INPUTS ACCESS AND PADDY PRODUCTIVITY: A CASE OF KILOMBERO DISTRICT, TANZANIA

GRACE MAKINGI

A DISSERTATION SUBMITTED IN PARTIAL FULLFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS IN RURAL DEVELOPMENT OF SOKOINE UNIVERSITY OF AGRICULTURE. MOROGORO, TANZANIA.

2015

ABSTRACT

The study on inputs access and paddy productivity was carried out in Kilombero District, Tanzania. The study specifically aimed at; identifying agricultural inputs used by paddy farmers in production, determining socio-economic factors influencing use of agricultural inputs, comparing paddy productivity between inputs users and non users and identifying inputs access challenges facing farmers. To address the above, the study adopted a cross – sectional research design whereby data was collected at one point in time. Simple random sampling was used to obtain 120 respondents, 40 from each of the selected villages. Data were collected using a structured questionnaire. Collected primary data was analysed using the Statistical Package for Social Science (SPSS), whereby descriptive statistics such as frequencies and percentages were determined. A logistic regression model was used to determine the association of socio-economic factors and use of agricultural inputs. The results from the logistic regression show that, availability of extension officers, involvement in other economic activities, access to credit cooperative membership, household size, annual income, education level and farm size were significantly associated with the use of agricultural inputs (fertilizers, improved seeds, pesticides and herbicides). The study also found that there was a difference in yields between inputs users and non users based on t – test analysis. However, some challenges such as high inputs prices, poor availability, long distance to agro–inputs centers, lack of knowledge and low quality inputs were reported by respondents as limiting factors in their paddy production. Therefore, the study recommends that, farmers should be advised and encouraged to join Savings and Credit Cooperative Societies (SACCOs) so as to access affordable loans hence increasing their ability to purchase agricultural inputs. The government should also promote the private sector's investment in agricultural inputs in the rural areas so as to facilitate timely availability of the inputs.

ABSTRACT

The study on inputs access and paddy productivity was carried out in Kilombero District, Tanzania. The study specifically aimed at; identifying agricultural inputs used by paddy farmers in production, determining socio-economic factors influencing use of agricultural inputs, comparing paddy productivity between inputs users and non users and identifying inputs access challenges facing farmers. To address the above, the study adopted a cross – sectional research design whereby data was collected at one point in time. Simple random sampling was used to obtain 120 respondents, 40 from each of the selected villages. Data were collected using a structured questionnaire. Collected primary data was analysed using the Statistical Package for Social Science (SPSS), whereby descriptive statistics such as frequencies and percentages were determined. A logistic regression model was used to determine the association of socio-economic factors and use of agricultural inputs. The results from the logistic regression show that, availability of extension officers, involvement in other economic activities, access to credit cooperative membership, household size, annual income, education level and farm size were significantly associated with the use of agricultural inputs (fertilizers, improved seeds, pesticides and herbicides). The study also found that there was a difference in yields between inputs users and non users based on t – test analysis. However, some challenges such as high inputs prices, poor availability, long distance to agro–inputs centers, lack of knowledge and low quality inputs were reported by respondents as limiting factors in their paddy production. Therefore, the study recommends that, farmers should be advised and encouraged to join Savings and Credit Cooperative Societies (SACCOs) so as to access affordable loans hence increasing their ability to purchase agricultural inputs. The government should also promote the private sector's investment in agricultural inputs in the rural areas so as to facilitate timely availability of the inputs.

DECLARATION

I, GRACE ISDORY MAKINGI, do here by declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work done within the period of registration and that it has neither been submitted nor being concurrently submitted in any other institution.

22/10/2015

Grace Isdory Makingi — **Date**

(M.A Rural Development Candidate)

The above declaration is confirmed by:

22/10/2015

Dr. Justin. K. Urassa — **Date**

(Supervisor)

COPYRIGHT

ACKNOWLEDGEMENTS

I thank the Almighty God who helped me in every step of my life and studies. I owe a debt of gratitude to my supervisor Dr. J.K. Urassa of the Development Studies Institute (DSI) for his assistance and sincere cooperation throughout the process of developing this dissertation. This work would never have been to this form without his advice, unwavering comments, constructive criticisms, patience and tireless reading. His constant quest for clarity and attention to details enabled me to learn a lot in making clear arguments. Working with him was a great privilege.

My appreciation also goes to all DSI staff, academic members and non- academic for their assistance and cooperation during the whole period of my studies. Their comments were instrumental in shaping my study. I further wish to express my sincere gratitude to my beloved brother George Makingi and his family for their untiring love, encouragement, moral and material support during my stay in Morogoro.

I also appreciate the contribution from all respondents who were readily available during the interview. I extend my appreciation to my brothers Moses and Edison and my sisters Siri and Rozalia for their encouragement and prayers which were blessings to my work. Lastly, I extend my sincere appreciation to friends, colleagues, staff members of Ihumwa secondary school and all other individuals who, in one way or another, assisted me at the different stages of my study. Their contribution is in no way being belittled by not acknowledging each one by name. I say thank you very much to you all and may God bless you.

DEDICATION

This work is dedicated to my father Isdory Ignas Makingi and my mother Bertha Cyprian Myonga for the immense sacrifies and efforts made to ensure my educational achievements and success, may The Almight God bless them.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS AND ACRONYMS

ASA	Agricultural Seed Agency
ASDP	Agriculture Sector Development Plan
CAN	Calcium Ammonium Nitrate
DALDO	District Agricultural and Livestock Development Officer
DAP	Di – Ammonium Phosphate
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
Fig	Figure
GDP	Gross Domestic Product
HYMVs	High Yield Modern Varieties
MAFC	Ministry of Agriculture, Food Security and Cooperatives
Mt	Million tonnes
N	Nitrogen
NAIVS	National Agricultural Input Voucher Scheme
NERICA	New Rice for Africa
NGO's	Non Government Organizations
NRDS	National Rice Development Strategy
NSGRP	National Strategy for Growth and Reduction of Poverty
SA	Sulphate of Ammonia
SAPs	Structural Adjustment Programs
SFP	Single Factor Productivity
SPSS	Statistical Package for Social Science
SSA	Sub – Saharan Africa

t	tonnes
TFP	Total Factor Productivity
TSP	Triple Super Phosphate
URT	United Republic of Tanzania
VEO	Village Executive Officer

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Agriculture is the backbone of Africa's economy. According to ECA (2007), about 70% of Africans and roughly 80% of the continent's poor live in rural areas and depend on agriculture for their livelihood. The sector accounts for about 20% of Africa's GDP, 60% of its labour force and 20% of all merchandise exports. However, food insecurity remains one of the main challenges facing many countries in Sub-Saharan Africa (SSA) despite the significant advancement in improving cereal grain yields especially for maize, wheat and rice (Block, 2010; Tsusaka and Otsuka, 2013).

Paddy is among the major cereals grown in Africa and its importance is rapidly increasing (Balasubramanian *et al.,* 2007). Its demand in SSA has doubled over the past few decades due to rapid urbanization and population growth (Balasubramanian *et al.,* 2007; Seck *et al.,* 2010). For instance, in Sub-Saharan Africa (SSA) total milled rice production increased from 2 million tons in 1961 to 16 million tons in 2009. At the same time, milled rice imports into SSA increased from 0.5 million tons in 1961 to 10 million tons in 2009 due to insufficient domestic production to meet the growing demand (Otsuka and Kijima 2010; Seck *et al.,* 2010).

So far, the increase in paddy production has mainly been due to the expansion of cultivated areas. However, paddy yield in African countries has remained significantly lower than consumption in SSA leading to a heavy reliance on imports which now constitute one-third of all rice traded in the world market (WARDA, 2008). Similarly, FAO (2012) reported that paddy yield in African countries has grown slowly from around 1.5 to 2.5 tons per hectare over a period of 50 years while in Southeast Asia the region's rice production increased by almost 18 percent between 2000 and 2010, or 1.6 percent per year (Headey and Shenggen, 2010).

One of the main reasons for Africa's low productivity is the low level of inputs use (access to fertilizers and improved seeds). Other reasons for low productivity include soil degradation, diverse agro-ecological system and policy distortion against agriculture (World Bank, 2008). Fertilizer use in SSA is 8 kg/ha, compared to 78 kg/ha in Latin America, 96 kg/ha in East and Southeast Asia, and 101 kg/ha in South Asia in 2002 (Morris *et al.*, 2007). Therefore, in responding to low paddy productivity, SSA came out with possible strategies for achieving productivity improvement. These strategies include the adoption of high-yielding modern varieties (HYMVs) and an increase in chemical fertilizer application (Otsuka and Kalirajan, 2005; World Bank, 2008). However, the mentioned strategies did not lead to the desired changes in paddy production due to different reasons such as inadequate investment in agriculture, limited access to credit by smallholder farmers, high cost of inputs and unavailability of inputs such as fertilizers and improved seeds, inadequate use of modern technologies, inefficient agricultural input markets, and the absence of a conducive policy environment (Nobeji *et al.*, 2014).

Generally, low paddy productivity has been identified to contribute to low use of modern inputs (Ricker *et al*, 2011). Similarly, Akadugu *et al.* (2012) reported that increased rates in input use in SSA countries has never been high due to price of these inputs especially, fertilizers which is very high relative to other developing countries.

Tanzania's agriculture like that of other SSA countries is still characterized by low input use. For instance, the country's 2007 Tanzania's Poverty and Human Development Report

(PHDR) revealed that 87 percent of Tanzanian farmers were not using chemical fertilizers; 77 percent were not using improved seeds; 72 percent were not using pesticides, herbicides or insecticides due to high costs of agricultural inputs and services (Salami *et al.*, 2010). Moreover, problems of accessing modern inputs during the Post - Structural Adjustment Programs (Post–SAPs) in many of the SSA countries have been reported by Akramov (2009).

Paddy is the second most important commercial and food crop in Tanzania after maize. The crop is among the major sources of employment, income and food security for Tanzania farming households. Tanzania is the second largest producer of paddy in Southern Africa after Madagascar with production level of 1 104 890 Mt (EUCORD, 2012). However, productivity (kg/ha) is low due to use of low-yielding varieties, low application of fertilizers, drought, low soil fertility and weed infestations. Other causes are prevalence of insect pests, diseases and birds. With a steadily growing demand due to increases in per capita consumption population growth, the total area under rice cultivation has also increased substantially (EUCORD, 2012). About 71 % of the rice grown in Tanzania is produced under rain fed conditions; irrigated land presents 29 % of the total with most of it in small village level traditional irrigation schemes.

As a consequence of the above, the average yield is very low, 1-1.5 t per ha (RLDS, 2009). Around 90% of Tanzania's rice production is done by smallholders and production is concentrated in Mbeya, Morogoro, Shinyanga and Mwanza regions. The situation of paddy yield in Tanzania is stagnant while arable land per agricultural population is declining due to rapid population growth (URT, 2009; FAO, 2012).

Kilombero District is the largest paddy producing district in Morogoro Region. It has high potential for paddy production and more than 80% of the income of the people is obtained from selling paddy or rice (Kato, 2007). However, yields are low on average about 2 t/ha mostly due to dependence on rain-fed agriculture, low use of agricultural inputs such as fertilizer, poor farm inputs use for example hand hoe and use of traditional seeds (Milder *et al.*, 2013). Therefore, this study was conducted to determine Kilombero District's farming households' paddy productivity in relation to their use of inputs.

1.2 Problem Statement

Despite various initiatives taken by the Tanzanian government through the Ministry of Agriculture, Food Security and Cooperatives (MAFC) for example, '*siasa ni kilimo*' (politics is agriculture - 1972), '*kilimo cha umwagiliaji*' (irrigated farming - 1974), '*kilimo cha kufa na kupona*' (agriculture for life and death - 1974/5) and '*mvua za kwanza ni za kupanda*' (first rains are for planting - 1974), the current '*kilimo kwanza*' (Agriculture First Initiative) and 'The National Agricultural Input Voucher Scheme (NAIVS) which promote use of inputs through government subsidies especially in fertilizers for the purpose of increasing productivity, low inputs use in paddy production is persistent.

According to Pan and Christianensen (2011), only 5.7% of paddy farmers use improved seed varieties together with fertilizer in Tanzania. Currently, the level of use of fertilizers in Tanzania is 9kg/ha in cereal crops production, paddy included while Malawi uses 27 kg/ha and South Africa uses 53 kg/ha. The average fertilizer usage per hectare in other regions is 41kg in Latin America, Asia is 85kg and Europe is 225 kg (URT, 2010). Similarly, according to the National Sample Census of Agriculture 2007/08, the reasons for low input use by the smallholder farmers are high prices, lack of purchasing power, insufficient knowledge of the effects of inputs and how to use them (NBS *et al.*, 2009).

According to RLDS (2009) apart from the above mentioned issues, most of the paddy farmers lack information on the improved seeds hence, stick to traditionally preferred varieties which are not economically efficient. However, they have prominent aromatic and palatability characteristics but they are low yielding varieties. Due to this constraint/scenario of low input access smallholder farmers productivity is low (Gadizirayi *et al.*, 2006). Several studies have been done such as that by Mpuya (2010) which focused on adoption of inputs in maize and Dulle and Ngalapa (2014) which focused on assessment of paddy farmers information needs. Nonetheless, there is little documentation on access to inputs by smallholder paddy farmers. Therefore, the study aimed at assessing Kilombero District's paddy producers' access to inputs and how this relates to paddy productivity.

1.3 Justification for the Study

The Tanzanian government over the years has taken different initiatives to promote growth in the Agriculture sector; this has mainly been through formulation of policies such as the 1997 Agriculture and Livestock Policy and Tanzania's 2013 Agricultural Policy. In addition, Tanzania has various programmes such as the Agriculture Sector Development Plan (ASDP) and the National Agricultural Input Voucher Scheme (NAIVS) all aiming at raising agricultural productivity in the country. However, paddy productivity in Tanzania remains low currently the national average yield for paddy rice (unmilled) is at 3.36 tonnes/ha, which is low relative to India (3.66 tonnes/ha), China Mainland (6.73 tonnes/ha) and the world average of 4.53 tonnes/ ha (FAO, 2014). Therefore, the findings of this study could inform the academia on the relationship that exists between use of inputs and productivity. Furthermore, the findings would be more useful to policy markers on strategies to put forward to enhance adoption of technologies especially to small-holder farmers.

In general, this study is in line with Tanzania's National Rice Development Strategy (NRDS) of 2010 which is to double paddy productivity by the year 2018 from 1.3 to 3.8 tons per ha. In addition, Tanzanian's *Kilimo Kwanza* initiative aims at enhancing use of critical inputs to increase agricultural productivity, The National Strategy for Growth and Reduction of Poverty (NSGRP I and II) which aimed at promoting growth in the agricultural sector to enhance increase in production and improvement of rural livelihoods. The 2003 Abuja declaration with resolutions to increase timely access and raise fertilizer use by farmers to an average of 50 kg/ha by 2015, the Comprehensive African Agriculture Development Program (CAADP) of 2003 which focuses on improving and promoting agriculture across Africa for the purpose of eliminating hunger and reducing poverty and the Malabo Declaration of 2014 which focus on accelerating Agricultural Growth (focusing on Inputs, irrigation, mechanization) and Transformation for Shared Prosperity and Improved Livelihoods. Furthermore, the government has selected Morogoro region to be one of the country's national basket (Mur and Nederlof, 2012).

1.3.1 Research objectives

1.3.2 General objective

The general objective of this study was to determine Kilombero District's farming households' paddy productivity in relation to their access or use of inputs.

1.3.3 Specific objectives

i. To identify agricultural inputs used by paddy producing households
ii. To determine social-economic factors influencing paddy producing households' use of agricultural inputs.

iii. To compare paddy productivity between households using agricultural inputs and those not.

iv. To identify agricultural input access challenges encountered by smallholder paddy producers.

1.4 Research Questions and Hypothesis

Both research questions and hypothesis were used in the study to shape and focus the purpose of the study and for capturing qualitative and quantitative information (Creswell, 1994).

1.4.1 Research questions

i. Which agricultural inputs do smallholder producers use in their paddy production?

ii. What challenges do smallholder paddy producers face in accessing agricultural inputs?

iii. What socio- economic factors are associated with a household's use of modern agricultural inputs in paddy production?

1.4.2 Null hypothesis (H_0)

i. Paddy productivity does not differ between households using inorganic fertilizers and non users.

ii. Paddy productivity does not differ between households using improved seeds and non users.

iii. Paddy productivity does not differ between households using herbicides and non users.

iv. Paddy productivity does not differ between households using pesticides and non users.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Conceptualization of Key Terms/Concepts

2.1.1 Productivity

Productivity is generally defined as a ratio of a volume measure of output to a volume measure of input use (OECD, 2001). Yield, which is commonly expressed in tonnes per hectare (t/ha) is the most frequent measure of agricultural productivity and is defined as amount of agricultural output per unit of land used in production (Wiebe *et al.,* 2001). Productivity in this study is based on total factor (multifactor) productivity (TFP) which refers to measure of outputs to a bundle of inputs used in the production process such as fertilizers, herbicides, pesticides and improved seeds. In the case of agricultural productivity, it is the quantity (value) of agricultural output per unit quantity (value) of input(s) used in production such as fertilizer application, pesticides, herbicides and improved seeds (OECD, 2001).

