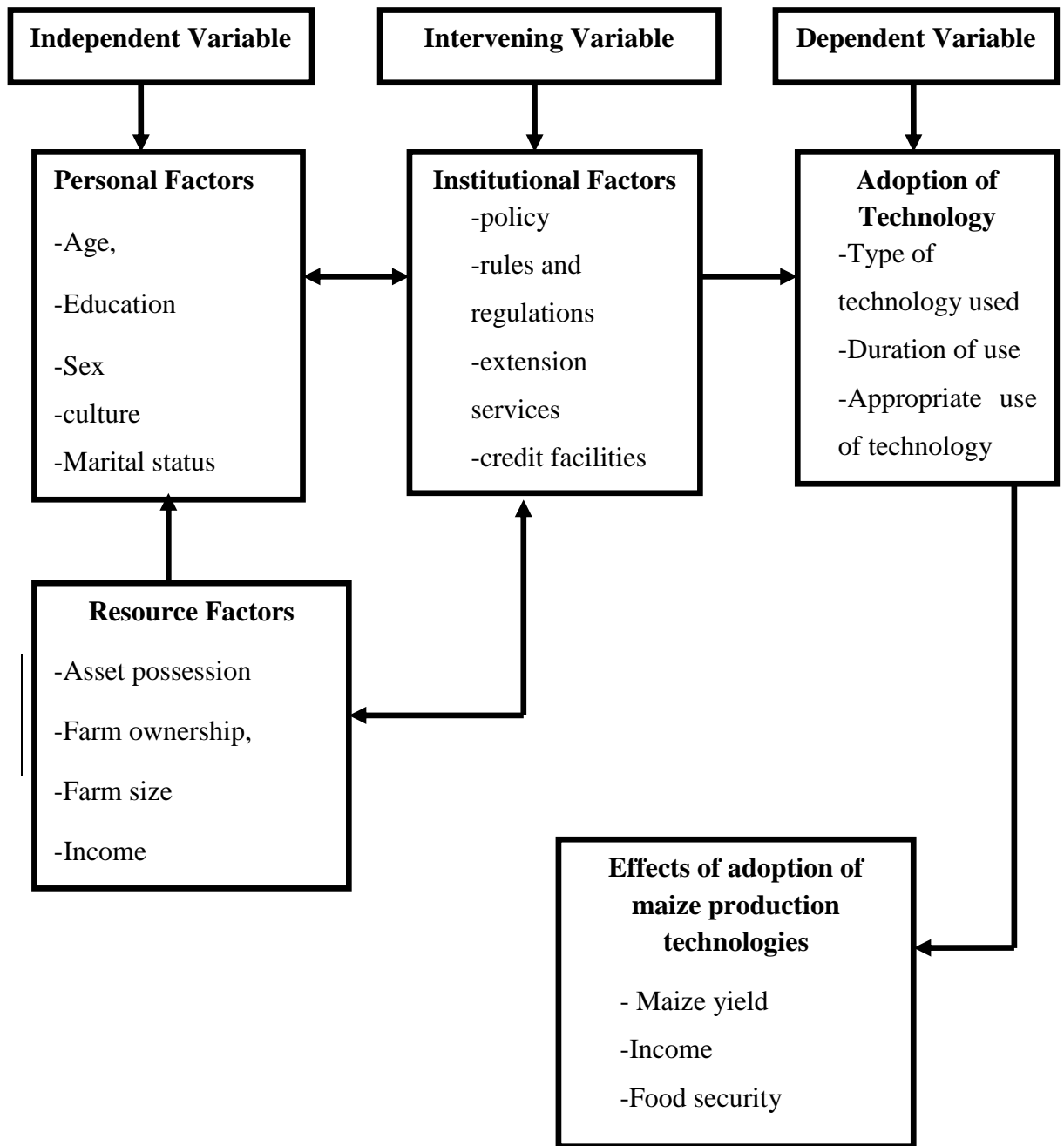


Figure 2.1: Conceptual Frame work

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Study Sites

3.1.1 Selection of the Study Site

The study was conducted in Karatu District, Arusha region. The reason for selecting the district was because of being among the districts in Arusha region where maize is one of the major crops grown but with little adoption of improved technologies. Four villages namely Endabash, Kansay, Qurus and Tloma were selected and involved in the study. Selection of these study villages was based on their cultivation of maize as one of their major crops with little adoption of technologies.

3.1.2 Description of the Study Area

3.1.2.1 Location of the Study Area

Karatu is one of the five districts in Arusha region, Tanzania. It is bordered by Ngorongoro District to the north, Shinyanga Region to the west, Monduli District to the east, and Manyara Region to the south and southeast. As of 2012 population census, the total population of Karatu District was 230,166 people including 117,769 and 112,397 male and female respectively (URT, 2012). The district is located at 3° 20' 27.74" S - 35° 39' 28.85" E and its area is 3,300 km² (URT, 2012). Karatu District is situated on the western part of Lake Manyara. Its elevation varies from 1000 meters above sea level in the Lake Eyasi basin to about 2400 meters above sea level in the southeastern parts of Mbulu plateau (Yala and Madula, 2003).

