ACCESS TO AND ADOPTION OF IMPROVED SEEDS BY SMALLHOLDER FARMERS IN TANZANIA: CASES OF MAIZE AND RICE SEEDS IN MBEYA AND MOROGORO REGIONS

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

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ABSTRACT

The research was done to assess accessibility and adoption of improved maize and rice seeds among 200 smallholder farmers in Mbeya and Morogoro Regions. The specific objectives were to: assess smallholder farmers' knowledge on improved maize and rice seeds, assess smallholder farmers' attitude towards improved maize and rice seeds, determine the accessibility of improved maize and rice seeds, estimate the adoption rate of improved maize and rice seeds and determine the impacts of some socio-economic factors on the chances of smallholder farmers' adopting improved maize and rice seeds. Data were collected by mainly using a household questionnaire, and SPSS was used to analyse the data whereby, among other analyses, binary logistic regression was used to determine impacts of improved seed related factors on the chances of farmers adopting the seeds. The results showed that 66% and 81% of the household heads were aware of improved maize and rice seeds, respectively; and 29.0%, 7.5% and 63% of the respondents had unfavourable, neutral and favourable attitudes towards improved seeds. It was also found that the proportions of households which had access to improved maize and rice seeds were 40.5% and 34.5% respectively, while those which had adopted the seeds were 56.0% and 71.0%, respectively. The factors which had the highest positive impact on the chances of smallholder farmers adopting improved maize and seeds were land for rice production (Wald statistic = 51.772, $p < 0.001$) and farmers' awareness of improved seeds (Wald statistic = 8.515, $p < 0.01$). It is concluded that increasing acreage for rice and creation of more awareness about improved seeds are big determinants of adoption of improved seeds. Therefore, it is recommended that the government and other institutions dealing with agriculture should put more emphasis on accessibility and adoption of improved maize and rice seeds in order to improve rice and maize productivity in Tanzania.

DECLARATION

I, Anna Gerald Monela, do hereby 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.

_____ _____

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The above declaration is confirmed by:

_____ _____

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(Supervisor)

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DEDICATION

I dedicate this dissertation to my beloved parents Prof. and Mrs. Monela for bringing me up with affection and for financial support during my graduate studies.

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LIST OF ABBREVIATIONS

APSF	The Anaesthesia Patient Safety Foundation
ASA	Agricultural Seed Agency
ASARECA	The Association for Strengthening Agricultural Research in Eastern and Central Africa
CIMMYT	International Maize and Wheat Improvement Centre
CGRFA	Commission on Genetic Resources for Food and Agriculture
FAO	Food and Agriculture Organization
IMV	Improved Pollinated Varieties
ITPGRFA	International Treaty on Plant and Genetic Resources for Food and Agriculture
KATC	Kilimanjaro Agricultural Training Centre
OECD	Organization for Economic Cooperation and Development
OPV	Open Pollinated Varieties
PASS	Private Agricultural Sector Support
RLDC	Rural and Learning Development Committee
RSS	Rice Sector Strategy
URT	United Republic of Tanzania
USDA	United States Department of Agriculture

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the Problem

According to Merriam Webster Dictionary (2014), seed is the reproductive structure in plants that consists of a plant embryo, usually accompanied by a supply of food (endosperm, which is produced during fertilization) and enclosed in a protective coat. Seeds are basic agricultural inputs. More importantly, quality seeds of any preferred variety are a basis of improved agricultural productivity since they respond to farmers' needs for both their increasing productivity and crop uses (Pelmer, 2005). Seed is a major investment by smallholder farmers, but across Africa there are multiple supply chain pathways, within which it is important to understand the different actors (breeders, seed companies, agro-input traders, etc.) and the behaviour of farmers that underpins more sustainable models of seed production, distribution and related impacts in farmers' fields (Pinto *et al.,* 2011). Access to improved seeds is an integral factor for stimulating technology uptake and increasing agricultural productivity in smallholder agriculture. Such access is constrained by weak seed supply systems in many sub-Saharan African (SSA) countries; the systems have been identified as limiting factors for widespread adoption of improved seed varieties (Tripp, 2000).

Over the long term, large investments and sustained political commitment are needed to ensure strong plant breeding and seed systems to serve smallholders, predicated on improved crop management practices to protect soils and cope with unreliable rainfall, and access to appropriate labour-saving technologies (Smale *et al.,* 2013). In view of that, more innovative extension and advisory systems are also needed to facilitate farmer learning and adapt techniques and technologies to local environmental and social

conditions. Nevertheless, better financial services, perhaps including new forms of insurance, are needed for smallholders.

In the case of Tanzania, seed production is not good compared to other neighbouring countries such as Kenya and Uganda, which gradually increased seed production from less than 1000 tones to more than 3000 tones. Proportionately, Sudan, Kenya and Ethiopia accounted for 36%, 32% and 14% of the total seeds produced over the 2002-2008 period while Tanzania produced the least amount of seed in the region at 4% (ASARECA, 2012). Relative to that, further evidence shows that there is no strong farmers' demand for seeds despite the efforts of research institutions to develop various seed varieties with more productivity patterns, and drought and disease tolerance. This has been a major constrain to farm input suppliers to sell improved seeds. First and foremost, farmers' awareness of the quality, availability, marketability of produce of these seeds is very low. It is a fact that most of the farmers lack knowledge on the improved seeds hence stick to traditionally preferred varieties which are not economically efficient but have prominent aromatic and palatability characteristics (RLDC, 2009).