2.1.2 Inputs use and productivity

An input is defined as any scarce resource used in production of goods and services. Mushtaq *et al.* (2007) classified inputs into; conventional such as land, labour, capital and management; physical such as fertilizer and pesticides; biological such as seeds and irrigation water; environment such as soil, rainfall and temperature. There is huge evidence suggesting that worldwide increased productivity in agriculture has been accounted for by input use such as; fertilizers, herbicides, pesticides and improved seeds (FAO, 2006). On the other hand, Morris *et al.* (2007) argue that, the substantial differences in agricultural productivity and yields seen between Asia and Africa can largely be explained by differences in modern input use. Gomez – Limon *et al.* (2004) point out that, output growth can be attained through expansion in farmed area, intensification of production and improvement in input use efficiency. The constraints imposed on agricultural development by an inelastic supply of land have been offset by the development of high yielding crop varieties designed to facilitate the substitution of fertilizer for land (Dalton *et al.,* 1997).

2.1.3 Agricultural inputs

Agricultural inputs refer to a range of materials, which may be used to enhance agricultural productivity. The most important agricultural inputs include fertilizers, herbicides, pesticides and improved seeds. The use of agricultural inputs is fundamental in modern agriculture. In 2002-2003 SSA farmers used on average 9 kg of fertilizers per ha of arable land compared to 100 kg per ha in South Asia, 135 in Southeast Asia and 73 in Latin America (Crawford *et al.,* 2006). While agricultural production and productivity soared in Asia and Latin America between 1960 and 2000, they have largely stagnated in Africa (Crawford *et al*., 2006). As a consequence, new subsidy programs began to emerge in several African countries. The Malawian government pioneered the return to large scale subsidies in 1998, when it began distributing free fertilizer to farmers (Banful, 2010).

2.2 Factors that Influence Farmer's Use of Improved Inputs

Langyintuo and Mekuria (2005) broadly categorize the factors associated with farmer's use of improved inputs as: farmer characteristics and institutional factors. Farmer characteristics among others include; gender, age, education, and household size while institutional factors include farm size, membership to an association, access to information, access to credit, and access to infrastructure such as roads or storage.

2.2.1 Farmer characteristics and use of improved agricultural inputs

2.2.1.1 Gender and use of agricultural inputs

Gender plays an important role in farmer's use of agricultural technologies such as improved seeds or fertilizers in production. Langyintuo and Mekuria (2005) urge for inclusion of gender in analysis of adoption studies by arguing that extension services provision which is important in use of improved inputs is mainly conducted by men who are biased towards fellow men yet women are dominant in African agriculture. In-depth studies indicate that, if women farmers had the same access as men to improved agricultural inputs, such as fertilizer and seed, maize yields would increase by as much as 16% in Malawi, 17% in Ghana, and 19% in western Kenya (World Bank, 2012).

2.2.1.2 Age and use of agricultural inputs

According to Pangani (2007) younger and energetic farmers have proved to be active and ready to try new innovations. The above is supported by Adesina and Baido-Forson, (1995) who reported a positive relationship between age and adoption of new sorghum and rice varieties in Burkina Faso and Guinea respectively. Kassie *et al.* (2010) have also reported a negative relationship between age and use of compost manure and stubble tillage technologies in Ethiopia. In Nigeria, Akramov (2009), Lawal and Oluyole (2008), and Tabi *et al.* (2010) have also reported a negative relationship between age and improved inputs use. Explanations offered for the above results regarding age and improved inputs use are that on the one hand, young farmers may have lower incomes and wealth, limited access to credit and extension services, and face labour constraints, all of which may make them less prepared to adopt and use improved agricultural technologies than older farmers (Langyintuo and Mekuria, 2005). On the other hand, young farmers are sometimes thought to be more open to change and hence eager to try out new ways of doing things thus, a negative relationship between age and improved inputs use (Tabi *et al.*, 2010).

2.2.1.3 Education and use of agricultural inputs

Farmers' education background is a potential factor in determining the readiness to accept and use an innovation. Educated farmers are believed to have higher ability to perceive, interpret and respond to new information about improved technologies than their peers with little or no education (Langyintuo and Mekuria, 2005; Tabi *et al.,* 2010). Thus, more educated farmers are more likely to access information and advice from extension workers, which influence their adoption and use of improved inputs. Moreover, education and the economic status of the farmer, which affects ability to buy and use of production inputs, are to a great extent positively correlated especially in developing countries including Uganda (UBoS, 2010).

In Tanzania, most farmers have low formal education and rely on traditional farming practices. The more complex the technology to be utilized the more likely it is that education will play a major role (CIMMYT, 1993). Education makes a farmer more enlightened and receptive to advice from extension workers or more able to deal with technical recommendations that require a certain level of literacy. The issue of education is therefore far more critical especially when dealing with smallholder farmers.

2.2.1.4 Household size and use of agricultural inputs

Household size may have a positive or negative influence on adoption of technologies. For labour intensive technologies family size positively influences adoption (CIMMTY, 1993). This is because for smallholder farmers, household labour is the most dependable source of labour. Consequently, households with more labour supply are expected to adopt labour intensive technologies. Similarly, Croppenstedt *et al.* (2003) argue that larger households have a larger pool of labour and as a result, they are more likely to adopt agricultural technologies than smaller households.

Some studies (Akinola, 1987; Igodan *et al.*, 1988), have reported a negative relationship between a household's size and use of improved inputs other studies (Perz, 2003; Tabi *et al.*, 2010) have nonetheless reported a positive relationship. The explanation offered for the negative relationship is that farmers with large households especially in rural areas are very poor and the limited financial resources are mostly spent on basic needs, leaving little or nothing for purchase of farm inputs. On the other hand, a large household may encourage adoption of improved inputs such as fertilizer and pesticides whose application is labour-intensive (Perz, 2003).

2.2.1.5 Income and use of agricultural inputs

A household's level of income determines to a large extent whether a particular innovation can be utilized or not. According to CIMMYT (1993), wealthier farmers may be the first to try a new technology especially if it involves purchased inputs. This is because wealthier farmers are more able to take risk or use their own cash resource to experiment with a new technology. Empirical evidence (Bradshaw, 2007) shows that a farmer's income has a positive relationship with the uptake of farming technologies since any adoption/adaptation process requires a farmer to have sufficient financial well-being. Most of the times it is farmers with more resources in terms of capital land and labour that are to take advantage of new technologies and practices. The extension system also tends to favour certain categories of farmers. According to Wambura (2004), young, richer and better educated farmers had higher extension contacts than poorer older and less educated farmers. According to CIMMYT (1993) many farmers who do not utilize technologies may complain of lack of cash as the principal factor limiting their utilization. Similarly, Gregory and Sewando (2013) reported that, nonfarm income is hypothesized to compensate for any additional financial resources that are associated with new technologies. Moreover, nonfarm income may encourage or discourage investment in new technologies. Smallholder farmers in Tanzania are also constrained by lack of cash due to very limited income resulting from low production. In such a situation poor farmers are normally left out for not being able to adopt new innovations.

2.2.2 Institutional factors

The effect of institutional factors (i.e. farm size, access to credit, access to information, access to infrastructure and membership to farmer's association) on farmers' use of improved inputs has received great attention in the literature as detailed in the sub-sections below.

2.2.2.1 Labour requirements

Some new technologies are relatively labour saving and others are labour using. For those labour-using technologies like improved varieties of seeds and fertilizer, labour availability plays a significant role in adoption. For example, Green and Ng'ong'ola (1993) found regular labour to be an important factor that positively influences adoption of fertilizers in Malawi. Therefore, any efforts to introduce new technologies needs to take into consideration the issue of labour requirement.

2.2.2.2 Availability of market

Market access plays an increasingly important role in determining the level of adoption. Available market for agricultural produce means opportunity to sell farmer's produce at an attractive price and this will increase adoption of agricultural technologies. Recent studies have shown that improvement in market access increases agricultural productivity, firstly by facilitating specialization and exchange transactions in rural areas, and secondly, through intensification of input use. According to Barret (2008), market availability leads to market-oriented production where the household specializes in the production of those goods for which it holds a comparative advantage. This could result in a more rapid productivity growth due to large scale production and increased technological change combined with welfare gains derived from trade. Furthermore, the distance and time required for the farmer to travel are important circumstances that determine the facility with which a farmer can obtain agricultural inputs, sell farm products and receive technical assistance (CIMMYT, 1993).

2.2.2.3 Access to credit

Access to credit may affect farm productivity because farmers facing binding capital constraints would tend to use lower levels of inputs in their production activities compared to those not constrained (Petrick, 2004). It is expected that access to credit will facilitate use of inputs purchased outside the farm, such as improved seeds (Kauzeni, 1988). Improved agricultural technologies are usually released as a package and farmers have to follow the researchers' recommendations on seed, fertilizer, herbicides and pesticides application.

The role of credit in financing farmer investments in improved technologies such as high yielding seeds, fertilizer and machinery particularly in developing countries where smallholder farmers are generally financially constrained cannot be overstated. Constraints to credit access have been identified among the barriers to adoption and use of improved agricultural inputs in developing countries (Feder *et al.,* 1985). Improved access to credit may therefore facilitate optimal input use and have a major impact on productivity. Thus, access to credit allows farmers to satisfy their cash needs induced by the agricultural production cycle and consumption requirements.

2.2.2.4 Availability of extension agents and use of agricultural inputs

Agricultural Extension agents are primarily concerned with the transmission of improved agricultural technologies to farmers who are the end users of all findings emanating from agriculture related researches as well as taking their problems to appropriate research or government agencies for solution (Erie, 2009).

Extension agents are some of the most important sources of agricultural information in any country. Farmer access to information on agricultural technologies through increased government investment in extension services is crucial in revealing the opportunities of using such technologies, thereby reducing the subjective uncertainty on one hand and fostering increased adoption on the other (Strauss *et al.,* 1991; Langyintuo and Mekuria, 2005).

2.2.2.5 Agricultural extension services

Agricultural extension services have been defined as the communication of improved skills, practices, innovations, technologies and knowledge to farmers (Ani, 2009). This implies that extension services help people, particularly farmers, by educating them about and promoting farming practices and techniques that will increase their production and make it more efficient. According to Pangan (2007) agricultural extension officers help farmers increase productivity of their farms and improve their living standards. These officers have many roles as advisers, technicians and middlemen operating between agricultural research institutions and farm families. They help farmers identify their problems and find their own solutions. Moreover, Ozowa (1997) found that, of all the existing channels of agricultural communication, Nigerian farmers rank extension services the highest in terms of providing credible information and advice, especially on agricultural technology. Another study by Daudu (2009) revealed that in Nigeria extension services are still the most preferred sources of agricultural information available. In Tanzania, extension services are the primary means by which the government channels information to farmers in an effort to increase agricultural production (Wambura, 2004). However, nowadays Non Government Organizations also provide extension services to farmers.

A study by Aina (2006) revealed that, the ratio of extension workers to farmers in Africa is low. Thus, many farmers are not supplied with information by extension workers in Africa. Studies also conducted in Tanzania by Salami *et al.* (2010) revealed that farmer's involvement in extension activities was low to the extent that, 60.7% had never attended extension meetings, 59.7% had never participated in field days, 49.4% had never been visited by an extension worker and 71% had never read extension pamphlets or bulletins. A study conducted in Zambia by Kalusopa (2005) revealed that, the most important sources of information for small scale farmers are NGOs, information centres and to so a lesser extent government extension services. This implies that farmer's seldomly use extension services as a source of agricultural information in solving their day to day agricultural problems.

2.2.2.6 Infrastructures and use of agricultural inputs

Availability of transportation infrastructure is one of the important factors that can motivate a farmer to adopt agricultural technologies. It is widely agreed that agricultural development requires good infrastructure (Kauzeni, 1988). Infrastructures such as roads, storage and irrigation are critical in agricultural production process. Roads are important in access to input and output markets while storage is important for storage to maintain the quality of crops and to postpone immediate sale to a future date. Some studies (Ransom *et al.*, 2003) show that availability and access to these infrastructures increases the likelihood of use of improved technologies. For example in Bangladesh, improved rural infrastructure tremendously increased the intensity of use of modern agricultural technologies such as irrigation, high yielding varieties and fertilizer in villages with developed infrastructure than in underdeveloped villages (Ahmed and Hossain, 1990).

2.3 Types of agricultural inputs

2.3.1 Fertilizer

The term fertilizers relates to inorganic manufactured products that supply plant nutrients. Before the introduction of mineral fertilizers in the 19^{th} century, soil fertility was maintained mostly by recycling of organic materials and crop rotations that included nitrogen-fixing leguminous crops (FAO, 2006). Fertilizer is a very important input for intensive rice production. Common fertilizers used particularly in paddy fields range from organic to inorganic. Organic fertilizers are farm yard manure and compost which are found locally and not very widely used. Fertilizer is very important input for intensive rice production Common fertilizers used particularly in paddy fields range from organic to inorganic.

Phosphate and Nitrogen nutrients are the most important nutrients in rice production. Nitrogen (N) is the most limiting nutrient in relation to rice production. Therefore, increased nitrogen use efficiency will translate into yield increase (Mustapha, 2004). The amount of nitrogen to be applied for rice is dependent upon a number of factors, such as likely losses of N through leaching, immobilization, mineralization and denitrification, plant characteristics (tillering potential, leaf area index, resistance to lodging and length of growing cycle), management practices (dry land/irrigated systems, sowing/planting density, pest and diseases and weed control (Mustapha, 2004).

2.3.2 Improved seeds

Seeds are among the most important agricultural inputs which contribute to agricultural productivity. Paddy is among the few crops that have an enormous number of improved varieties developed and released by national research institutions. Tanzania has traditionally grown local varieties of rice which have descended from the seeds originally imported by Arab traders before 1960 (RLDS, 2009). These varieties include *Supa, 'Behenge,'' Kula na bwana,'' Kalamata'* and many others which are well adapted to the climate and the taste preference of Tanzanians (EUCORD, 2012). However, these varieties are relatively low yielding, averaging 1 – 1.5 tons per acre (Tulole, 2011).

Generally, many efforts have been put in place to make sure farmers use the recommended varieties which are economically viable. Such varieties include, TXD 306 and NERICA (New Rice For Africa). NERICA is an upland rice variety which is a result of the Asiatic type of rice, *Oryza sativa*, and the African rice, *O. glaberrima.* As reported by Mghase *et al.* (2010), NERICA combines the high yield potential, responsiveness to improved and short stature for lodging resistance from *sativa* and the resistance to diseases, and drought resistance has potential for high yield, matures early 30 – 50 days earlier than the other upland varieties and is resistant to common environmental stresses of upland rice such as low moisture stress.

TXD 306 on the other hand has recently been released and is in high demand from farmers. According to Tulole (2011) the good attributes of TXD 306 rice include; early maturing, production of many tillers, resistance to water lodging and high yield. In Kilombero District the recommended rice variety is TXD 306 (RLDS, 2009).

2.3.3 Pesticides and herbicides

Herbicides use by farmers help them to control weed, minimizes tillage and releases farmers from hours of back-breaking labour (Bray, 1986). Weeds are the most important biological barriers in rice production in a way that a noticeable part of the production costs are allocated to them and are among the most important inhibiting factors with regards to increasing rice production. Looses caused by weeds exceed the losses from any category of agricultural pests (Rao, 2000). Unsuccessful weed control can result in almost total loss of paddy yield. For instance on-farm trials of weed management using herbicides and fungicides in Kenya showed that their use resulted in higher yield of maize and beans compared to hand-hoe weeding (Muthamia *et al.,* 2001). An example of the herbicides used in paddy production is *round up* which kills all broad-leaves weeds.

Pesticides are natural or synthetic agents that are widely used in agricultural production to prevent or control pests, diseases and other plant pathogens in an effort to reduce or eliminate yield losses and maintain high produce quality. According to Rao (2000) pests are major threats to increased agricultural production and to the health and well - being of human being. The need to reduce and if possible eliminate altogether the ravages of the pests is very important. Examples of pesticides used in paddy production are *2-4D* and *karate* which used to kill aphids.

2.4 Paddy Production in Tanzania

Tanzania is the second largest paddy producer in Eastern, Southern and Central Africa and rice is the second most important food crop, after maize, and most of the rice consumed is produced in the alluvial lowlands, coastal plains, along bottom valleys of mountains, and land depressions as well as along river-valley basins within the country. It is estimated that over 400 000 hectares are under rice cultivation in various parts of the country (Minot, 2010). Nearly half of the country's rice production is concentrated in the regions of Morogoro, Shinyanga, Tabora, Mwanza and Mbeya (Fig. 1). The first four rice producing regions are located in the northern part of the country and the fifth is located in the south. Rice is mainly grown by small-scale farmers who typically cultivate 1 to 5 acres while small-scale irrigation farmers grow about 2 to 2.5 ha in irrigation schemes often initiated and controlled by the government (Minot, 2010; USAID/COMPETE, 2010).