3.1.2.2 Major Economic Activities

Crop production and livestock keeping are the major economic activities in Karatu District, with crop production being the dominant (REPOA, 2003). Both small scale

and large-scale farming are practiced in this district with small scale being the dominant.

3.1.2.3 Major Crops Grown

The major crops cultivated in Karatu District include maize, beans, wheat, barley, pigeon pea, finger millet, sunflower, flowers and coffee. Karatu District is among the major maize producing districts accounting for more than half of the Arusha regional maize production (Giller, 2009). Farmers also keep livestock such as cattle, goats, sheep, donkeys and poultry (Nyathi, 2010)

3.1.2.4 Climate

The average annual temperature of Karatu is 21⁰ C in the highlands and 24⁰C in the lowlands. Karatu District enjoys double season rains involving long and short rains. The short rains fall between October and December and the long rains between March and June (KDC, 2001). The rainfall in this district is usually reliable (Kessler, 1997) ranging from 800 to 1000 mm. Karatu District is drained by permanent and seasonal streams like the Mtowa Mbu, Simba and Kirurumo. These streams originate from the highlands to the north-west of the basin and enter Lake Manyara on the northern part (Meindertsma and Kessler, 1997).

3.1.2.5 Uses of Agricultural Technologies

Farmers in Karatu District use different technologies in agricultural production including conservation agriculture. However, on average the level of adoption of many technologies is as low as 13% (Lugando, 2013).

3.1.2 .6 Social Services

Karatu District is well connected to Arusha region and its neighboring districts and regions by road transports. Therefore it enjoys a good transport services. The District

has a total of 278 feeder roads that connect it to the regional main roads (URT, 2002).

3.2 Target Population

Parahoo (2006) defines a population as the total number of individuals from which data can be collected and researcher can generally draw a conclusion. The target population for this study included all farmers in Karatu District and other areas with similar situations.

3.3 Research Design

According to Kothari (2004) research design constitutes a plan for collection, measurement and analysis of data. This research used a cross-sectional survey research design. Cooper and Schindler (2006) define cross-sectional survey as one in which data is collected at one point only once. Hall (2011) explains that, cross-sectional surveys can be conducted using variety of data collection methods including face to-face interviews and questionnaires. This research preferred to use cross-sectional survey because it allows combination of more than one methods of data collection.

3.4 Sampling Design

This refers to research plan that shows the way respondents or study materials will be chosen for the study (Kothari, 2004). This research used the following sampling procedures.

3.4.1 Sampling Frame

This is the source list from which a sample is to be drawn. It contains the number of all items in the population (Kothari, 2006). The sampling frame for this research was a list of all households in the study area, which was obtained from the respective village government offices. The list of key informants was obtained from the district

agricultural office, ward and village offices. Key informants comprised of District Agricultural Officer, Ward Agricultural Extension Officers, Village Agricultural Extension Officers, Village Executive Officers and village chair persons.

3.4.2 Sample Size

The sample size of 117 respondents was involved in the study, 100 being representation of households from selected villages and additional of 17 as key informants (See Table 1). The sample size was estimated using the formulae by Yamane (1967) as indicated in equation (1)

$$n = N / (1 + (N * e^2)) \dots \dots \dots (1)$$

Where

N = Estimate of the total population

n = Desired sample size

e = Standard error (1- 10%)

1 = constant

Using population of N = 55, 471, e = 10%, the estimated sample size, n = 100

3.4.3 Sample Size Distribution

Proportionate sampling approach was used to distribute the sample size of 100 respondents. Through this approach the number of respondents in each village was proportion to its population size. The formulae by Wilinkison and Bhandarkar, (1979) indicated in equation (2) was used.

$$n_i = \frac{P_i \cdot n}{P} \dots \dots \dots 2$$

Whereas,

P = Total population,

n = Total sample size,

n_i = Sample size of strata I,

P_i = Population for strata i .

For the case of this study;

$P = 55,471$,

$n = 100$,

$P_1 = 14,358$ (Population of Endabash),

$P_2 = 14,198$ (Population of Kansay),

$P_3 = 15,919$ (Population of Qurus) and

$P_4 = 10,996$ (Population of Tloma).

Table 1: Sample distribution

Sample Category	Respondents (No.)				Total
	Endabash	Kansay	Qurus	Tloma	
Head of Households	26	25	29	20	100
Village Chair person	1	1	1	1	4
Village Executive Officer	1	1	1	1	4
Village Agricultural Extension officer	1	1	1	1	4
Ward Agricultural Extension Officer	1	1	1	1	4
District Agricultural Officer					1
Total	29	28	32	23	117

Source: Researcher Own Construct, 2015

3.4.4 Sampling Procedure

A sampling procedure implies process of selecting items or individuals from a population (Orodho and Kombo, 2002). This research used simple random sampling to get 100 head of households from the study area. According to Sekaran (2003) simple random sampling is a way of selecting subjects in which every element in the population has an equal chance of being selected. The random sampling was done by

lottery method that is, each member of the population (sampling frame) was assigned a unique number in a paper and placed in a box and mixed thoroughly. Each household whose number was picked was involved in the study.