Large-scale commercial rice production is limited to few private farms which emerged following the privatization of the National Agricultural and Food Corporation (NAFCO). To date, there are three large-scale rice irrigation schemes in Mbarali District, namely, Madibira 3 000 ha, Kapunga 3 000 ha and Mbarali 3 200 ha, and a few others in Kilombero and Mtibwa (USAID/COMPETE, 2010).

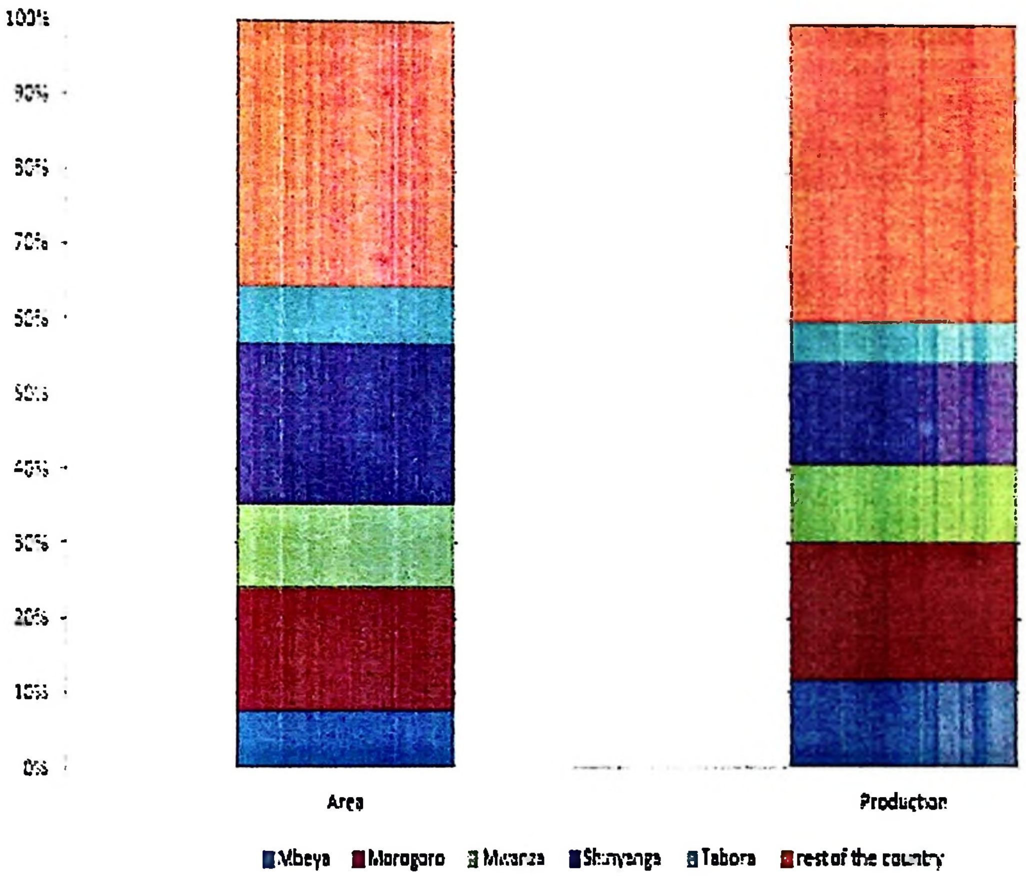

Figure 1: Distribution of paddy production and area by region for the period 2005-2010

Source: Ministry of Agriculture, Food Security and Cooperatives (MAFSC)

2.5 Constraints Encountered by Paddy Producers in Tanzania

2.5.1 Occurrence of insect pests and diseases

Pests and diseases are among the major factors that contribute enormously to reducing crop yields and post harvest crop losses. In Tanzania, estimates show that insects contribute about 30 – 40% of total harvest crop losses (Milder and Buck, 2013). As a consequence of high prevalence of pests farmers spend large sums of money to protect crops from damage. The extensive damage by pests and diseases to food crops implies that self-sufficiency in food production cannot be achieved solely by increasing production. In order for the potential yield to be achieved, prevention or reduction of crop damage and losses due to pests and diseases is mandatory.

2.5.2 Lack of extension services

According to URT (2011) the general purpose of agricultural service delivery is to improve the productivity of agricultural system, to raise incomes of the families and improve the quality of life of farm households. Mpuya (2008) in his study of input use efficiency for maize production in Iringa observed that most extension officers visit farmers during planting and harvesting season for the purpose of collecting data on acreage of different crops grown crop yields. Productivity improvements are possible only if farmers adopt technologies. The adoption can be influenced by educating farmers about improved varieties, cropping techniques, optimal input use, prices and market conditions, more efficient methods of production management, storage and nutrition (Akadugu *et al.*, 2012). To do so, extension agents must be able to visit farmers frequently in order to understand an often complex situation, identify problems and come up with appropriate solutions which will improve productivity and farmer's general well- being.

2.5.3 Lack of support from the private sector

Farmers are not credit worth and most of the productive areas are far distant from the service providers. With respect to financial service, the SACCOS established by farmers are the major sources of the financial services although most are faced with the structural problems and operational hick ups. However, participation of financial private sector is noted in rice milling, supply of agro-inputs (fertilizers, pesticides) and trading. Participation of financial private sector in production is only manifested in large scale rice production farms at Mbarali and Kapunga in Mbeya Region (RLDS, 2009).

2.5.4 Limited number of improved paddy varieties

Availability of adequate varieties having tolerance to drought, cold weather, major insect pests and diseases are major challenges facing paddy farming in Tanzania. There are hundreds of local/traditional rice varieties grown by farmers in the rain-fed lowland, irrigated lowland and upland ecosystems. According to RLDS, (2009) most of these varieties are low yielding, late maturing and are prone to lodging when improved management practices such as application of fertilizers are used. Improved seeds have been applied by only 10 percent of farmers. The use of self-saving seeds is common among small scale paddy farmers in Kilombero District and these seeds are of low quality.

2.6 Theoretical Framework

The current study is related to the Technology Diffusion Theory based on farmers' decision to adopt new technologies (Isham, 2002). Adoption means that a person does something differently than what they had previously (i.e., purchase or use a new product, acquire and perform a new behaviour, etc.). This theory is used to accelerate the adoption of important practices that typically aim to change the farming behavior of farmers for the purpose of increasing productivity. However this theory doesn't take into account an individual's resources or social support to adopt the new behavior (or innovation). The theory further postulates that farmers with more education and larger land will have more knowledge of improved farming systems and are likely to adopt technologies more rapidly. According to Doss and Morris (2001) factors influencing adoption of technologies include; farm size, income, labour availability, access to financial institutions, and access to information. Others are social capital, household characteristics, type and price of inputs, extension services, infrastructure, soil characteristics and rainfall distribution. Therefore, promoting accessibility to agricultural inputs contributes to increased production, leading to human economic growth, eradication of hunger, reduction of poverty and a nation's economic growth.

- **Conceptual framework**

The conceptual framework on which the study was based is shown in Fig. 2. Generally, inputs access by farmers is influenced by different factors such as information access, availability of agro-dealers, markets and organizational factors. For example, presence of extension services can influence easy access to information on existence of agricultural inputs to farmers, the more contact a farmer has with the extension services, the more will be the information/knowledge s/he has thus, the possibility of using agricultural inputs (Haji, 2003). In addition, personal factors such as age, gender, marital status and education may influence access and use of agricultural inputs for example; Adeogun *et al.* (2010) argue that, younger farmers could most likely be willing to spend more time to obtain information on improved technologies compared to older farmers. Situational factors such as infrastructure and distance to the nearest input center can influence farmer's access of inputs. Generally, shorter distances will mean that farmers can easily access improved technologies as for longer distance the converse is true. Other income generation activities and access to credit can provide money for the farmer to purchase agricultural inputs.

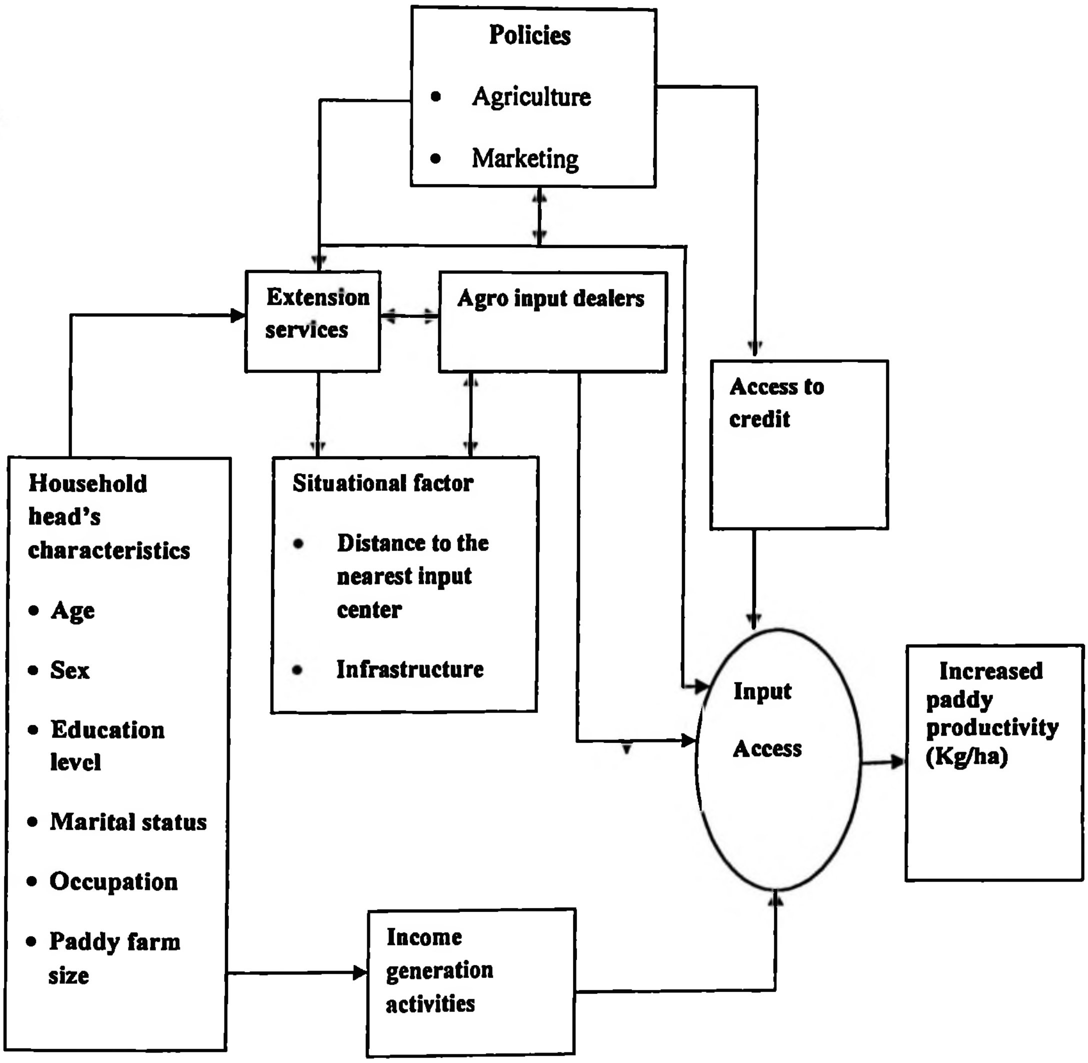

Figure 2: Conceptual Framework for farming households input access and paddy productivity

CHAPTER THREE

3.0 METHODOLOGY

3.1 Description of the Study Area

3.1.1 Geographical location

Kilombero District is among Morogoro Region's six districts, located in Southwest of Morogoro region. The district lies between Latitudes 8^{O} and 9^{O} south of the Equator and Longitudes 30^{O} and 36^{O} East of the Greenwich Meridian. The District extends to the south-west of Morogoro Region. To the north-east it borders Morogoro District and Kilosa District, respectively. To the North West it borders Mufindi (Iringa Region) and Njombe Region, while to the south–east extremes it shares borders with Songea District (Ruvuma Region) and Ulanga Districts (Morogoro Region).

3.1.2 Climate and soils

The district has high temperatures (hot weather condition) and has bimodal rainfall patterns. Short rains begin towards the end of November and ends in January or February. Long rains usually start in March and end in May or June. The average temperature in the District ranges from 26° to 32°C. The average rainfall ranges from 1,200 to 1,600 mm. Kilombero experiences seasonal flooding which causes some parts of the district to be inaccessible during the long rain season. The soil type is characterized by alluvial lowlands covered mostly by heavy clays as a result of periodical/permanent flooding.

3.1.3 Population and economic activities

According to Tanzanian's 2012 Population and Housing Census, Kilombero district has a total of 407 880 people whereby 202 789 were male and 205 091 were female. The main occupation of the people in Kilombero District is agriculture. About 80% of the population are engaged in Agricultural production, predominantly at the subsistence level. However, in recent years agricultural production has transformed to be more commercial. Rice and maize are the main food crops while sugarcane, simsim, sunflower and cocoa are grown for commercial purposes. Livestock keeping is another economic activity and most livestock keepers are pastoralists and agro-pastoralists. Fishing is also regarded as an economic activity even though not yet utilized to its full potential. Normally, fishing is undertaken along the Kilombero River and in small swamps found in the Kilombero valley.

3.1.4 Justification for choosing Kilombero District as the study area

The study was purposively conducted in Kilombero district based on two important criteria. Kilombero district has a high potential for paddy production and more than 80% of the income of the people in Kilombero district is obtained from selling paddy or rice (Kato, 2007). According to Kato (2007) paddy production is more pronounced in Kilombero district compared to other districts in Morogoro region (Kato, 2007).

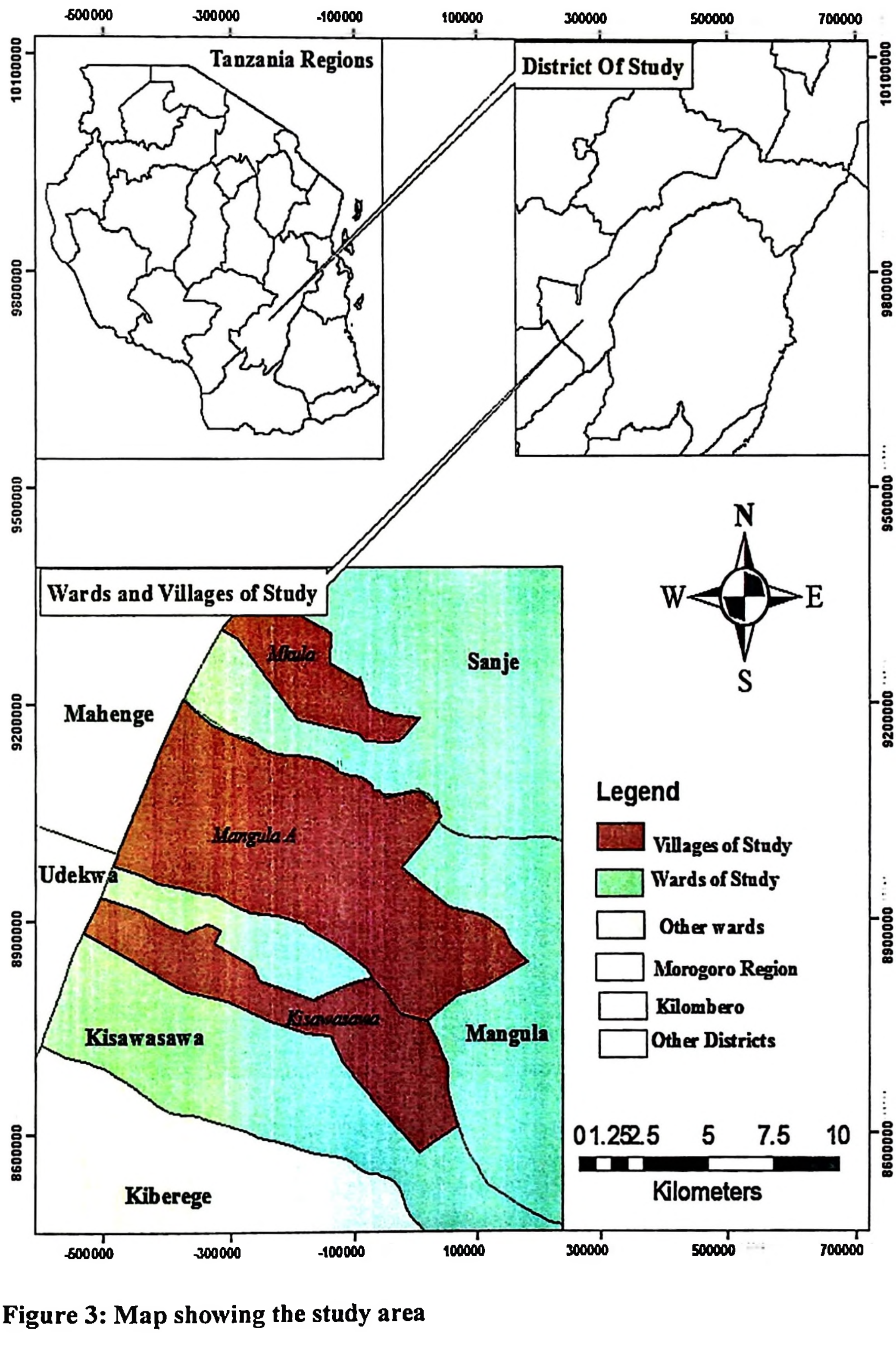

Figure 3: Map showing the study area

3.2 Research Design

According to Hox and Boeije (2005) a research design can be thought of as the *logic* or *master plan* of a research that throws light on how the study is to be conducted. The present study adopted a cross-sectional research design whereby data were collected at a single point in time (Bob and Liz, 2010). The design was thought to be suitable for the current study because it allows the identification of the population of interest. Moreover, it is suitable where time and resources are limited and offers quick results with low costs (Agrest and Finlay, 1999). The method can also be used for a descriptive study as well as for determination of relationships between variables (IDRC, 2003).

3.3 Population of the Study

Population refers to an aggregate of people or things that a researcher has in mind from which one can obtain information and draw conclusions (Fraenkel and Wallen, 2000). The population for the present study was all the smallholder paddy producers in Kilombero district.

3.4 Sample Size and Sampling technique

3.4.1 Sample size

A total of 120 respondents from 3 selected villages from each 40 respondents were randomly selected to engage in the interview. In addition to the above, 7 key informants were selected of which 3 were extension workers, 1 ward executive officer and 3 village chairpersons were interviewed. These were selected to compliment and to offer clarification on information collected from respondents. In addition, three focus group discussions involving 18 individuals 6 per FGDs were conducted. Therefore, the total number of individuals involved in the study was 145.

3.4.2 Sampling procedure/technique

The present study employed a multi-stage sampling to select 3 wards out of the 35 wards producing paddy in the study area. The use of the multi-stage sampling technique was paramount for this study because it allows the use of multiple sampling techniques within the single study. In order to obtain representative village's random sampling technique was employed to select 1 village from each ward to get the total of 3 villages of Mang'ula A, Kisawasawa and Mkula.

3.4.3 Sampling unit

The sampling unit for the study was households involved in paddy production whereby the household head of selected household was interviewed.

3.5 Data Collection

The present study employed both qualitative and quantitative data collection methods. The use of multiple methods of data collection within a single study simultaneous broadens and strengthens the study.

3.5.1 Primary data

According to Hox and Boeije (2005), primary data refers to data collected for a specific research problem at hand, using procedures that fit the research problem at hand. In the present study primary data were gathered using a semi - structured questionnaire with both open and close ended questions (Appendix I). Focus Group Discussions (FGD) with the use of designed interview guide were used to obtain qualitative information to supplement the primary data obtained through questionnaire. A total number of 3 FGDs were conducted comprised a group of 6 farmers who were purposively selected for the discussion. Hox and Boeije (2005) recommend the membership of an ideal focus group to range from six to twelve subjects. The study used an FGD guide (Appendix II) to guide the discussion with the farmers. The aim of using FGDs was to confirm the general information provided in the individual interviews.

Moreover, key informant interviews were also used as a method of collecting primary data. The purpose of key informant interviews was to collect information from a range of people including local leaders, professionals and government officials who had first-hand knowledge about paddy production. These community experts, with their particular knowledge and understanding were seemed indispensable to provide insight on the nature of problems and give recommendations for solutions. The key informant interview was conducted using an in-depth interview guide (Appendix 3).

3.5.2 Secondary data

Secondary data are data originally collected for different purpose and re – used for another research question (Hox and Boeije, 2005). The present study used secondary data to supplement the primary data, this included data on use of inputs, land size under paddy production and paddy productivity which were obtained from Kilombero district agriculture office. The use of secondary data is of advantage as in addition to being of a lower cost and it provides faster access to relevant information that complements primary data (Hox and Boeije, 2005).

3.6 Data Processing and Analysis

Data collected from the field were summarized, coded and analyzed using Statistical Package for Social Science (SPSS) computer software (version 16). Both descriptive and inferential statistics were used to analyze the collected data before interpretation and presentation of the results.

3.6.1 Descriptive statistics

Descriptive statistics such as frequency and percentage were determined in relation to objective number 1 and 4 and on socio-economic characteristics of the respondents.

3.6.2 Inferential statistics

To compare paddy productivity between input user and non users an independent samples t-test was employed to measure the mean score difference between the two groups. Independent-samples t-test is used to compare the mean score, on some continuous variable for two different groups of subjects (Pallant, 2002). An independent sample t-test was required for research objective 3 whose dependent variable was categorical (1=input user 2=non input user) and independent variable which was continuous (i.e. paddy productivity measured by production per unit of land).

In addition to the above, a binary logistic regression model was used in objective two to determine the socio-economic factors influencing farmers' use of agricultural inputs (fertilizers, pesticides, herbicides and improved seeds) in the study area. The logistic regression model was chosen out of range of alternative regression models such as probit only because it accepts a mixture of continuous and categorical independent variables and the dependent variable must be categorical (0=non input user, 1=input user).

The likelihood of a farmer using agricultural inputs (fertilizers, herbicides, pesticides and improved seeds) is predicted using the following binary logistic model:-

$$Lg\,(P/1\text{-}P) = \beta_o + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \ldots\ldots\ldots\ldots\ldots\ldots \beta_n x_n + \varepsilon i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where P=Decision for farmers to use agricultural input

1-P= Decision for farmers not to use agricultural inputs

X^1-X^8= Explanatory socio-economic predictor variables

X^1= Age of head of household

X^2= Sex of head of household

X^3= Marital status of the household head

X^4= Education qualification of household head

X^5= Income (Estimation of household's income)

X^6= Household size

X^7= Farm size (Number of acres cultivated)

X^8= Distance in kilometres from agro – inputs centres to farm

X^9= Land ownership

X^{10} = Availability of extension officer

X^{11} = Access to credits

X^{12} = Group membership

X^{13} = Other economic activities (petty trade, livestock keeping, wage employment and carpentry)

3.7 Study Limitations

This study encountered some limitations during its undertaking. These include unwillingness of the farmers to be interviewed without payment. Data collection was done during the period of local government elections (October, 2014) hence, most of the respondents were busy in attending campaigns and election of their hamlets leaders, this made their access difficult. In addition, a few of the respondents were not willing to respond to some questions for fear that there could be a hidden agenda. These problems were resolved by following them during evening time after election activities and also through discussion and educating the respondents and their leaders on the purpose of the study.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Socio-demographic Characteristics of Respondents

Socio-demographic characteristics that were taken into account were: age, sex, marital status, education level, and household size. These characteristics were considered important generally because they have been reported in literature (Adam *et al.*, 2013; Ayoola *et al.*, 2011) to have a certain influence on adoption of agricultural technologies.

4.1.1 Age of the Household Head and Adoption of technologies

According to the study findings (Table 1) the age of household heads ranged between 20 and 71 years with the average being of 40.2. Household head's age is often considered to be a determinant of adoption of new technologies (Perz, 2003). An individual's, age has some influence on individual's preference of whether or not to participate in certain activities. Table 1 shows that the majority (75.8%) of the respondents were in age category of 20 to 60 years. The results imply that, most of the respondents were of the active and energetic age group. These results further suggest that, the active age group seems more ready to adopt and practice agriculture innovations compared to younger (age below 20) and older (above 60 years) who in most cases are retired individuals. The current study is in agreement with the findings of Alexander and Van Mellor (2005) who found that, adoption of genetically modified maize was adopted more by younger farmers and declined with age for those farmers closer to retirement in India.

4.1.2 Sex of the household head and adoption of technologies

Sex also influences technology adoption since the head of the household is the primary decision maker (Mignouna *et al.*, 2011). The results in Table 1 show that the majority

(61.7%) of respondents were males and about a third (38.3%) were females. These results imply that males in the study area had adopted agricultural technologies easily as compared to their female counterpart because men have more access to and control over vital production resources than women due to socio-cultural values and norms. In addition males are often more energetic and could readily be available for energy demanding jobs such as paddy farming. Generally, males own major means of production while females are considered as assistants in households. These results conform to the study in Nigeria by Obisesan, (2014) which indicated male farmers adopted more organic fertilizers unlike their female counterparts.

4.1.3 Marital status of the household head and adoption of technologies

Marital status is an important social factor having a manifestation in the social standing and sense of responsibility of married individuals in the society (Samson, 2007). Generally, marriage has a great influence on family matters since parents are forced to engage in agricultural activities so as to meet family needs. Results in Table 1 show that the majority (73.3%) of paddy farmers were married individuals and a few (26.7%) were not. These results imply that married household heads had to adopt agricultural technologies so as to produce more to have enough surplus for selling to cover for other family responsibilities such as shelter and paying for other services. These results are similar to those by Doss and Morris (2001) who observed high adoption of improved maize technologies in married households in Ghana.

Table 1: Socio-demographic characteristics of respondents and adoption of technologies in paddy production (n=120)

Characteristics			Fertilizer	Pesticides	Herbicides	Improved seeds
Age of household head	20 – 40	58(48.3)	39(32.5)	46(38.3)	40 (33.3)	40(33.3)
	41 – 60	33(27.5)	16(13.3)	22 (18.3)	25(20.8)	22(18.3)
	≥ 61	29(24.2)	6 (5)	6(5)	8(6.6)	9(7.5)
Sex of household head	Male	74(61.7)	35(29.2)	43(35.8)	40(33.3)	41(34.2)
	Female	46(38.3)	26(21.7)	31(25.8)	33(27.5)	30(25)
Marital Status of household head	Married	88(73.3)	46(38.3)	57(47.5)	54(45)	52(43.3)
	Single	32(26.7)	15(12.5)	17(14.2)	19(15.8)	19(15.8)
Education Level of household head	Primary and above	102(85)	54(45)	67(55.8)	62(51.6)	58(48.3)
	No formal education	18(15)	7(5.8)	7(5.8)	11(9.2)	13(10.8)
Household size	Small 1 – 5	59(49.2)	17(14.2)	24(20)	17(14.2)	19(15.8)
	Large 6 – 10	61(50.8)	44(36.6)	50(41.6)	56(46.6)	52(43.3)
Household head's other income ganeration activities	Petty trade	42(35)	21(17.5)	26(21.7)	22(18.3)	28(23.3)
	Livestock keeping	40(33.3)	17(14.2)	18(15)	16(13.3)	19(15.8)
	Wage employment	24(20)	16(13.3)	20(16.7)	30(25)	14(11.7)
	Carpentry	14(11.7)	7(5.8)	10(8.3)	5(4.2)	10(8.3)
Household head's main occupation	Farming	120(100)	61(50.8)	74(61.7)	73(60.8)	71(59.2)

NB: Numbers in parenthesis indicates percentages

4.1.4 Education of the household head and adoption of technologies

Education is always valued as a means of liberation from ignorance, developing human skills and knowledge as a way of empowering the community to participate in certain activities (Salehin *et al.,* 2009). Results in Table 1 show that the majority (85%) of respondents had attained primary education and above. The results suggest that education level (primary and above) of the individual influence adoption of technologies and innovations, since some of the innovations can be introduced through posters, leaflets, and brochures which require individuals with reading skills. These results conform to Lapar and Ehui (2003) who reported that farmers who are better educated are generally more open to innovative ideas and new technologies that promote technical change. These results further agree with Orojobi and Damisa (2007) who reported that education facilitated the adoption of modern technologies and improved farm practices in Nigeria.

4.1.5 Household size and adoption of technologies

Household size is simply used as a measure of labour availability. According to Mignouna *et al.* (2011) a household includes persons living together and sharing household resources such as accommodation, farmland and foodstuffs. Results in Table 1 show that more than half (50.8%) of the respondents had a household size ranging from 6 to 10 members and less than half (49.2%) of respondents had household size ranging from 1 to 5 members. The observed household size of above 5 members is considered to be large based on the 2012 Tanzania census whereby, the country's average household size was 4.8 (URT, 2013). Nonetheless, more members in the household if utilized properly in economic activities will highly contribute to high production. The results of the current study is in agreement with the study conducted in Nigeria by Orojobi and Damisa (2007) which showed that, household size was crucial to adoption of agricultural technologies especially, inorganic fertilizers which required the family as a source of labour. According to Akadugu *et al.* (2012) small sized households with low level of income may not be able to hire required labour in case of labour intensive activities.

4.1.6 Household head's main occupation and adoption of technologies

Table 1 shows that (100%) of respondents were engaged in farming as their main economic activity. However, off-farm activities were also undertaken to supplement the main activity, 35% of the respondents were involved in petty trade. About 33.3% were engaged in livestock keeping and the rest, less than 15% of the respondents were earning a regular salary through formal employment. These results conform to what was reported by Uaiene *et al.* (2009), that income from off-farm sources is important in financing purchase of farm inputs (e.g. seeds, fertilizers, labour).

4.2 Household Economic and Farm Characteristics

4.2.1 Household's average annual income and adoption of technologies in paddy production

Income is a crucial component in adoption of agricultural technologies. The higher a farmer's income, the more likely he/she would seek and adopt technologies and innovations. With more income, the farmer will be in a better position to spend more on recommended farm practices leading to more farm earnings other things being constant. This is because farmers who are well off can afford the prices of farming inputs compared to low income earning farmers (Rogers, 2003). The results in Table 2 indicate that more than half (54.2%) of respondents had incomes that ranged between 100 000 - 500 000 Tshs. Generally, the observation indicates the majority of the surveyed household had low income compared to average per capital of 570 USD which is about 900 600 Tshs (URT, 2012). Results further show that (45.8%) of the respondents had average annual income in the range of 600 000 – 1 000 000 Tshs. The results of the current study are in line with the study on conservation agriculture in Nigeria by Bradshaw (2007) which showed that a farmer's income had a relationship with the uptake of farming technologies since any adoption/adaptation process requires a farmer to have sufficient financial well-being.

4.2.2 Farm size and adoption of technologies in paddy production

In terms of farm size in the study area, results in Table 2 show that the majority (62.5%) had farm sizes in the range of 0.25-1 ha and very few farmers (15%) had farm sizes in the range of 3.25-7 ha. These results indicate that majority of farmers had small farms compared to the national average of 0.2-2.0 ha per household (Tulayi and Hingi , 2006). These results imply that the majority of respondents in the study areas practice smallscale farming which is common in rural areas in Tanzania. Farmers with large farm size are likely to adopt a new technology as they can afford to devote part of their land to try new technology unlike those with less farm size (Uaiene *et al.*, 2009).

4.2.3 Farm ownership and adoption of technologies in paddy production

Results in Table 2 show that the majority (69.2 %) of the respondents owned the land used in paddy production while a few (30.8%) of respondents rented. The result implies that a substantial proportion of the paddy producers rent land for paddy production. These results suggest that it was easy for farmers who owned land to adopt technologies because they are not limited by a landlord in regards to application of agricultural innovations. It is general practice for some land owners to prohibit their tenants to use organic fertilizers on assumption that, doing so affects the soil farm's fertility. The above explanations are supported by the quote below;

> *''As for me, I don't have my own farm on which I can freely apply fertilizers, I have rented the land on which I cultivate paddy and my landlord does not allow me to apply fertilizers on his farm, because he believes its fertility will be reduced''* (A female farmer aged 39, Mkula village; 9/11/2014).

Table 2: Respondents farm characteristics and household's average annual income (n=120)

Characteristic		n(%)	Fertilizers	Pesticides	Herbicides	Improved seeds
Farm size	0.25 – 1ha	75(62.5)	38(31.7)	48(40)	40(33.3)	36(30)
	1.25 – 3ha	27(22.5)	19(15.8)	22(18.3)	25(20.8)	26(21.7)
	3.25 – 7ha	18(15.0)	4(3.3)	4(3.3)	8(6.7)	9(7.5)
Farm ownership	Rented	37(30.8)	18(15)	19(15.8)	21(17.5)	18(15)
	Owned	83(69.2)	43(35.8)	55(45.8)	52(43.3)	43(35.9)
Households' average annual income	100 000 – 500 000Tsh	65(54.2)	20(16.7)	30(25)	26(21.7)	30(25)
	600 000 – 800 000Tsh	48(40)	36(30)	37(30.8)	40(33.3)	34(28.3)
	900 000 – 1 100 000Tsh	7(5.8)	5(4.2)	7(5.8)	7(5.8)	7(5.8)

NB: Numbers in parenthesis indicate percentages

4.2.4 Paddy farming households' access to extension services

Extension services are important services that enable farmers to improve their productivity. Extension services play a positive role in creating awareness in adopting modern farming techniques to improve agricultural productivity (FAO, 2002). The study results (Table 3) show that about a third (34.2%) had access to extension officers who provided advice on the use of appropriate agricultural inputs to increase productivity. The results imply that access to extension services was a problem because there is inadequate number of extension officers which makes them fail to perform their extension responsibilities. These results conform to the study by Sadak (2007) in Nepal which showed that agricultural extension staffs were few and they did not have adequate resources such as transport to reach individual farmers who needed their services in remote areas.