Purposive sampling was used to select key informants. According Bernard (2002), key informants are observant, reflective members of the community of interest who know much about the culture and are both able and willing to share their knowledge. Therefore, in this study key informants were selected based on their knowledge, experience of the study area and the study problem.

3.5 Data Sources and Collection Methods

This research used both primary and secondary data sources. Primary data involve the data collected directly from first hand (original) experience (Dodge, 2003), whereas secondary data are obtained from books, newspapers, or from other people's work but useful for the study at hand (Kombo, 2006).

3.5.1 Primary Data Collection

The primary data was collected by using the following methods:

3.5.1.1 Structured Interviews

This involved data collection in which questionnaire was used as a tool to collect data (Appendix 1) from the 100 households. The questionnaire was used because of their relatively low cost and ability to collect data from large number of population. The questionnaires were researcher administered assisted by research assistants. Both closed and open-ended questions were included in the questionnaire. Before administering the questionnaire to the head of households, the researcher pre-tested the questionnaire to few selected respondents from the local community. Research assistants were trained to help administering the questionnaire.

3.5.1.2 Semi-Structured Interviews

This method of data collection involved asking oral questions with face to face communication between researcher and the respondents (Kothari, 2004). This research used semi-structured interview to collect data from the key informants to allow in-depth discussion about the problem of the study. A check list was used to guide the interview (Appendix 2).

3.5.1.3 Observations

Observation method involved data collection by a researcher through observing without interviewing the respondents (Kothari, 2004). There searcher observed the use of improved technologies (fertilizers, improved seeds, oxen ploughs, tractors and herbicides) and possession of resources within households. Checklist was used to guide the observation (Appendix3). Observation method was useful to observe the real situation of the farmers and to verify information collected by other methods.

3.5.1.4 Focused Group Discussion (FGD)

Focused Group Discussion (FGD) is a convenient method for providing information quickly and in identifying and exploring beliefs, ideas, and opinions from groups (Kombo and Tromp, 2006). This research used two groups of 5 to 10 members per group, one group of male and the other group for females in each village. The group discussion was guided by a checklist (Appendix 4). This method was used to enable open discussion and exploring different opinions of respondents about the research problem, and to confirm the data collected by other methods. Also through FGD it was possible to obtain sensitive information which could be difficult to obtain from an individual.

3.5.2 Secondary Data Collection Methods

Secondary data was collected through review of relevant document on adoption of technologies from important sources including library, internet, and from District and Ward agricultural offices.

3.6 Types of Variables (Data)

The type of variables that were collected was governed by the specific objectives of this research as follows:-

Objective 1: To Identify the Types of Maize Production Technologies Used in Karatu District

The type of data included production technologies (type of fertilizer, seed varieties, pesticides use, farming tools, type of labor used, and frequency of use and duration of uses) and other recommended agronomic practices.

Objective 2: To Analyze Social-Economic Characteristics of Maize Farmers

Researcher collected data on personal characteristics (age sex, marital status, and educational level and farming experience) resources (size of farm, land possession, availability of labor, livestock ownership) and institution factors (extension services, training, access to market)

Objective 3: To identify Socio-Economic Factors Influencing Adoption of Maize Production Technologies

Factors were identified by analysis of information collected from the two objectives above.

3.7 Data Analysis

Data analysis is a process of systematically working with data or applying statistical and logical techniques to describe, organize, summarize, and compare the data collected and divide them into manageable portions (Bogdan and Bicklen, 1992). Having collected data, the information contained in the questionnaires was processed, analyzed and interpreted by objective as follows:

Objective 1: To Identify the Types of Maize Production Technologies Used in Karatu District

Researcher used cross tabulation to compare frequencies and percentages of the types of maize production technologies used in the study area. Technologies with relatively large percentages of users were considered as the most adopted and used technologies.

Objective 2: To Analyze Social Economic Characteristics of Maize Farmers

The data under this objective was analyzed through descriptive statistics (Lund, 2013). Descriptive statistics such as mean, frequencies, and percentages were computed to establish the value and proportions of each variable of interests (Michael, 2011). Cross-tabulation was used for simple comparisons of the characteristics between and within the villages using means, frequencies and percentages. Variables with relatively high frequencies were considered to anticipate important characteristics.

Objective 3: To Identify Factors Influencing Adoption of Maize Production Technologies

Researcher used cross tabulation for comparing frequencies and percentages of adoption of improved technologies versus social economic variables (Kothari, 2004) which were categorized as personal, resources and institution. Particular factor was

identified to influence adoption based on the proportion (percentages) of adoption non-adopters of the improved technology under the particular factor.

3.8 Data Reliability and Validity

3.8.1 Reliability of the Data

This is the ability of research instruments to provide the same results when applied at different time in the same study area (Katunzi, 2004). To ensure reliability of the data researcher pre-tested the questions and other data collecting tools as well as, training researcher assistants.

3.8.2 Validity of the Data

Validity is an ability of a research instrument to measure what is intended to measure and provide generalized research findings (Kothari, 2004). To ensure validity of the data from the respondents, researcher explained clearly objective of the study to the respondents, and used researcher assistants from the local community within the study area. This helped to build trust with the respondents so that they could provide relevant information. Confidentiality was also assured to the respondents.

3.9 Ethical Consideration

Before data collection, researcher asked permission from all relevant authorities in targeted research sites. Also, researcher assured the respondents that information they would give would be confidential and used for research intended purpose only.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter presents and discusses results according to the study objectives. It has three sections. Section one presents results on types of maize production technologies used, Section two presents personal characteristics of the respondents, section three identifies socio-economic factors influencing adoption of maize production technologies.

4.2 Types of Maize Production Technologies Used

Results about maize production technologies are indicated in Figure 2. The results show that major types of maize production technologies used include improved seeds (87.6%) oxen plough (81.6%) and insecticides (76.3%). Farmers have adopted these technologies more because they are more relevant to them. Results also show that few (14.4%) proportion of respondents used chemical fertilizer. According to the Focused Group Discussion and the Key informants, this low use of chemical fertilizer was due to lack of training, cost of the fertilizer and belief that inorganic fertilizer degrades the soil. This partial adoption of the technologies may not increase production as these technologies are independent and need to be adopted as a package.

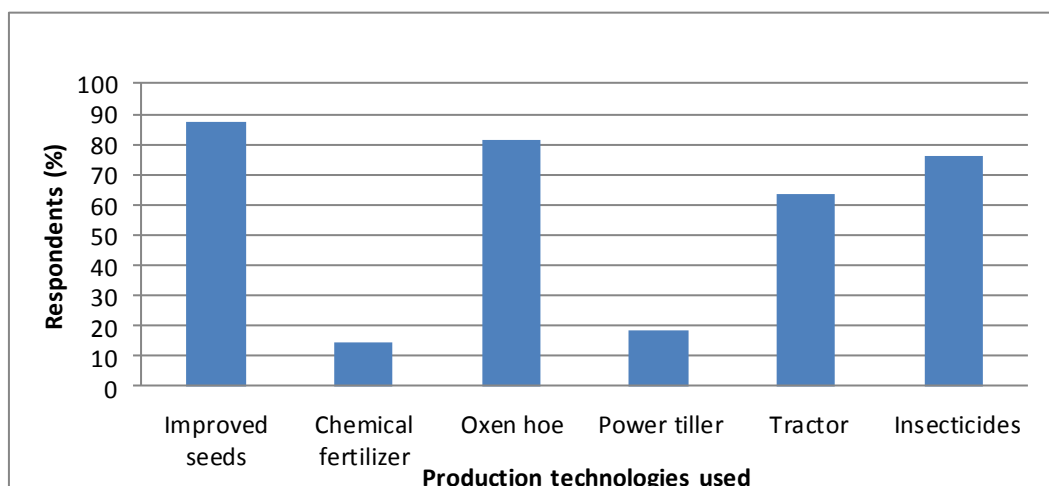


Figure 1: Types of maize production technologies used

4.3 Socio-economic characteristics of respondents

4.3.1 Personal Characteristics

Personal characteristics of head of households based on sex, age, educational level, marital status, place of birth and household size are shown in Table 1. The results indicate the following;

4.3.1.1 Educational Level

The results on educational level as indicated in Table 2 show that 50% of the respondents had primary school education while 40% had secondary education and 10% had received tertiary education. Majority had primary school education because, this is in a compulsory education level in Tanzania. Presence of few respondents with tertiary education imply that many educated people don't stay in the villages either because they are lacking interest in farming or seek for better social services away from the rural areas. This is in line with findings by Khatibu (2012) in Sub-Saharan Africa that interests in farming decreases with increase in levels of education.

Table 2: Respondent's personal characteristics

Variable	Description	Respondents (%)				
		Endabash n = 26	Tloma n = 25	Qurus n = 29	Kansay n = 20	Total n =100
Education level	Primary	42.3	50	53.6	53.8	50
	Secondary	38.5	50	35.7	38.5	40
	Tertiary	19.2	-	10.7	7.7	10
Sex	Male	65.4	65.0	64.3	57.7	63.0
	Female	34.6	35.0	35.7	42.3	37.0
Marital status	Married	96.2	85.0	89.3	84.6	89.0
	Single	2.8	10.0		.0	3.0
	Widow	1.0	5.0	10.7	15.4	8.0
	Young	15.4	.0	3.6	11.5	8.0
Age	Middle	61.5	60.0	57.1	61.5	60.0
	Old age	23.1	40.0	35.7	26.9	32.0
	Within	96.2	95.0	92.9	96.2	95.0
	Outside	13.4	10.0	7.1	7.7	5.0
Place of birth	Small(1-3)	0	10.0	.0	.0	2.0
Household size	Medium	69.2	45.0	35.7	26.9	44.0
	(4-6)					
	Large (7 ≥)	30.8	45.0	64.3	73.1	54.0