4.2.5 Respondent's access to credit

Results from the study (Table 3) show that a quarter (25%) had access to credit in terms of cash and in – kind. Farmers were receiving loans from different sources such as lenders (people lending out money informally and charging high interest rates). Other services include friends and Savings and Credit Cooperative Societies (SACCOS); according to respondents, credit was mainly used to purchase farm inputs such as fertilizers and pesticides. Results further show that the majority (75%) had no access to credit which can result into low use of agricultural inputs and subsequently low crop yield and income to farmers. Similar observations were made by Wennink and Heemskerk (2007) who point out that smallholder farmers lack the capacity to access formal credit in terms of collateral, knowledge, skills and organization.

4.2.6 Membership to farmers association

Cooperative groups are organized for the promotion of special interest or to meet certain needs that cannot be achieved through individual efforts. They contribute to the dissemination of new ideas, practices and products as well as in sourcing for loan and farm inputs. Findings from the study (Table 3) revealed that a third (33.3%) of the respondents were members of farmers associations from which they were able to get services like access to loan, farm inputs (fertilizers, pesticides and improved seeds) and attending agricultural training. These results imply that membership to farmers association could help in adopting agricultural technologies. According to Benin *et al.* (2011), membership to farmers association led to a high adoption of agricultural technologies which then resulted into achievement of higher yields for banana and cassava in Uganda.

Table 3: Farming households' access to extension services, credit and their membership to farmers' associations (n = 120)

Characteristic		Frequency	Percent
Access to extension services	Yes	41	34.2
	No	79	65.8
Membership to farmers association	Yes	40	33.3
	No	80	66.7
Access to credit	Yes	30	25
	No	90	75

4.3 Agricultural Inputs Used by Paddy Producing Households

In paddy production, farming inputs are important resources that determine farm productivity. Paddy farmers were asked on their use of improved seed varieties, application of fertilizers, herbicides and pesticides which were the main inputs often applied to improve paddy productivity in the study area as detailed below.

Table 4: Percentage distribution of Agricultural Inputs used by paddy producers (n = 120)

Use of inputs in paddy production	Frequency	Percent
Improved seeds	71	59.2
Pesticides	74	61.7
Inorganic Fertilizers	61	50.8
Herbicides	73	60.8

4.3.1 Use of improved rice varieties

Paddy is among the few crops that have an enormous number of improved varieties developed and released by national research institutions. Results in Table 4 show that (59.2%) of the surveyed households used improved rice varieties. The mostly used improved seeds varieties by paddy farmers was SARO, other varieties reported include; Supa and Mzambia while Wahiwahi, Kahogo, Mbawa mbili, Kalamata and India rangi were local varieties. These results are supported by Lwezaura *et al.* (2011) who observed that the most preferred improved paddy variety in Kilombero District was SARO due to its high yield performance. Literature further shows that SARO satisfies multiple criteria such as high productivity, lodging resistance and early maturity which outweigh other varieties (URT, 2011; Lwezaura *et al.,* 2011). According to observations from the focus group discussions (FGDs), participants pointed out why they preferred SARO as shown in the quote below;

''We prefer growing SARO in our plots because it is a high yielding variety with improved grain quality, it is aromatic and palatable and it can be planted twice per year'' (A 45 years old female FGD participant, Mang'ula A, village, 4/11/2014).

4.3.2 Use of pesticides

Use of pesticides is considered very effective in reducing pest infestations and increasing agricultural production and productivity among smallholder farmers. As one of the important inputs in paddy production, paddy farmers were asked to indicate if they used pesticides in their paddy production. Results in Table 4 show that under two thirds (61.7%) of the surveyed households were applying pesticides in controlling and eliminating pests. Examples of pesticides used in paddy production are *kungfu and ninja* (which have the same active ingredient of *lamdea cyhalothrin 50gm/lt).* In addition, these results were supported by the key informant interview and FGDs carried out as illustrated in the following quotes;

''Currently there has been a spectacular increase in the use of pesticides such as kungfu and ninja among the paddy farmers in response to the pests infestation which has become a problem to farmers as a result of climate change'' (Extension officer, Mang'ula A village, 4/11/2014).

'' Flies always attack our crops and if you do not control them using pesticides you will end up harvesting nothing. Therefore, I have to buy pesticides by any means including cost sharing with my neighbours'' (A female farmer aged 36 years, Kisawasawa village, 9/11/2014).

4.3.3 Use of fertilizers by paddy farmers

The use of fertilizers by farm households is an important ingredient for higher output and production per unit of land. Common fertilizers used in the study area particularly in paddy were inorganic fertilizers. Results in Table 4 show that half (50.8%) of the surveyed households were using fertilizers in their paddy production. Use of fertilizers in paddy production is among the factors recommended to increase production. Phosphate and Nitrogen nutrients are the most important nutrients in rice production. Nitrogen (N) is the most limiting nutrient in relation to rice production. According to Mustapha (2004) increased nitrogen use efficiency will translate into yield increase. The amount of nitrogen to be applied in paddy production is dependent upon a number of factors, such as likely losses of Nitrogen through leaching, immobilization, mineralization and denitrification, plant characteristics (tillering potential, leaf area index, resistance to logding and length of growing cycle), management practices (dry land/irrigated systems, sowing/planting density, pest and disease and weed control. However, the recommended amount of urea on paddy farm is 50 kg/ ha (Kato, 2007).

4.3.4 Herbicides

In the face of scarcity and increasing wage rate of farm labour, use of herbicides has been observed as a major labour saving device. Labour requirement for weeding always accounts for a high proportion of the total farm labour cost in rice production. Paddy, like other grains, requires prompt application of agro-chemicals such as insecticides and herbicides to check the menace of pest and disease infestation that may occur as a result of overgrowth of weeds. The results (Table 4) show that under two thirds (60.8%) of the surveyed households were using herbicides to control weeds. Generally, non use of herbicides can affect production especially when weeding is delayed. Unsuccessful weed control can result in almost total loss of paddy yield. For instance, on-farm trials of weed management using herbicides and fungicides in Kenya showed that their use resulted in higher yields of maize and beans compared to hand-hoe weeding (Muthamia *et al.*, 2001). Common herbicides used by paddy farmers include Round up (*Glyphosate salt 100gm/lt*) and *2-4D* (*Dichloropheloxy Acetic acid 720gm/lt*).

4.4 Socio-economic Factors Influencing Paddy Producing Households' use of Agricultural Inputs in Kilombero District

This section examines in detail households' use of agriculture inputs by the use of binary logistic regression models. The use of the regression model allows assessment of how well a set of predictors, predict or explain the relationship between categorical dependent variables (i.e. 0=none input user 1=input user) and determine the association of household socio-economic characteristics and use of agricultural inputs (fertilizers, pesticides, herbicides and improved seeds) in their paddy production.

A total of 13 independent/predictor variables were used against four inputs used (fertilizers, herbicides, pesticides and improved seeds). Independent/predictor variables used include; household head's age, sex of households' head, marital status, household head's education level, household size, household's average annual income, farm size, land ownership, access to extension officer, distance to agro- input shops, access to credit, group membership and other economic activities. All these independent/predictor variables were included in model that was used to determine their likelihood influence to a household's use of inputs in paddy production.

4.4.1 Socio – economic factors associated with a household's use of fertilizers

Results for the factors associated with a household's use of fertilizers are shown in Table 5, the model's R^2 was 0.405 (Cox and Snell R^2) and 0.455 (Negelkerke R^2). This implies that independent variables were able to explain the dependent variables by 45% and the rest (55%) could not be explained by variables in the equation. Based on the analysis three independent variables were significant associated with a household's use of fertilizers. Variables associated with household's use of fertilizers include availability of extension officer, access to credit and involvement in other economic activities (petty trade, livestock keeping, wage employment and carpentry). Availability of extension officer had a Wald statistics (Wald statistic = 5.969) which was statistically significant (p = 0.05) associated with the farmer's use of fertilizers. Generally, the Wald test is an alternative test which is commonly used to test the significance of individual logistic regression coefficient for each independent variable. The Wald statistics is the squared ratio of the unstandardized logistic coefficient to its standard error. Therefore, based on the above results availability of an extension officer and hence access to extension services could be instrumental in influencing farmer's use of fertilizers through providing training on how to apply the same consequently leading to increased paddy production and productivity (kg/ha). These results conform to those reported by Lawal and Oluloye, (2008) that, the rate at which innovations are used by farmers is largely dependent on sensitization, mentoring and demonstration by extension agents.

Results (Table 5) also show that access to credit was associated with the farmer's use of fertilizers (Wald statistic = 5.670) this was statistically significant (p = 0.05). This is probably due to the fact that access to credit enables farmers to purchase fertilizers easily. The current study is in line with Ouma *et al.* (2006) who observed that access to credit enhanced farmers' capacity to adopt improved maize seeds and fertilizer use in Kenya which in turn increased their productivity in the agricultural sector. Accessibility to credit also reduces the level of risk associated with adoption of technologies on the side of a farmer, thereby increasing the likelihood of adoption.

Results (Table 5) show that distance to agro-input shop was associated with the farmer's use of fertilizers and had a Wald statistics (Wald statistic = 1.552) which was slightly significant (p = 0.1). This is probably due to the fact that being close near to agro-input shops could influence a farmer to use fertilizer because transportation cost could be reduced. These results conform to that of Kassali *et al.* (2009) who found near distance to agro-input centers had influenced farmer's use agricultural inputs in Nigeria.

The logistic regression results (Table 5) further show that, involvement in other economic activities (petty trade, live stock keeping, wage employment and carpentry) was associated with the farmer's use of fertilizers and had a Wald statistics (Wald statistic = 6.200) which was statistically significant (p = 0.013). The results suggest that farmers' involvement in other economic activities provides them with extra income/capital with which they can purchase fertilizers. These results conform to that of Uaiene *et al.* (2009) who reported that income from off-farm sources is important in financing purchase of farm inputs (e.g. seeds, fertilizers, labour).

Other variables such as age, education and annual income were expected to positively influence adoption of technologies but, they were not significantly associated with adoption of fertilizers. For example, age of household head was hypothesized to have positive influence on adoption of fertilizer. According to Alexander and Van Mellor (2005), age has a direct bearing on farmer approach, openness or conservativeness and level of exposure to new technologies. Generally, younger farmers are more interested in trying out new agricultural technologies because of their risk taking character.

Farm size was also hypothesized to have positive influence on adoption of agricultural technology. Small farms have been reported to have greater likelihood of adopting recommended practices as they are more intensively managed. Household size was hypothesized to have a positive influence on adoption of agricultural technology. It is believed that households with adequate and a readily accessible labour pool can affect the adoption decision and amount of technology adopted.

Table 5: Binary logistic regression results for socio – economic factors associated with a household's use of fertilizers

Variables	B	SE	Wald	df	Sig	Exp(B)
Age	.292	.238	1.504	1	.220	.746
Sex	.409	.582	.494	1	.482	1.505
Marital status	.160	.686	.055	1	.815	.852
Education	.077	.355	.047	1	.829	.926
Household size	-.085	.579	.022	1	.883	.918
Annual income	.000	.000	.540	1	.463	1.000
Other economic activities	**.000**	**.000**	**6.200**	**1**	**.013****	**1.000**
Farm ownership	.030	.603	.003	1	.960	1.031
Extension officer availability	**1.623**	**.664**	**5.969**	**1**	**.015****	**.197**
Distance to agro- input shop	**-.054**	**.031**	**1.552**	**1**	**.078***	**.947**
Access to credit	**2.109**	**.886**	**5.670**	**1**	**.017****	**.121**
Farmers association membership	.260	.739	.124	1	.725	.771
Farm size	-.238	.245	.939	1	.332	.789
Constant	8.060	2.682	9.029	1	.003	3.1663

***NB*: Cox and Snell R square 0.405 Nagelkerke's R Square =0.455 **significant at p=0.05 *significant at p=0.1**

4.4.2 Socio – economic factors associated with a households use of pesticides

Results for the factors associated with households use of pesticides are shown in Table 6, the model's R^2 was 0.331 (Cox and Snell R^2), and 0.450 (Negelkerke R^2). This implies that independent variables were able to explain the dependent variable by 45% and the rest (55%) could not be explained by variables in the equation. Based on the analysis two independent variables were significantly associated with a household's use of pesticides.

Variables associated with a household's use of pesticides are availability of extension officers and cooperative membership. Availability of extension officers was associated with farmer's use of pesticides and had a Wald statistic (Wald statistic= 4.774) which was statistically significant (p = 0.029). This is probably due to the fact that extension officers may influence farmer's use pesticides through paying visits to their farms plots and have many roles as advisers, technicians and act as liaison between agricultural research institutions and farmers.

The results further show that membership to farmers association was associated with the farmer's use of pesticides and had Wald statistics (Wald statistic = 3.977) which was significant (p = 0.05). This is probably due to the fact that membership to farmers association may lead to adoption of high yielding technologies (e.g. use of inorganic fertilizer, improved seeds and pesticides application). Being in farmers association leads to easy access to extension services since it is easy to offer services to those in groups rather than individuals. Membership to farmers association is expected to assist farmers to get easy access to credit and other production inputs. It can also enhance access to technological information. These results conform to the study by Benin *et al.*(2011) who observed that membership to farmer groups had lead to high adoption of agricultural technologies which resulted to achievement of higher yields for banana and cassava in Uganda.

Table 6: Binary logistic regression results for socio – economic factors associated with a household's use of pesticides

Variables	B	S.E.	Wald	df	Sig.	Exp(B)
Age	-.227	.224	1.028	1	.311	.797
Sex	.549	.567	.937	1	.333	1.731
Marital status	.540	.629	.738	1	.390	1.717
Education	.198	.324	.374	1	.541	1.219
Household size	-.746	.541	1.899	1	.168	.474
Household's average annual income	.000	.000	.127	1	.722	1.000
Other economic activities	.000	.000	1.610	1	.205	1.000
Farm ownership	.413	.552	.561	1	.454	1.512
Availability of extension officer	1.399	.640	4.774	1	.029**	.247
Distance to agro-input shop	-.035	.028	1.552	1	.213	.965
Access to credit	.641	.747	.736	1	.391	.527
Membership tofarmers association	1.399	.702	3.977	1	.046**	.247
Farm size	.185	.229	.650	1	.420	.832
Constant	6.829	2.422	7.953	1	.005	924.370

NB: **Cox and Snell R square 0.331 Nagelkerke's R Square =0.450 **significant at p=0.05**

4.4.3 Socio – economic factors associated with a household's use of improved seeds

Results for the factors associated with households use of improved seeds are shown in Table 7, the model's R^2 was 0.405 (Cox and Snell R^2), and 0.547 (Negelkerke R^2). This implies that independent variables were able to explain the dependent variable by 54% and the rest (46%) could not be explained by variables in the equation. Based on the analysis four independent variables were significantly associated with a household's use of improved seeds. Variables associated with a household's use of improved seeds include; household size, average annual income, farm size and education level. Household size had a Wald statistics (3.631) which was statistically significant (p-value 0.057) associated with the household's use of improved seeds. This imply that many larger household were using improved seeds which could lead to high production and increased income which ultimately contributes to the households increased purchasing power of improved seeds.

These results are in line with those reported by Feder *et al.* (1985) who observed that adoption of new varieties requires more labour inputs. It is assumed that large families can easily provide the labour required for improved paddy production practices. On the other hand, a large household may encourage adoption of improved inputs such as fertilizer, improved seeds and pesticides whose application is labour-intensive (Perz, 2003). Moreover, large households also have more needs which could be met by increasing production; one of the ways of doing the above is by use of improved technologies.

Annual income had a Wald statistics of (5.001) which was also statistically significant (p = 0.05), this probably could be due to the assumption that higher income levels generally mean that a farmer is more able to purchase improved seeds varieties. These findings are in line with Bradshaw (2007), who observed that a farmer's income has a positive relationship with the uptake of farming technologies since any adoption/adaptation process requires a farmer to have sufficient financial well-being.

Farm size was also associated with a household's use of improved seeds (Wald 9.532) this was significant (p-value 0.05). The implication of this finding is that farmers who have big farms are more likely to adopt improved rice seeds compared to those with small farms. This is mainly because they are profit oriented.

Logistic regression results (Table 7) further show that, education level of a household head was associated with a household use of improved seeds (Wald 5.243, p – value 0. 022). This implies that increases in the level of a household head's education increase the adoption of improved agricultural practices and new technologies and consequently increase agricultural productivity. The positive and significant relationship between level of education and extent of adoption in this study is in line with what others have reported in other studies. For example according to Ouma *et al.* (2006) literacy level positively influenced the adoption of improved maize seeds and fertilizer use in Kenya.