Source: Field Survey, 2015

4.3.1.2 Sex

The results in Table 2 show that on average 63.0% of respondents were male and 37.0% were female. This is because the sampling frame for this research targeted the household heads and in most patrilineal societies in Tanzania, heads of households are men (Jambiya, 1998). This implies that if men's decision doesn't favor adoption then it will affect adoption technologies. This suggests for development of strategies and an approach that create conducive environment and empower women to participate in decision-making for adoption activities (FAO, 1996). Kansay has relatively more (42.3%) female than other villages. This is because most men work outside their villages. This observation was evident when the researcher held further discussion with the respondents and the key informants.

4.3.1.3 Marital Status

The results on marital status as shown in Table 2 indicate that majority of respondents (89%) were married whereas very few were single (3%) and widow (8%). Majority of head of households being married may imply stable families and responsibilities to meet family needs. They are likely to adopt production technologies if they increase their ability to meet family responsibilities.

4.3.1.4 Age

The results in Table 2 show three age groups of young aged (30-40 years) with proportion of 8%, middle aged groups (41-50 years) with proportion of 60.0% and Old aged groups (>50 years) with proportion of 32.0%. The observation that over half of the respondents were middle aged farmers ensures availability of labor for adoption of agriculture technologies in the study areas.

4.3.1.5 Place of Birth

Results in Table 2 indicate that majority (95%) of the respondents were born within the villages they were living while few (5%) were born outside the villages in which they were living. This means that there is low trend of people moving from other places into these villages. The observation that almost all the heads of household were born within the villages imply long experience on farming practices in their area.

4.3.1.6 Household Size

Results in Table 2 indicate that majority (54%) of households belong to large household sizes (>7 people). This household size is greater than the national average of 5 household sizes. This is because majority of respondents live in extended families. However, large household size implies availability of labor force (family labor) for farming activities.

4.3.2 Resource Characteristics

4.3.2.3 Land Ownership

The results on the types of ownership of land are shown in Table 3. The results indicate that large proportion (59.0%) of respondents obtained farming lands by inheritance from their parents, few (31.6%) by purchasing and very few by renting (14.4%). Land ownership by inheritance involves process in which parents give or allow their children to own a part of family land. Land ownership by purchasing means to use money to buy land from an individual or institutional such as a local government (Pat, 2010), whereas land ownership by renting is referred to as temporarily using land from a land owner in agreement to payment (Pat, 2010). Farmers who had inherited land from their parents are more likely to adopt agriculture technologies than those who purchased and rented because of more security ownership in the inheritance than in other forms of ownership. These results imply that the types of land ownership influence adoption. According to Nnadi and Akwiwu (2005) youths who owned land by inheritance participated more in agriculture than those not.

4.3.2.1 Major Economic Activities

The results in Table 3 show that majority of respondents are engaged in crop farming (71.5%) and in livestock keeping (58.5%). The observation that about three quarters of the respondents are involved in crop production indicates the likeliness of the farmer to adopt the production technologies if they are aware of it and it can increase maize production. However, the observation of low adoption rates on fertilizer uses suggest that other factor may be important to consider.

Table 3: Resources characteristics of respondents

Variable	Description	Respondents (%)				
		Endabash n = 26	Tloma n=25	Qurus n= 29	Kansay n=20	Total n=100
Land ownership	Inherited	61.5	60.0	53.6	61.5	59.0
	Bought	46.2	25	32.9	22.3	31.6
	Renting	16.2	25.0	24.9	12.3	14.4
Major economic activities	Crop farming	63.1	65.0	75.7	82.3	71.5
	Livestock keeping	53.1	60.0	65.0	56.1	58.5
	Formal employment	24.2	20.0	18.6	15.4	19.5
Farm size (acres)	Average cultivation	3.31	4.00	3.57	5.96	4.21
Sources of Labor	Family	80.8	70.0	60.7	69.2	70.0
	Farm machinery	46.2	80.0	78.6	53.8	64.0

Source: Field Survey, 2015

4.3.2.2 Farm Sizes

Results on farm sizes owned by the households are shown in Table 3. The results indicate the average farm sizes owned by the households to be 4.2 acres. In general these farm sizes are small compared to farm sizes (4.9 -12.3 acres) in other agricultural areas of Africa and Asia. Small farm sizes may make the farmer to fear in taking risks related to early adoption and to conduct experiment of using improved technology (Nkonya *et al.*, 1997). But for proved technologies the opposite may be true, farmers with relatively small farm size may use technologies to ensure increased production.

4.3.2.4 Sources of Labor

Results in Table 3 show the main sources of labor used by farmers. The results indicate that the major sources of labor are family (70.0%) and farm machinery (64.0%). This is because majority of households belong to large HH size which in turn provides labor forces. Important farming tools are oxen plough (81.6%) and tractor (63.3%). The results show more use of oxen plough than tractors due to the fact that farmers in the study area keep livestock. The researcher could observe this when leading a focused group discussion with the respondents and the key informants. These results imply availability of labor for farming activities and using improved technologies if motivated.

4.3.3 Institutional Characteristics

4.3.3.1 Training

The results in Table 4 show that only few households (16.7%) have received training related to improved agriculture technologies and those who had attended it was for only short period ranging from one to two days in a year. These results in the Table, have considered only those received training and excluding those not. These observations show that very few had attended training so implies that majority of farmers don't have access to information related to improved agricultural technologies. This may contribute to low adoption as farmers will not adopt the technology if not aware of it and its benefits.

Table 4: Training in agricultural technologies.

Variable	Description	Respondents (%)				
		Endabash n = 26	Tloma n = 25	Qurus n =29	Kansay n = 20	Total n=100
Training	Received	24.0	10.0	23.1	8.0	16.7
Duration (Day) of training	1	19.2	5.3	15.4	8.0	12.5
	2	7.7	10.5	7.7	.0	6.2

Source: Field Survey, 2015

4.4 Socio-economic Factors Influencing Adoption of Maize Production

Technologies

In this research adoption of improved technologies is grouped into three categories; active, less active and non- adopters. Active adopters include farmers who have used at least four improved technologies (>4) in maize farming for at least one farming season. Such technologies include improved seeds, chemical fertilizer, oxen plough and insecticides. Less active adopters are those farmers who have used less than four improved technologies whereas non-adopters involve farmers who have not used any of the improved technologies in maize farming for at least one farming season.

Socio-economic factors that were analyzed for their influence on adoption of maize production technologies are grouped into personal, resources and institution. These factors have been selected based on their likeliness to influence adoption as indicated by experiences elsewhere. The results indicate the following:-

4.4.1 Personal Factors

Table 5 shows the influence of personal characteristics such as sex, marital status, education level and age on adoption of maize production technologies.

4.4.1.1 Educational Level

Results in Table 5 indicate the influence of educational level on adoption of improved technologies. The findings reveal that head of households with primary education level are more active adopters (66.7%) than those with secondary school education (33.3%). This is because most of the respondents with primary education live in the rural areas where they are more engaged in agricultural farming than others. Results also indicate that majority of households with secondary school level are (67%) non-adopters. This implies that interests in farming declines with increase in level of education because of the risks involved in agricultural activities, alternative employment opportunities and pro-living conditions in rural areas. This result is similar to the study by Charlotte et al., (2000), that higher educated people seem less inclined to participate in SWC if their occupation is less dependent on crop production. This finding also concurs with the results from the study by Khatibu, (2012), that interest in farming decreases with increase in levels of education.

Table 5: Influence of personal characteristics

Variable	Description	Respondents (%)		
		Active	Less active	Non-adopters
Education level	Primary	66.7	49.5	33.0
	Secondary	33.3	39.6	67.0
	Tertiary	-	11.0	-
Marital Status	Single	16.7	2.2	33.3
	Widowed	-	6.6	66.7
	Married	83.3	91.2	-
Age category	Young	-	9.9	64.0
	Middle	66.7	58.2	1.0
	Old age	33.3	31.9	35.0
Sex	Female	16.7	37.4	66.4
	Male	83.3	62.6	33.6

Source: Field Survey, 2015

4.4.1.2 Marital Status

Results on the influence of marital status on adoption of improved technologies are indicated in Table 5. The results show that married head of households are more active adopters (83.3%) than single (16.7%). Married households are more active adopters than other marital status because of their stable long term labor supply in farming family responsibilities implying that can adopt technologies if they contribute in meeting the family needs. These results are similar to the findings by Nnadi and Akwiwu (2005) in Nigeria that married people are more disposed to farming than those not.

4.4.1.3 Age

Influence of age on adoption of improved technologies is shown in Table 5. The results indicate that middle aged group has more (66.7%) active adopters than other age groups. This is because this age belongs to married group with more family

responsibilities than the young. But also have relatively long experience in agriculture, exposed to the available technologies and are active group to implement different types of technologies. Very old age group may be constrained with availability of labor to adopt the technology.

4.4.1.4 Sex

The results in Table 5 show that females have very few (16.7%) active adopters than males (83.3%). This is due to limited access to information and resources because of social-economic barriers. This suggests for development of strategies and approaches that create conducive environment and empower women to participate in decision-making for adoption activities (FAO, 1996).

4.4.2 Resource Factors

Resource factors investigated if they influence adoption of maize production technologies include location and farm sizes.