Table 7: Binary logistic regression results for socio – economic factors associated with a household's use of improved seeds

Variable	B	S.E.	Wald	df	Sig.	Exp(B)
Age	.047	.239	.039	1	.843	1.048
Sex	.692	.623	1.237	1	.266	1.998
Marital status	.294	.650	.205	1	.650	.745
Farmers association membership	.662	.383	2.790	1	.104	.516
Household size	1.143	.600	3.631	1	.057*	3.137
Access to credit	.000	.000	.646	1	.421	1.000
Other economic activities	.000	.000	.500	1	.479	1.000
Farm ownership	.979	.612	2.558	1	.110	.376
Extensio officer availability	.198	.590	.113	1	.737	1.219
Distance to Input shop	-.056	.038	2.115	1	.146	1.058
Annual income	1.650	.738	5.001	1	.025**	5.209
Education level	1.605	.701	5.243	1	.022**	4.978
Farm size	1.394	.452	9.532	1	.002**	4.032
Constant	6.394	2.518	6.448	1	.011	832.102

***NB*: Cox and Snell R square 0.405 Nagelkerke's R Square =0.547 **significant at p=0.05 *significant at p=0.1**

4.4.4 Socio – economic factors associated with a households' use of herbicides in paddy production

Results for the factors associated with a household's use of herbicides are shown in Table 8, the model's R^2 was 0.575 (Cox and Snell R^2), and 0.670 (Negelkerke R^2). This implies that independent variables were able to explain the dependent variable by 67% and the rest (33%) could not be explained by variables in the equation. Based on the analysis two independent variables were statistically significant and hence associated with a household's use of herbicides. Variables associated with household's use of herbicides include access to credit and availability of extension officers. Results (Table 8) show that access to credit was associated with the farmer's use of herbicides and had a Wald statistics of 3.003 which was statistically significant (p = 0.05). This is probably due to the fact that access to credit would assist farmers to purchase necessary inputs for crop production. Many sources of credit give the farmer more chances of securing improved inputs.

The results (Table 8) further show that, availability of extension officers had Wald statistics (Wald statistic = 5.219) which was statistically significant (p = 0.022) associated with the farmer's use of herbicides. Extension contact is a very important determinant of adoption of technologies because, any newly developed technology is introduced to farmers through the activities of extension agents. A farmer whose contact with extension agents is very high is expected to be more familiar and more knowledgeable about the use of improved agricultural innovations including use of herbicides and the resultant is benefits. This study conforms to the studies by Akudugu *et al.* (2012) who reported that regular contact with extension staff increased farmers' awareness on availability of new agricultural technologies in Ghana.

Based on literature (Adam *et al.,* 2013; Akadugu *et al.*, 2012) some variables such as marital status, education and annual income were expected to positively influence adoption of technologies. However, for the current study they were not significantly associated with adoption of herbicides. It was hypothesized that married household head have greater chance of using inputs than single headed households (Doss and Morris, 2001). This is because it is not necessary that all married couple have chances of using inputs. due to multiple roles within the household. These results are consistent with observations by Noorhosseini-Niyaki *et al.* (2012) who found that marital status did not significantly influence use of inputs among the rice farming households in North Iran.

Education was expected to have a positive effect on decision to use inputs. Literature indicates that educational level of the respondents is critical to the use of farm inputs necessary to increase rice output (Ogundele and Okoruwa, 2006). These results are consistent with observations by Ayoola *et al.* (2011) who found that education level was not a significant factor influencing adoption of technologies in rice production in Nigeria. It was also hypothesized that higher income implies the ability to invest in paddy production and bear the associated risks, thus, positively influencing use of inputs. However, these results are consistent with observations by Tabi *et al.* (2010) who found income was not a determinant factor for adoption of maize and cassava technologies in the Forest-Savannah Zone of Cameroon.

Table 8: Binary logistic regression results for socio – economic factors associated with a household's use of herbicides

Variables	B	S.E.	Wald	df	Sig.	Exp(B)
Sex	.549	.567	.937	1	.333	2.385
Marital status	.420	.492	.731	1	.393	1.731
Education	.414	.275	2.266	1	.132	.661
Annual income	.000	.000	.690	1	.406	1.000
Access to credit	.264	.212	3.004	1	.041**	1.302
Distance to inputs shops	-.035	.028	1.552	1	.213	.965
Farm size	.185	.229	.650	1	.420	.832
Other economic activities	.000	.000	2.467	1	.116	1.000
Extension officer availability	1.172	.513	5.219	1	.022**	.310
Constant	3.105	1.559	3.967	1	.046	22.315

***NB*: Cox and Snell R square 0.575 Nagelkerke's R Square =0.670 **significant at p=0.05**

4.5 A Comparison of Paddy Productivity between Input and Non Inputs Users

4.5.1 Application of fertilizers and paddy productivity

Fertilizer is known to be one of the most critical inputs in rice production because of the high response of the crop to fertilizer application. The two major types of fertilizer used are organic and inorganic fertilizers. Literature (Mghase *et al.,* 2010) indicates that, in order for a plant to grow and thrive, it needs a number of different chemical elements. The study intended to compare paddy productivity between households using fertilizer and those not using in 2013/2014 farming season.

Results of the independent sample t-test (Table 9) show that there was a statistically significant ($p<0.000$) difference in paddy productivity between fertilizer users and non users. The mean difference in productivity was 997 kgs/ha for fertilizer users compared to 617 kgs/ha for non user in 2013 season and 890 kgs/ha for fertilizer user compared to 586 kgs/ha for non users in 2014 season. Based on the findings the null hypothesis is rejected because there is statistically difference in paddy productivity between fertilizer users and non users at the 1% level. These results emphasize on the importance of using fertilizers in improving paddy productivity. These results conform to observations by Ogundele and Okoruwa (2006) who found a difference in productivity between fertilizer users and non users in Nigeria. The results are also supported by Focus Group Discussion (FGD) participants as shown in the quotes below:

> *'' The knowledge that we gained on the use of fertilizer in paddy production has enhanced farm productivity amongst the users in comparison to those who do not. The knowledge I am referring to here includes the appropriate quantity and type of fertilizer to be applied (i.e. NPK and UREA) and the timing of application of fertilizer''* (A male farmer aged 53 years, Mang'ula A Village; 5/11/2014).

A large percentage of farmers that use appropriate quantities of fertilizer in their farms have been seen to have sufficient productivity of paddy. For example through training we were taught that the recommended rate of 125-250 kg and 120- 220 kg of UREA per hectare for upland and lowland respectively swamp production system respectively. This has serious effects on yield.... " (A female farmer aged 47 years old, Mkula village; 7/11/2014).

Table 9: Independent sample test for paddy productivity between fertilizer users and non users (n=120)

Period	Groups	n	t	Sig. (2-tailed)	Mean group (Kgs/ha)
2013	Fertilizer users	61	4.230	.000	997.42
	Non fertilizer users	59	4.230	.000	616.63
2014	Fertilizer users	61	3.718	.000	890.25
	Non Fertilizer users	59	3.718	.000	586.41

4.5.2 Application of pesticides and paddy productivity

The application of pesticides is considered important in reducing pest infestations and increase of farm productivity among smallholder farmers. Rice, like other grains, requires prompt application of agro-chemicals such as insecticides and herbicides to check the threat of pest and disease infestation that may occur as a result of overgrowth of weeds. In view of this, the study compared paddy productivity between pesticide users and non users in the study area. Results of the independent sample T-test in Table 10 show that there was a statistically significant difference ($p<0.000$) in paddy productivity between pesticide users and non users. The mean group difference in paddy productivity was 622 kgs/ha amongst pesticides users compared to 315 Kilograms/ha of the non users in the 2013 season and 536 kgs/ha amongst pesticides user compared to 336 kgs/ha for non users in

2014 season. Based on the above the null hypothesis is rejected. These results are somewhat similar to observation by Lwezaura *et al.* (2011) who reported high paddy productivity among pesticide users as compared to non users in Kilombero District. The above is supported by the quote below;

> *'' Pest infestation in paddy production has been a common problem to most of the farmers in our areas which if not well controlled leads to losses. However, with the current awareness amongst the farmers on the use of pesticides such as 'kungfu' and 'ninja' the pest problem has been reduced* (Extension officer, Kisawasawa village; 4/11/2014).

Table 10: Independent sample test for paddy productivity between pesticides users and non users (n=120)

Period	Groups	n	t	Sig. (2-tailed)	Mean group (Kgs/ha)
2013	Pesticides users	74	4.230	.000	622.02
	Non pesticides users	46	4.230	.000	315.01
2014	Pesticides users	74	3.718	.000	536.51
	Non pesticides users	46	3.718	.000	336.07

4.5.3 Use of improved paddy seeds and paddy productivity

Paddy is among the cereal crops with numerous seed varieties ranging from local to improved ones. According to IRRI (1995), the recommended amount of seed per hectare for both upland and lowland rice production system is 100 kgs/ha. The present study compared paddy productivity between users of improved seed varieties and non users.

The results in Table 11 show there was a statistically significant ($p<0.001$) difference in paddy productivity between users and non users of improved seed varieties as expected.

The mean group difference of paddy productivity between users of improved seeds and non users was 626 kgs/ha compared to 317 kgs/ ha in the 2013 season and 541 kgs/ ha compared to 334 kgs/ha in the 2014 season. Based on the results the study rejects the null hypothesis that there is no difference in paddy productivity between improved seeds users and non users. According to literature (Kajisa and Payongayong, 2011; Otsuka and Larson, 2013; Nakano *et al.*, 2013) modern varieties have exhibited high paddy productivity especially in Sub- Saharan Africa. The empirical findings are supported by the focus group discussion participants as shown in the quote below:

> *For a couple of years we have been using local rice varieties such as Supa, Wahiwahi, Kilombero, Kahogo, Mbawa mbili, Shinyanga, Tela, Zambia, Kalamata, and India rangi which are most preferred by consumers because of their taste but, do not give a high yield. This has forced farmers to embark into using the advised improved seed varieties such as SARO which gives a high yield and is more resistant to pests and diseases... "* (A female farmer aged 48 years, Mkula village; 8/11/2014).

Table 11: Independent sample test for paddy productivity between user of improved paddy varieties and non users (n=120)

Period	Groups	n	t	Sig. (2-tailed)	Mean group (Kgs/ha)
2013	Improved seed users	71	3.977	.000	626.78
	Non improved seed users	49	3.977	.000	317.53
2014	Improved seed users	71	3.514	.001	541.62
	Non improved seed users	49	3.514	.001	334.59

4.5.4 Application of herbicides and paddy productivity

In the face of scarcity and increasing wage rates of farm labour, use of herbicides could be a major labour saving device as the labour requirement for weeding always accounts for a high proportion of the total farm labour cost in rice production. Paddy, like other cereal crops, requires prompt application of agro-chemicals such as insecticides and herbicides to check the menace of pest and disease infestation that may occur as a result of overgrowth of weeds. Based on this the study compared paddy productivity between users of herbicides and non users in the study area. Results in Table 12 show that, there was a statistically significant ($p<0.001$) difference in paddy productivity between users of herbicides and non users. The mean group difference of paddy productivity was 623 kgs/ha compared to 319 kgs/ha in the 2013 farming season and 536 kgs/ha compared to 336 kgs/ha in the 2014 season respectively. Based on the results the study rejects the null hypothesis that there is no difference in paddy productivity between herbicides users and non users. These results are similar to observation by Pacanoski *et al.* (2009) who reported on use of herbicides for weed control which lead to increased paddy productivity in Macedonia.

Table 12: Independent sample test for paddy productivity between herbicides users and non users (n=120)

Period	Groups	n	t	Sig. (2-tailed)	Mean group (Kgs/ha)
2013	Herbicides users	73	4.230	.000	623.20
	Non herbicides users	47	4.230	.000	318.71
2014	Herbicides users	73	3.718	.000	536.32
	Non herbicides users	47	3.718	.000	335.59

4.6 Agriculture input access challenges facing smallholder paddy producers in Kilombero District

Access and use of agricultural inputs among paddy farmers is important if farm productivity is to be increased. Agricultural inputs use stands as the pre-requisite for achieving sufficient productivity of smallholder farmers. Farmers were asked to point out the challenges they face in their access and use of agricultural inputs. Five challenges were reported by farmers as shown in Table 13. These challenges were high cost of inputs, poor availability, long distance to agro-input dealers, inadequate knowledge on use of inputs and low quality of inputs.

Results in Table 13 show that the majority (57.2%) of respondents respectively reported on high cost of inputs as the major challenge. These results are similar to observations from literature that, high costs of inputs have been reported as a major challenge in Kilombero District (Lwezaura *et al.*, 2011). These results suggest that if the cost was affordable use of improved agricultural inputs could be higher. In response to observation from empirical findings the focus group discussion carried out in the three villages support the above as shown in the quote below;

> '' *We are so eager on the use of agricultural inputs such as pesticides and fertilizers because of the decline of farm output. However, we fail to do so because of the current high cost of inputs for example, a 50 kg bag of fertilizer is sold at 60 000 Tshs to 65 000 Tshs which is expensive for smallholder farmers who depend only on paddy production.* (A male FGD participant aged 51 years, Kisawasawa village, 17/11/2014).

Apart from the high cost of inputs about a quarter (26.7%) of the respondents reported unreliable inputs as another challenge. Farmers reported that despite their interest in use of improved agricultural inputs, unavailability of inputs in their villages also prevents them from doing so. The study's observation is further supported by observations by Salam (2003), who reported that smallholder farmers faced the problem of timely availability of inputs such as fertilizer in India.

Few farmers (11%) respondents reported on the long distance from their farms plot to agro-input dealers. Observations from the FGDs were in support of what was observed during the surveys as shown below;

> "*In the last season, I planned to use pesticides following the current increase of diseases in my paddy plot. However, I failed to do so because of lack of an agro-shop in our village. If you want to purchase inputs you are forced to travel to Ifakara or to Ruaha where there are many agro-shops. But, then you need more money to cover your transport and luggage cost. For most of us this is a constraint*" (A female participant aged 36 years, Mang'ula A village, 4/11/2014)

Results also show that few (2.5%) of the respondents reported on inadequate knowledge on the use of improved inputs. Paddy farmers in the study lacked enough skills on when and how to use agricultural inputs especially fertilizers, herbicides and pesticides which needed some instructions from extension officer. These results conform to observations by URT (2011) that farmers lack knowledge and skills on use of inputs and as a consequence this slows down use of improved inputs in Tanzania leading into low productivity which may result into food shortage.

Results further show that 4.1% of the respondents had reported on low quality of seeds. According to Faltermeier and Abdulai (2009) persistence or lack of access to certified improved rice seeds can jeopardize the efforts to achieve self-sufficiency in rice production. As a consequence, dependence on imports would continue to expose the nation to international shocks such as the 2008 global food crisis that led to a global doubling of prices of major staple food crop products such as rice, maize and wheat.

Table 13: Inputs access challenges in the study area (n=120)

Challenge	Frequency	Percent
High price of inputs	69	57.5
Poor availability	32	26.7
Long distance to inputs shops	11	9.2
Lack of knowledge	3	2.5
Low quality inputs	5	4.1

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

This study was conducted to determine Kilombero District's farming households' paddy productivity in relation to their use of inputs.The study specifically aimed at; identifying agricultural inputs used by paddy farmers in production, determining socio-economic factors influencing use of agricultural inputs, comparing paddy productivity between inputs users and non users and identifying inputs access challenges facing farmers.

Based on the study results it can be concluded that the majority of the respondents used agricultural inputs in paddy production. However, there is a difference on types of inputs used whereby the most used agricultural inputs were improved rice varieties, use of fertilizers, pesticides and herbicides application. The level of use varied from farmer to farmer depending on a household's financial capability.

As regards to socio - economic factors associated with use of agricultural inputs, it can be concluded that some variables such as availability of extension officers, involvement in other economic activities, access to credit, farmers association membership, household size, annual income, education level and farm size were significantly associated with a household's use of agricultural inputs in terms of fertilizers, herbicides, pesticides and improved seeds varieties.

It is further concluded that, paddy productivity differs between agricultural inputs users and those not using the same. Generally, for high paddy productivity farmers need to use improved seeds, fertilizer and land management practices as a package.

On the basis of agricultural inputs access challenges it is concluded that factors such as high prices, non availability of inputs at the right time, long distance to agriculture input centers were mentioned. However, high price was reported to be the main challenge.

5.2 Recommendations

In view of the study findings and above conclusions, the following recommendations are made;

i. Farmers should be advised and encouraged to mobilize themselves into genuine Savings and Credit Cooperative Societies (SACCOs). The SACCOs will not only unite farmers and hence increase their bargaining power, but will also make farmers access affordable loans from financial institutions and other lending organizations. In addition, SACCOS can engage in distribution of inputs in rural areas. Furthermore, farmers should also be linked to sources of affordable credit so as to enable them purchase necessary inputs and their complementary needs.

ii. The government should promote the private sectors investment in agricultural inputs particularly in the rural areas, doing this will facilitate availability of agricultural inputs at the right time.

iii. Extension services should be strengthened so as to teach farmers the need to adopt improved technologies, how to apply these technologies and how best to utilize the outcomes of these technologies so as to increase paddy productivity reduce poverty and improve food security.

On the basis of agricultural inputs access challenges it is concluded that factors such as high prices, non availability of inputs at the right time, long distance to agriculture input centers were mentioned. However, high price was reported to be the main challenge.