4.4.2.1 Farm Sizes

Results about the influence of farm sizes are indicated in Table 6. The results show that households with large farm sizes are more active adopters than those with small farm sizes. This is because farmers with small farms fear to take risk of using part of their farms for testing a new technology. These results concur with Sengalawe (1998) on adoption of SWC that farmers with smaller farm sizes mostly don't use SWC measures on their plots because the conservation measures takeoff large area of land that would be used for crop production.

Table 6: Influence of farm size and location on adoption of improved technologies

Variable	Description	Respondents (%)		
		Active	Less active	Non-adopters
Farm size (acres)	Small (1-2)	-	46.2	33.3
	Medium (3-4)	33.3	24.2	22.4
	Large (5≥)	66.7	28.6	44.3
Location (Villages)	Endabash	15.7	26.4	33.3
	Tloma	31.3	19.8	-
	Qurus	35.3	28.6	-
	Kansay	17.7	25.3	66.7

Source: Field Survey, 2015

4.4.2.2 Location

Results on influence of location on adoption of improved technologies are indicated in Table 6. The results show that adoption varies by villages where by Kansay has less (17.7%) active adopters compared to other villages. This is because the village is located in very remote areas with less access to information and extension services. Also, the remoteness of the village makes marketing of agricultural products also a problem hence discouraging adoption. These results can lead to conclusion that location of the farms with respect to access of information, extension services and market influences adoption.

4.4.3 Institutional Factors

4.4.3.1 Access to Markets

The results in Table 7 show that farmers with very good access to market are more active adopters than those with little or no access to market. This is because access to market assures farmers returns to the investment in technology hence reducing the risks.

Table 7: Influence of market and training on adoption of improved technologies

Variable	Description	Respondents (%)		
		Active	Less Active	Non-adopters
Market access	Very good	60	5.5	0
	Good	25	28.6	30.3
	Moderate	15	60.4	31.3
	Not good	0	5.5	38.3
Training	Yes	90.5	19.5	0
	No	9.5	80.5	100

Source: Field Survey, 2015

4.4.3.2 Training

Results on influence of training on adoption are indicated on Table 7. The results show that heads of households who had received training were more actively (90.5%) adopters of improved technologies than those without training. This is because training brings awareness to farmers about the technology and its benefits.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The following are major conclusions based on the findings from this study:

The major improved maize production technologies used in the study area include insecticides, oxen plough and improved seeds. There is little adoption of fertilizers.

This partial adoption of the technologies may be leading to low crop production.

Majority of respondents in the study area engage in agriculture with small farms, low level of education and little training. These characteristics influence adoption of improved technologies.

The socio-economic factors that influence adoption of improved maize production technologies include education level, marital status, age, sex, place of birth, village location and farm sizes. Others are training and access to market.

5.2 Recommendations

The local government authority through its district agricultural offices should make sure that there are adequate training and extension services in all villages. This can be achieved through recruitment of more extension officers and providing appropriate training specifically to enhance the adoption the adoption of technologies.

The district council must prepare incentive policies which will motivate farmers towards adopting the improved agricultural technologies particularly chemical fertilizer for maize farming. This can be done by distributing fertilizer to farmers at subsidization at village agricultural offices in every planting season.

5.3 Area for further Research

In this research the researcher discovered that there were some respondents who adopted the use of improved technologies in maize farming, but later on dropout. Therefore this study suggests further research to be done on investigating factors for continued use of improved technologies.

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APPENDICES

Appendix 1: Questionnaire for heads of household

QUESTIONNAIRE FOR SOCIAL-ECONOMIC FACTORS INFLUENCING ADOPTION AND CONTINUED USE OF IMPROVED TECHNOLOGIES FOR MAIZE PRODUCTION A CASE OF KARATU DISTRICT, TANZANIA

Questionnaire Number

Date

Part 1: Background Information

District..... Ward..... Village.....

1. What is your Age?..... (Years)

2. Sex of respondent

i. Male ()

ii. Female ()

3. What is your marital status?

a) Married Divorced ()

b) Single ()

c) Widowed ()

d) Married ()

e) Married but living separately ()

4. What is your educational level?

a) Primary level- Standard () Std

b) Secondary level () Form

c) College/ University () Diploma /Degree

5. What is your relationship with the head of household?

a) Head ()

b) House worker ()

c) Wife ()

d) Husband ()

e) Child ()

f) Others (specify)

6. What is the size of your household including yourself? (Number)

7. For how long have you been living in this area? (Years)

PART II: RESOURCES USE AND AVAILABILITY

8. What are your major economic activities? (Can be more than one)

a) Livestock keeping ()

b) Crop farming ()

c) Casual labor ()

d) Formal employment ()

e) Doing business ()

f) Any other (Specify)

9. Which types of livestock do you own among the following?

Type	Number
I. Cattle	
II. Goat	
III. Sheep	
IV. Poultry	
V. Others (Specify)	