5.2 Recommendations

In view of the study findings and above conclusions, the following recommendations are made;

i. Farmers should be advised and encouraged to mobilize themselves into genuine Savings and Credit Cooperative Societies (SACCOs). The SACCOs will not only unite farmers and hence increase their bargaining power, but will also make farmers access affordable loans from financial institutions and other lending organizations. In addition, SACCOS can engage in distribution of inputs in rural areas. Furthermore, farmers should also be linked to sources of affordable credit so as to enable them purchase necessary inputs and their complementary needs.

ii. The government should promote the private sectors investment in agricultural inputs particularly in the rural areas, doing this will facilitate availability of agricultural inputs at the right time.

iii. Extension services should be strengthened so as to teach farmers the need to adopt improved technologies, how to apply these technologies and how best to utilize the outcomes of these technologies so as to increase paddy productivity reduce poverty and improve food security.

5.3 Area for Further Research

i. Paddy is the major food and cash crop in the study area. Thus, there is a need to undertake a study on the contribution of paddy sales to smallholder farmers' well - being.

ii. There is also a need to undertake a study on cost benefit analysis (Gross margins) to see whether paddy production is profitable in its current state.

REFERENCES

Adamu, M.T., Biwe, E.R. and Suleh, Y. G. (2013). Socio-economic characteristics of farmers under national Fadama Development Project in Billiri Local Government Area of Gombe State Nigeria. Pro-journal of Agricultural Science Research (PASR) 1 (2): 7-21.

Adeogun, S.O., Olawoye, J.E. and Akinbile, L.A. (2010). Information sources to cocoa farmers on cocoa rehabilitation techniques (CRTs) in selected states of Nigeria. *Journal Media and Communication Studies* 2(1): 009-015.

Adesina, A. and Baidu-Forson, A. (1995). Farmers' Perception and Adoption of New Agricultural Technology: Evidence from Analysis in Burkina Faso and Guinea, West Africa. *Agricultural Economics,* 13:1-9.

Africa Rice Centre (WARDA), (2008). 'Africa Rice Trends 2007', Cotonou: Africa Rice Centre (WARDA). pp 5-7.

Agrest, T. and Finlay, B. (1999). *Statistical Methods for Social Sciences* (3^{rd} ed.) Prentice-Hall, New. 56pp.

Akudugu, M.A. Guo, E. and Dadzie, S.K. (2012). Adoption of Modern Agricultural technologies by Farm Households in Ghana: What factors Influence their Decisions? *Journal of Biology, Agriculture and Health,* 2 (3): 34-60.

Aina, L.O. (2006). Information Provision to Farmers in Africa: The Library – extension service linkage'', World library and information congress, 72nd IFLA general conferences and council 20 -24 August 2006, Seoul, Korea [http://www.ifla.org/iv/ifla72/index.htm] site visited on 12/12/2014.

Ahmed, R. and Hossain, M. (1990). Developmental Impact of Rural Infrastructure in Bangladesh, IFPRI. Research Report 83. Washington, D.C.: IFPRI. 77pp.

Akinola, A.A. (1987). An Application of Probit Analysis to the Adoption of Tractor Hiring Service Scheme in Nigeria, *Oxford Agrarian Studies* 16: 70-81.

Akramov, T.K. (2009). Decentralization, Agricultural Services and Determinants of Input Use in Nigeria. IFPRI Discussion Paper 0094, [www. ifpri.org/ sites/default/files/publications/ifpridp00941.pdf] site visited on 12 /7/2013.

Alexander, C. and Van Mellor, T. (2005). Determinants of corn rootworm resistant corn adoption in Indiana. *AgBioForum* 8(4): 197-204.

Ani, A.O. and Baba, S.A. (2009). Utilization of selected electron mass media as sources of agricultural information by farmers in northern Taraba state Nigeria'' *Journal of Tropical Agricultural Research and Extension*, [http:www.agri.ruh.ac.lk/ tare/Viewfiles/V12%281%29/AEC77.htm].site visited on 2/1/2015.

Ayoola, J.B.C., Dangbegnon, C.K., Daudu, A., Mando, T.M., Kudi, I.Y., Amapu, J.O., Adeosun, and Ezui, K.S. (2011). Socio-economic factors influencing rice production among male and female farmers in Northern Guinea Savanna Nigeria: *Agriculture and Biology Journal of North America* 2(6): 1010-1014.

Balasubramanian, V.M., Sie, R., Hijmans, A. and Otsuka, K. (2007). Increasing Rice Production in Sub-Saharan Africa: Challenges and opportunities. *Advances in Agronomy* 94 (1): 55-133.

Banful, A.B. (2010). Old problems in the new solutions? IFPRI Discussion Paper 01002, Washington D.C., IFPRI.Barrett, C.B. 2008. "Smallholder Market Participation: Concepts and Evidence from Eastern and Southern Africa." *Food Policy* 33(4): 299-317.

Barrett, C.B. (2008). "Smallholder Market Participation: Concepts and Evidence from Eastern and Southern Africa." *Food Policy* 33(4): 299-317.

Benin, S., Nkonya, E., Okecho, G., Randriamamonjy, J., Kato, E., Lubadde, G., Kyotalimye, M. and Byekwaso, F. (2011). Impactof Uganda's National Agricultural Advisory Services Program. IFPRI, Washington, DC., USA. 56pp.

Bradshaw, B. (2007). Farmers' adoption of conservation agriculture: a review and synthesis of recent research. *Food Policy* 32 (1): 25–48.

Block, S. (2010). The decline and rise of agricultural productivity in Sub-Saharan Africa since 1961. "National Bureau of Economic Research, Working Paper No. 16481. 34pp.

Bob, M. and Liz, R. (2010). *Research Methods. A Practical Guide for the Social Sciences.* Rotolito Lombarda, Italy 121pp.

Bray, F. (1986). The Rice Economies: Technology and Development in Asian Societies. Basil Blackwell: Oxford, UK. 28pp.

CIMMYT (1993). *Econometric Application to Modeling the Adoption of Agricultural Technologies Proceedings of CIMMYT Workshop*, Harare, Zimbabwe 21- 25 February, 2005. 29 pp.

Crawford, E., Jayne, W., Valerie, T. and Kelly, A. (2006). Alternative Approaches for Promoting Fertilizer Use in Africa. Agriculture and Rural Development Discussion Paper 22, Washington D.C., The World Bank. 43pp.

Creswell, J.W. (1994). Research Design; Qualitative and Quantitative Approaches. Sage Publisher, London. 228pp.

Croppenstedt, A., Demeke, M. and Meschi, M.M. (2003). Technology adoption in the presence of constraints: the case of fertilizer demand in Ethiopia. *Review of Development Economics* 7(1): 58–70.

Dalton, T.J., Master, W.A. and Foster, K.A. (1997). Production Cost and Input Substitution in Zimbabwe's Smallholder Agriculture. *Agricultural Economics* 17(3): 201 – 209.

Daudu, S., Chando, S.S. and Igbashal, A. A. (2009). ''Agricultural Information Utilized by farmers in Benue State, Nigeria. *Publication Agriculture and Technology* 5(1): 39 – 48.

Doss, C.R. and Morris, M.L. (2001). How does gender affect the adoption of agricultural innovations? The case of improved maize technology in Ghana. *Agricultural Economics* 25: 27 - 39.

Dulle, F. and Ngalapa, H. (2014). Assessment of information needs of rice farmers in Tanzania; A case study of Kilombero District, Morogoro. Library Philosophy and Practice (e-journal). Paper 1071. 45pp.

Economic Commission for Africa (ECA), (2007). Africa review report on agriculture and rural development". Fifth Meeting of the Africa Committee on Sustainable development 27 (ACSD-5)/regional implementation meeting for CSD-16 Addis Ababa 22-25 October 12pp.

Erie, A. P. (2009). *A Conceptual Framework for the Privatization and Commercialization of Agricultural Extension Services: A Case Study of Edo State, Nigeria.* Rudel printers and publishers, Edo State, Nigeria. pp 1, 4, 25.

European Cooperative for Rural Development (EUCORD), (2012). *Rice Sector Development in East Africa, A desk study prepared for the Common Fund for Commodities,* Common Fund for Commodities (CFC). 87pp.

Faltermeier, L. and A. Abdulai. (2009). "The Impact of Water Conservation and Intensification Technologies: Empirical Evidence for Rice Farmers in Ghana." *Agricultural Economics* 40: 365–379.

FAO (2002). Farmers organization in central and eastern European countries and their role. In: Provision of input- output Services in the Context of Accession of European Union Proceeding FAO Workshop, 11 – 14 June 2001, Prague, Czech Republic. pp.187 – 190.

FAO (2006). Fertilizer use by crop [http://faostat.fao.org] site visited on 05/08/2014.

FAO, (2012). FAOSTAT. [http://faostat.fao.org/ default.aspx] site visited on 26/04/2014.

FAO (2014). *Tanzania Country fact sheet on food and agriculture policy trends, Food and Agriculture Policy Decision Analysis* [http://www.fao.org/3/a-i4125e.pdf]. Site visited on 01/05/2015.

Feder, G., Just, R. E. and Zilberman, D. (1985). Adoption of agricultural Innovations in developing countries: A survey. *Economic Development and Cultural Change* 33(3): 255 – 297.

Fraenkel, J.R. and Wallen, N.E. (2000). *How to Design and Evaluate Research in Education.* New York; McGraw- Hill. 123pp.

Gadizirayi, C.T., Mutandwa, E. and Chikuvire, T.J. (2006). *Effectiveness of Maize Cob Powder in controlling Weevils in Stored Maize Grain. In: African Quarterly.* 8(4). [http://www.african.ufl.edu/asq/v8/v8i4al.htm] site visited on 25/04/2014.

Gomez- Limon, J.A. Riesgo, L. and Arriaza, M. (2004). Multi- Criteria Analysis of Input Use in Agriculture. *Journal of Agricultural Economics* 55(3): 541 – 564.

Green, D.A.G. and Ng'ong'ola, D.H. (1993). Factors affecting fertilizer adoption in less developed countries :An application of Multivariate Logistic analysis in Malawi. *Journal of Agricultural Economics* 1: 99 – 109.

Gregory, T. and P. Sewando. (2013). Determinants of the probability of adopting quality protein maize (QPM) technology in Tanzania: A logistic regression analysis, *International Journal of Development and Sustainability* 2: 729-746.

Haji, B. (2003). Adoption of cross bred Dairy Cows in Arsi Zone. The case of Tiyo and Lemu Bilbilo woredas. MSc. Thesis (Unpublished) Presented to School of Graduate Studies of Alemaya University, Ethiopia.12pp.

Headey, D. and Shenggen, F. (2010). *Reflections on the Global Food Crisis: How did it happen? How has it hurt? And how can we prevent the next one?* Research Monograph 165, International Food Policy Research Institute 22pp.

Hox, J.J. and Boeije, H.R. (2005). Data Collection, Primary vs. Secondary; Utrecht University, Utrecht, The Netherland. 8pp.

IDRC (2003). *Design and Conducting Health System Research Projects.* Proposal Development and Field work. Mauristikade 63, 1090 HA Amsterdam, Netherlands. 357pp.

International Rice Research Institute (IRRI), (1995). World Rice Statistics, International Rice Research Institute. Metro Manila. Philippines. pp 341-342.

Igodan, C.O., Ohaji, P.E. and Ekpere, J.A. (1988). *Factors Associated with the Adoption of Maize Production*. Practice for in the Kainji Lake Basin of Nigeria. Agricultural Administration and Extension. pp.149-156.

Isham, L. (2002). The effect of social capital on fertilizer adoption: evidence from rural Tanzania. *Journal of African Economies* 11(1): 39-60.

Kajisa, K. and Payongayong, E. (2011). Potential of and constraints to the rice Green Revolution in Mozambique: A case study of Chokwe irrigation scheme. *Food Policy* 36: 614-625.

Kalusopa, T. (2005). The challenges of utilizing of Information Communication Technologies (ICTs) For the Small Scale Farmers in Zambia''. *Journal of Hi Tech* 23: 414 – 424.

Kassali, R., Ayanwale, A.B. and Williams, S.B. (2009). Farm location and determinants of agricultural productivity in the Oke-Ogun area of Oyo state, Nigeria. *Journal of Sustainable Development in Africa* 11(2): 19-21.

Kassie, M., Zikhali, P. Manjur, K. and Edwards, S. (2010). *Adoption of Organic Farming Technologies*: Evidence from a Semi-Arid Region in Ethiopia. FAO, Rome. 13pp.

Kato, F. (2007). Development of a major Rice cultivation area in the Kilombero valley, *Tanzania African Study Monographs, Supplement* 36: 3 -18.

Kauzeni, A.S. (1988). The transfer of Agricultural Technology in Tanzania. In:Science and Farmers in Tanzania. (Edited by Teri, J.M. and Mattee, A.Z.). Sokoine University of Agriculture, Morogoro, Tanzania. pp 126 – 135.

Langyintuo, A. and Mekuria, M. (2005). Modeling Agricultural Technology Adoption Using the Software STATA. CIMMYT-ALP Training Manual No. 1/2005 (Part Two). International Maize and Wheat Improvement Center, Harare, Zimbabwe. 24pp.

Lapar, M.L.A. and Ehui, S. (2003). Adoption of Dual – Purpose Forages: Some policy implications. *Trop. Grasslands* 37: 284 – 291.

Lawal, J.O. and Oluyole , K.A. (2008). Factors Influencing Adoption of Research Results and Agricultural Technologies among Cocoa Farming Households in Oyo State, Nigeria. *Int. J. Sustain. Crop Prod.* 3(5): 10-12.

Lwezaura, D., Madulu, R., Ndunguru, A., Charles, P. and Chalamika, B. (2011). Baseline Survey Report; Regional Rice Center of Excellence. 46 pp.

Mghase, J., Shiwachi, H., Nakasone, K. and Takahashi, H. (2010). Agronomic and socio-economic constraints to high yield of upland rice in Tanzania. *African Journal of Agricultural Research* 5(2): 150-158.

Mignouna, B., Manyong, M., Rusike, J., Mutabazi, S. and Senkondo, M. (2011). Determinants of Adopting Imazapyr-Resistant Maize Technology and its Impact on Household Income in Western Kenya: *AgBioforum* 14(3):158-163.

Milder, J.C., Hart, A.K. and Buck, L.E. (2013). Applying an Agriculture Green Growth approach in the SAGCOT Clusters: Challenges and opportunities in Kilombero, Ihemi and Mbarali. Dar es Salaam: SAGCOT Centre.

Minot, N. (2010). Staple food prices in Tanzania, Paper prepared for the COMESA policy seminar on *"Variation in Staple Food Prices: Causes, Consequence, and Policy Options"*, Maputo, Mozambique, 25-26 January under the African Agricultural Marketing Project (AAMP) 67pp.

Morris, M., Valerie, A.K. Kopicki, R.J. and Byerlee, D.R. (2007). *Fertilizer Use in African Agriculture: Lessons Learned and Good Practice Guidelines.* Washington: World Bank.17pp.

Mpuya, J.H. (2010). Input Use Efficiency for Maize Production in Tanzania. A case of Small Holder Farmer in Iringa Region. Dissertation for Award of MSc Degree at Sokoine University of Agriculture, Morogoro. pp 34-36.

Mur, R. and Nederlof, S. (2012). Innovation for fashion or action? Building Innovation Capacity. Learning from Research into Use in Africa (1). KIT Publishers. Amsterdam.

Mushtaq, S., Hafeez, M. and Khair, S.M. (2007). Determination of Optimal Input usage into the Wheat Production for Kareze Irrigation in the Balochistan, *Pakistan Asian Journal of Plant Science* 6(6): 809-814.

Mustapha, M.C. (2004). Management of rice production system to increase productivity in Gambia, West Africa. Dissertation for Award of Doctor of Philosophy Degree at Cornell University.159pp.

Muthamia, J.G.N., Musembi, F., Maina, J.M., Okuro, J.O., Amboga, S., Muriithi, F., Micheni, A.N., Terry, J., Overfield, D., Kibata, G. and Mutura, J. (2001). Participatory On-farm Trials on Weed Control in Smallholder Farms in Maize-Based Cropping Systems. Seveth Eastern and Southern Africa Regional Maize Conference, Nairobi, Kenya. 11th – 15th February 2001, pp.468-473.

National Bureau of Statistics (NBS), Ministry of Agriculture and Food Security (MAEC), Ministry of Water and Livestock Department (MWLD), Ministry of Cooperative and Marketing (MCM) and Presidents Office, (2009). National Sample Census of Agriculture 2007/2008 Small Holder Agriculture Crop Sector. National Report. Dar es Salaam. 88pp.

Nakano, Y., Bamba, I., Diagne, A., Otsuka, K. and Kajisa, K. (2013). The possibility of a rice Green Revolution in large-scale irrigation schemes in Sub-Saharan Africa. In Otsuka, K. and Larson, L. (eds.) An African Green Revolution: Finding 21 ways to boost productivity on small farms. Dordrecht: Springer Netherlands. 67pp.

Nobeji, S., Boniphace, N., Fengying, K. and Fang, C. (2014). An Analysis of Factors Affecting Smallholder Rice Farmers' Level of Sales and Market Participation in Tanzania; Evidence from National Panel Survey Data 2010 -2011. *Journal of Economics and Sustainable Development* www.iiste.org ISSN 2222-1700 (Paper) ISSN 2222-2855 (Online) 5(23): 2014- 2015.

Noorhosseni-Niyaki, S.A. and Allahyari, M.S. (2012). *Logistic Regression Analysis on Factors affecting Adoption of rice fish farming in North Iran;* Rice Science. pp153-160.

Obisesan, A. (2014). Gender Differences in Technology Adoption and Welfare Impact among Nigerian Farming Households, MPRA Paper No. 58920.

OECD (2001). Measuring Productivity: Measurement of Aggregate and Industry-Level. OECD Manual. [www.SourceOECD.org] site visited on 14/06/2014.

Orojobi, J.O. and Damisa, M.A. (2007). Assessment of Agrochemical Input Application on Smallholder Farms in Kaduna State Nigeria. *Nigerian Journal of Rural Economy and Society* 4 (2): 56-61.

Ogundele, O.O. and Okoruwa, V. O. (2006). "Technical Efficiency Differentials in Rice Production Technologies in Nigeria". AERC Research Paper 154. African Research Consortium, Nairobi. pp 1 - 37.

Ouma, J.O. De Groot, H., Owuor, G. (2006). Determinants of improved maize seed and fertilizer use in Kenya: Policy implication. Paper presented at the International Association of Agricultural Economists' Conference, Gold Cost, Australia, August 12-18.

Otsuka, K. and Kalirajan, K. (2005). An exploration of a Green Revolution in Sub-Saharan Africa. *Electronic Journal of Agricultural and Development Economics* 2 (1): 1-7.

Otsuka, K. and Kijima, Y. (2010). Technology policies for a Green Revolution and agricultural transformation in Africa. *Journal of African Economies* 19 (2): 60-76.

Otsuka, K. and Larson, D. (2013). *An African Green Revolution: Finding Ways to Boost Productivity on Small Farms*. Dordrecht: Springer Netherlands.35pp.

Ozowa, V.N. (1997). Information Needs of Small Scale Farmers in Africa. The Nigerian Example [http://www.world bank. Org/ html/cigar/ newsletter/June/ kiroku] site visited on 30/5/ 2014.

Pacanoski, Z. and Glatkova, G. (2009). The Use of herbicides for Weed Control in Direct Wet-Seeded Rice (Oryza sativa) in Rice Production Regions in the Republic of Macedonia: *Journal of plant Protect. Sci.* 45: 113-118.

Pallant, J. (2002). SPSS survival manual: A step by step guide to data analysis using SPSS for windows (version 12), Allen and Unwin, Sydney. pp136.

Pan, L. and Luc Christianensen, (2011). Who is Vouching for the Input Voucher? Decentralized Targeting and Elite Capture in Tanzania. World Bank Policy Research Working Paper Series 5651. Washington D.C., The World Bank. available at SSRN. [http://ssrn.com/abstract=1833175] site visited on 12/06/2014.

Pangani, M.D. (2007). Perceptions of small holder on the effectiveness of female and male agriculture and Livestock extension field officers based on the Akap sequence. A case study of Mvomero District. Dissertation for award of MSc. in Agriculture Economics of Sokoine University of Agriculture. 65pp.

Perz, S.G.L. (2003). Social Determinants and Land Use Correlates of Agricultural Technology Adoption in a Forest Frontier: A Case Study in the Brazilian Amazon. *Human Ecology* 31(1): 133-165.

Petrick, M. (2004). Farm investment, credit rationing, and governmentally promoted credit access in Poland: a cross-sectional analysis. *Food Policy,* 29(3): 275-294.

Ransom, J.K., Paudyal, K. and Adhikari, K. (2003). Adoption of Improved Maize Varieties in the Hills of Nepal. *Agricultural Economics* 29(2): 299 – 305.

Rao, V.S. (2000). *Principle of Weeds Science*. Science Publishers INC, USA. 555 pp.

Ricker-Gilbert, J., Jayne, T.S. and Chirwa, E. (2011). Subsidies and crowding out: A double-hurdle model of fertilizer demand in Malawi. *American Journal of Agricultural Economics* 93(1): 26-42.

Rogers, E. (2003). *Diffusion of Innovations, Fifth Edition,* Free Press, New York. 221pp.

Rural Livelihood Development Strategy, (2009). Improving rice profitability through increased profitability and better marketing focusing on Tanzania's central corridor, [http://www.rldp.org/downloads/rice_strategy.pdf] site visited on 13/03/2014.

Sadak, P.T.G. (2007). *Impact Study on Farmer's Group Approach Adopted in Agricultural Extension System of Nepal.* Directorate of Agriculture Extension Department of Agriculture, Harihar Bhawan, Lalitpur. 98pp.

Salehin, M.M., Kabir, M.S., Morshed, K.M. and Farid, K.S. (2009). Socio-economic changes of farmers due to adoption of rice production technologies in selected areas of Sherpur district: *J. Bangladesh Agril. Univ.* 7 (2): 335-341.

Salam, A. (2003). *Factor Inputs use and Farm Productivity on Different Farm Categories in the Punjab*; The Pakistan development review; Pakistan. pp.16.

Salami, A., Kamara, S., Abdul, B. and Brixiova, Z. (2010). *Smallholder Agriculture in East Africa: Trends, Constraints and Opportunities, Working Papers Series No. 105* African Development Bank, Tunis, Tunisia. 32pp.

Samson, E.L. (2007). Communication pertains among Extension personnel and farmers. A case of Dire Dawa administrative council Ethiopia. Dissertation for award of MSc. Degree at Sokoine University of Agriculture, Morogoro, Tanzania. 139pp.

Seck, P.A., Tollens, E., Wopereis, M.C., Diagne, A. and Bamba, I. (2010). Rising trends and variability of rice prices: Threats and opportunities for Sub-Saharan Africa. *Food Policy* 35(5): 403-11.

Strauss, J.J., Barbosa, M., Teixeira, S., Thomas, D. and Gomes, R.J. (1991). Role of Education and Extension in the Adoption of Technology: A study of Upland Rice and Soybean Farmers in Central-West Brazil. *Agricultural Economics* 5(4): 341- 359.

Tabi, A.J., Vabi, M.B. and Malaa, D.K. (2010). Adoption of Maize and Cassava Technologies in the Forest-Savannah Zone of Cameroon: Implications for Poverty Reduction. *World Applied Sciences Journal,* 11(2): 196-209.

Tsusaka, T. and Otsuka, K. (2013). The impact of technological changes on crop yields in Sub-Saharan Africa, 1967-2004, in: Otsuka, K. and Larson, D. (eds.) An African Green Revolution: Finding Ways to Boost Productivity on Small Farms, Dordrecht, Netherlands: Springer. 32pp.

Tulahi, R.C. and Hingi, P.M. (2006). Agrarian reform and rural development in Tanzania. Paper presented at the International Conference on Agrarian Reform and Rural Development pp.118.

Tulole, L.B. (2011). Assessment of Rice Production Constraints and Farmers Preference in Nzega and Igunga Districts. *Journal of Advances in Developmental Research* 2(1): 30 – 37.

Uaiene, R., Arndt, C. and Masters, W. (2009). Determinants of Agricultural Technology Adoption in Mozambique. Discussion papers No. 67E. 66pp.

UBoS (2010). Uganda National Household Survey: Socio-economic Module. Abridged Report. Kampala, Uganda: UBoS. 77pp.

URT (2009). Rice Sector Strategy Improving Rice Profitability through Increased Productivity and Better Marketing Focusing on Tanzania's Central Corridor: Rural Livelihood Development Company pp.37-39.

URT (2010). National Sample Census of Agriculture 2007/08: Preliminary Report. 22pp.

URT (2011). *Regional Rice Centre of Excellence*; *Inventory of Rice Technologies*; Extension Services section. 34pp.

URT (2012). Agricultural Public Expenditure Review (PER) for Inputs Support Programme, for FY 2012/13. 20pp.

URT (2013). National Population and Housing census, National Bureau of Statistics Ministry of Finance Dar es Salaam and Chief Government Statistician President Office, Finance, Economy and Development Planning Zanzibar. pp 264.

USAID/COMPETE, (2010). United States Agency for International Development (USAID) and the Competitiveness and Trade Expansion Program. *Staple Foods Value Chain Analysis: Country Report: Tanzania.* Prepared by CHEMONICS International Inc.

Wambura , J.B. (2004). Socio economic factors influencing the adoption of agro- forestry practices in Nyanja Division, Musoma rural. Dissertation for of MSc. Degree at Sokoine University of Agriculture, Morogoro, Tanzania. 87 pp.

Wennink, B. and Heemskerk, W. (2007). Access of the Poor to Agricultural Services : The role of farmers, organization in social inclusion. Bulletin No. 376. KIT Publishers, Amsterdam. 160pp.

Wiebe, K.D., Soule, M.J. and Schimmelpfennig, D. (2001). *Agricultural Productivity for Sustainable Food Security in Sub-Saharan Africa.* In Zepeda L (ed), Agricultural Investment and Productivity in Developing Countries, FAO, Rome. 54pp.

World Bank (2008). Agriculture for Development. World Development Report 2008. Washington, DC: World Bank. 2007 Available at [**Error! Hyperlink reference not valid.**] site visited on 3/5/2014.

World Bank (2012). *Gender Equality and Development.* The World Bank, Washington, DC.19pp.

APPENDICES

Appendix 1: Farmers questionnaire for the study on inputs access and paddy productivity

A case of Kilombero District, Tanzania.

Demographic Factor

Questionnaire no………. Date of interview……….. Interviewers name…………

Division……………..Ward……………Village………… Respondents name…………

SECTION 1: **Respondent's personal characteristics**

1. Household's head year of birth………..

2. Gender of the house hold head………… 1=Male 2=Female

3. Marital status………….1=Married (tick appropriate)

2= Single 3=Widowed

4=Divorced

4. Education level of the household head………. (Tick appropriate)

1=No formal education 2=Standard four 3= Standard seven

4=Secondary education 5= Others (Specify)

5. Household's approximate annual income in Tsh……………. (Tick appropriate)

1= Less than 50000Tsh 2= 50000 – 100000Tsh

3=100000 – 200000Tsh 4 = Above 200000Tsh

Information on crop production and respondents other source of income

Crops Grown and their Area

S/N	Crop type	Area under production in 2013 - 2014
1	Paddy	
2	Maize	
3	Other (specify)	

6. House hold head experience in paddy production (years)..................

7. How much land do you own................................acres?

8. Is all the land you own on one plot Yes/No?

9. If no how many plots do you own.................

Show their sizes in the Table below;

Land owned	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5
Plot size					
Distance from home to plots					

10. How have you obtained the land you own?

1. Inheritance
2. Buying
3. Others (specify)

11. Amount of crop harvested

Year	Amount harvested in bags
2012/2013	
2013/2014	

Households' use of inputs in paddy production

12. When did you start using agricultural inputs in paddy production?

1 = Last year   2 = Obvious/Always

3. Others (specify)

13. How many bags did you use to harvest before starting to use agricultural inputs in paddy production per acre?

1 = 0 – 5 bags   2 = 6- 10 bags

3= 11 – 15 bags   4 = Above 20 bags

14. How many bags do you harvest since the application of agricultural inputs in paddy production per acre?

1 = 10-15bags 2 = 16 – 20 bags 3 = 21-25bags 4 = above 25 bags

15. Did you purchase fertilizer or any other agrochemical in 2013/2014 growing season? (Tick appropriate)

1=YES 2 = NO

16. If YES please indicate the amount used in table below 21. Which rice varieties did you plant in 2012/13 and 2013/14 season?

Variety	2012/13	2013/14
Local varieties(Afaa, Mwanza Tule na bwana,Moshi wa sigara,Shingo ya mwali,Kalamata,Mbawa mbili)		
Kilombero,Kihoko red,Sindano		
Super India		
TXD88		
TXD306		
Others specify		

17. Indicate amount of fertilizer used in production

	2012/13	2013/14
Urea (50 kg bag)		
SA (50 kg bag)		
CAN(50 kg bag)		
DAP (50 kg bag)		
Minjingu (50 kg bag)		
Others specify		

18. Indicate amount of herbicides and pesticides used in paddy production

	2012/13	2013/14
Pesticides		
Herbicides		

19. If NO why? (Tick appropriate)

1= Not available 3= Not necessary

2=Higher prices 4.Others (specify)

20. Do you seek agricultural advice Yes/No?

21.If yes from whom? 1. Village/Ward/Division Agricultural Extension Officer

2. Neighbours/Friends

3. Others (specify)....................................

22. If yes, what time of the year or during which operations?

Time	Number of visits
1. Ploughing	
2. Planting	
3. Weeding	
4. Harvesting	

23.If no give reasons...

24.Have you ever participated in extension training? 1. Yes 0. No

25. If yes, in what area of extension training have you participated?

____

____

26. Did the training contribute for the use of improved agricultural inputs? 1. Yes 0. No

27. If yes what are the significant contribution of the training in using agricultural inputs?

1. Increased demand for fertilizer use 2. Increased demand for seed use

3. Increased demand for farm tools use 4. Increased demand for pesticide use

5. Others specify______________

28. If your answer is no, why?

1. Not invited to participate 2. No interest in the program 3. Others specify

29. Where do you get agricultural inputs?

1= Agriculture office

2=Input supplier

3=From neighbour farmer

4= Other source (specify)

30. Would you advice your fellow farmer who is not using agricultural inputs to start using them in paddy production?

1 = YES 2 = NO

31. If NO, please give reasons

....

Social economic factors influencing paddy producing household's use of agricultural inputs

32. Are there credit institutions at your disposal? 1. Yes 0. No

33. If your answer is yes, what is the name of credit institution?__________________

34. Have you ever used credit from the organization? 1. Yes 0. No

35. If your answer is yes, how frequent are you using credit from the institution?

1- Once per a year 2- twice per a year 3- others specify_________

36. What is the type of credit did you obtain? 1- In cash 2. In kind

37. If it is cash, for what purpose did you borrow the money?

1- To purchase inputs 2. For home consumption 3. Others specify____________

38. If your answer is to purchase inputs, what type of inputs did you purchase?

1- Seeds 2. Fertilizer 3. Farm tool 4. Pesticides 5. Others specify___________

39. If it is in kind, what are the inputs did you borrow?

1- Seeds 2. Fertilizer 3. Farm tools 4. Pesticides 5. Others specify___________

40- If your answer is no, what is the source of your money to purchase inputs?

1. From own farm income 2.Borrowed from neighbors 3.Gift from relatives

4. Others specify_______________

41. Are you a member of any farmers' organization?

1= Yes 2= No

42. If yes, which one?

1 = Self help group 2 = Cooperative 3 = Others

43. If no, give

reason____

44. Which advantages do you get from being a member of farmers group?

Advantages	1 = Yes, 2 = No
1. Easily access to agricultural inputs	
2.Getting knowledge on the use of agricultural inputs	

45. Indicate the quantities and respective prices for non subsidy inputs purchased for paddy production in 2013/2014

INPUTS	QUANTITY	UNIT PRICE	TOTAL COST
UREA(50kg)			
SA(50kg)			
CAN(50kg)			
DAP(50 kg)			
Minjingu(50kg)			
Seeds(5kg)			
Seeds(2kg)			
Pesticides			
Herbicides			
Total			

Paddy marketing

46. Do you have market for your surplus?

1= YES 2=NO

47. If yes, then, where do you sell?

1= Local traders, 3=Fellow farmers

2=Middle men outside the village 4=Other (specify)

48. If no, what is/are the main constraint (s) regarding access to market?

1. Unable to get market information 2. Far distant of market place

3. Unable to get alternative market 4. Lack of means of transportation 5. High market tax

6. If other, specify_______________

49. **Challenges facing small holder farmers towards accessing agricultural inputs**

What challenges do you face in your paddy production?

....

....

50. In your opinion what can be done to raise paddy productivity in your area?

....

....

....

....

THANK YOU VERY MUCH FOR YOUR TIME AND COOPERATION.

Appendix 2: Guidelines for Focus Group Discussion.

1. Kinds of agricultural inputs used by paddy producers in the village

2. Their sources of information on paddy production technology

3. Kinds of agricultural organization they have in their areas and benefits they get from being members of that particular organization.

4. Whether paddy producers consult Extension Officers in relation to their paddy production
5. Whether they receive any support from the government in promoting access to agricultural inputs
6. Current performance in paddy production compared to other crops like maize
7. How they use surplus obtained from paddy production
8. Challenges they face towards accessing agricultural inputs
9. Suggestion on how to improve agricultural inputs services in paddy production

Appendix 3: Checklist for Key Informants

1. General use of modern agricultural inputs in paddy production
2. Willingness of farmers to use modern agricultural inputs
3. Paddy production levels in KDC
4. Availability of FFS to train farmers on importance of using agricultural inputs
5. Whether there is any type of training provided to farmers on importance of using agricultural inputs
6. Does KDC have strategies in place to ensure smallholder farmers get access to agricultural inputs?
7. Whether there is any capacity building initiative in the area to ensure both men and women get access to agricultural inputs
8. Challenges facing the KDC's agriculture department in delivering services to smallholder farmers.

THANK YOU VERY MUCH FOR YOUR TIME AND COOPERATION