10. What do you do with farm yard manure from your livestock? (Can be more than one answer)

i. Apply in farms () ii) Burn ()

iii. Sell () (iv) Others (specify)

11. What types of crops do you grow? (Can be more than one answer)

a) Maize ()

b) Beans ()

c) Sunflower ()

d) Others (Specify)

12. How many farm plots do you have? (Acres)

13. What is the total area of your maize cultivated farms?..... (Acres)

14. What is your main source of labor for maize farming? [Can be more than one answer]

a) Family labor ()

b) Hired labor ()

c) Farm machinery ()

d) Others (Identify)..... ()

15. What type of ownership of the farm plots you cultivate? (Can be more than one)

a) Village government allocation ()

b) Inherited ()

c) Borrowing ()

d) Bought ()

16. What assets do you own among the following? Put a tick \surd (Can be more than one option)

(a) Bicycle ()

- (b) Car ()
- (c) Motorcycle ()
- (d) Other (specify).....

17. What is your source of energy? Put a tick \surd (Can be more than one options)

- (a) Electricity ()
- (b) Gas ()
- (c) Charcoal ()
- (d) Kerosene ()
- (e) Firewood ()
- (f) Other (specify)

18. What type of house do you own? Put a tick \surd

- (a) Wall: mud (), Block (), Timber (), others (specify).....
- (b) Floor: mud (), cement (), Stones (), Tiles (), others (specify).....
- (c) Roofing: Corrugated iron sheet (), grass (), Tiles (), others (specify).....

19. What type of communication facilities do you own among the following? (Can be more than one option)

- (a) Radio ()
- (b) Mobile phones ()
- (c) Television ()
- (d) Computer ()
- (e) Others (specify).....

20. Which of the following tools do you use in doing farm activities? [Can be more than one]

- i. Hand hoe ()
- ii. Oxen hoe ()
- iii. Power tiller ()
- iv. Tractor ()
- v. Others () Specify.....

21. Have you ever been used any of the following improved technology in maize farming?

Type of improved technology used	Yes	No	For how long (years)	Continuing to use?		Reasons if dropped out
				Yes	No	
1.Improved seeds						
2.Inorganic fertilizer						
3. Organic fertilizer						
4. Herbicides						
5. Pesticides						
6.Oxen hoe						
7.Power tiller						
8.Tractor						
9.Planting by spacing						
10. Others (specify).....						

22. What are the actual prices of the major improved inputs you use in maize farming?

Input	Crop used	Amount (liter/g/kg)	Price (Tsh)
Insecticides			
Improved maize variety			
Inorganic fertilizer			
Others (Specify)			

23. Which crops do you apply fertilizer?

Crop	Type of fertilizer	Frequency (Per season)	Amount

24. If not applying fertilizer to all crops what are the reasons?

i..... ii.....

25. Which varieties of maize do you grow?

Maize variety	Reasons for preference	Duration of growth

		(years)

26. Have you ever attended any training related to maize farming?

Type of training attended	Facilitator	Place of training	Period of training (year/month/days)

27. What is the market situation for maize in your area?

(a) Very good ()

(b) Good ()

(c) Moderate ()

(d) Not good ()

28. Where do you sell your maize?

.....

29. Who are the main buyers of your maize?

i..... ii.....

30. What is the highest price? (Tsh) and month

31. What is the lowest price?..... (Tsh) and month

32. What are the yield levels for crops you grow?

Type of crop	Variety	Yield levels (kg/bag)

33. How many meals do you take per a day?

- a) Two ()
- b) One ()
- c) Three ()
- d) Others () Specify

34. What are the reasons for the above observation?

i.....ii

35. Which rules governing farming in your area?

i.....ii.....
iv.....iv.....

Thanks for your cooperation.

Appendix 2: Check list questions for the key informants

Date:

Name: Position:

Village/Ward/District Professional:

1. What maize production technologies commonly used in your area?

i) ii)

iii) iv)

2. What proportion of farmers do you estimate to be using the technologies?

Type of technology	Farmers using (%)

3. During your stay in the area have you experienced any dropouts from technology use?

a) Yes ()

b) No ()

4. If yes what are the possible reasons?

i) ii)

iii) iv)

5. What proportion of farmers has dropped out from using improved maize production technologies?

Technology	Dropout rate			Reasons
	low	medium	High	

6. What are the major economic activities of the people in this area?

i) ii)

iii) iv)

7. Which factors influencing adoption of improved technology in maize farming?

i. ii.....

iii. iv.....

8. Which factors influencing continued use of improved technologies in maize farming?

i. ii..... iii.....

9. How does agricultural policy influence adoption of fertilizer?

.....

Thanks for your cooperation.

Appendix 3: Checklist to guide Focus Group Discussion

1. What factors influencing adoption of improved technologies in maize production at your place?

Factors						Points	Positions

2. Which factors motivating farmers continue to use improved technologies in maize production?

Factors						Points	Positions

3. What makes farmers dropout from using improved technologies after adopting?

Factors						Points	Positions