Tanzania has the capacity to produce 1.3 to 1.5 metric tons of rice per hectare annually if small holder farmers were to adopt improved farming practices (PASS Trust, 2013). Tanzania is the second largest producer of rice in Southern Africa after Madagascar with a production level of 818 000 tonnes (USDA World Rice Statistics, 2007). Tanzania has traditionally grown local varieties of rice which have descended from the seeds originally imported by Arab traders before 1960. These varieties include Supa, Behenge, Kula na bwana, Kalamata and many others which are well adapted to the climate and the taste preference of the Tanzanians, but they are relatively low yielding, averaging 1 to 1.5 tons per acre (RLDC, 2009). The current trend reveals that there is no significant use of

improved seeds by farmers; nor are rice seeds distributed by private seed companies operating in Tanzania today sufficient. Such companies were about 15 in number in 2009. Hence, most of the seeds planted by the majority of farmers are obtained either by using their own seeds or by farmer to farmer exchange (RLDC, 2009).

Maize is the third most important cereal crop after wheat and rice. Improving maize production is considered to be one of the most important strategies for food security in the developing countries. The diffusion of the improved maize varieties (IMV), like hybrids and open pollinated varieties (OPV) can greatly increase maize yield per unit of land. However, farmers' choice on improved varieties is one of the most crucial factors affecting the productivity of a crop. This is influenced by many factors that affect the farmers' variety adoption decisions (Rogers, 2003). Therefore, this study intended to assess the accessibility and adoption of improved seeds among smallholder farmers in Mbeya and Morogoro Regions, particularly why there is low accessibility and adoption of improved seeds varieties among smallholder farmers, despite the presence of agricultural policies that promote the adoption of fertilisers and hybrid seed technologies.

1.2 Problem Statement

Despite decades of agricultural policies that promoted the adoption of fertiliser and hybrid seed technologies as ways of improving productivity in the agricultural sector, there have been low rate of adoption of improved seeds among smallholder farmers in Tanzania. According to the Agricultural Census of 2002/03, only 5.7% of maize farmers and 0.7% of paddy farmers in Tanzania use improved varieties of the crops together with fertilizer. The few farmers who use improved maize and rice varieties with fertilizer obtain significantly higher yields than those who use unimproved varieties (Agricultural Census, 2002/03).

One wonders why the adoption of improved seeds is still so low, despite the fact that suppliers of improved maize and rice seeds have been increasing and there is high production of maize and rice crops in Mbeya and Morogoro regions. The probable answers to this overarching problem could be small farm sizes, risk exposure, low capacity to bear risks, low human capital, low availability of labour, land tenure, access to financial and produce markets, access to information, participation in off-farm activities, social capital, household characteristics and ecological and environmental factors. However, it is not known empirically whether any of these factors holds; even if some of them may hold, the extents to which they hold are not known. Therefore, the aim of the research was to assess accessibility and adoption of improved maize and rice seeds among smallholder farmers in Mbeya and Morogoro Regions.

1.3 Research Justification

Efforts have been made by different institutions to ensure development of seed systems in order to improve accessibility and adoption of seed varieties to small holder farmers. The efforts include the programme for Africa's Seeds Systems (PASS), *Kilimo Kwanza* (Agriculture First), and Ministry of Agriculture, Food Security and Cooperatives which is actively involved in participatory extension of improved rice and maize technologies and management of smallholder irrigation schemes through training of farmers and extension staff. On top of that, different institutes and centres for development of seeds have been established; they include Kilimanjaro Agricultural Training Centre (KATC) in Moshi, MATI Ukiriguru in Mwanza, MATI Igurusi in Mbeya, MATI Ilonga in Morogoro and Mkindo Farmers Training Centre in Morogoro (URT, 2009).

Despite the efforts and roles of various institutions towards development of various seed varieties with more productivity patterns, drought and disease tolerance, still there is low

adoption and access of improved seed varieties among smallholder farmers. If more farmers do not adopt improved seed varieties, while their main source of livelihood is agriculture, it is very likely that they will remain poor. This study is timely because it is in line with the Rice Sector Strategy (RSS) objective to increase rice production by 2018 in Tanzania through the Agricultural Seed Agency (ASA), which aims at increasing awareness and access of farmers to improved rice seeds, among other things. It is also timely during this era when the Government of Tanzania is emphasizing on bringing about a green revolution. Adoption of improved seeds will help increase agricultural productivity for the green revolution.

This research was important as to reveal factors for non adoption or poor adoption of improved seeds. The findings have a potential to help increase awareness of the range of actors along the entire system of seed production, processing, planting, harvesting and finally to the end use at the market. Moreover, the findings are important to planners, policy makers and implementers towards the joint goal of improving small farmers' lives through emphasizing on the adoption and easy access to improved seed varieties.

1.4 Research Objectives

1.4.1 General objective

The general objective of the research was to determine accessibility and adoption of improved maize and rice seeds among smallholder farmers in Mbeya and Morogoro Regions, Tanzania.

1.4.2 Specific objectives

The specific objectives of the research are:

i. To explore smallholder farmers' knowledge about improved maize and rice seeds.
ii. To establish smallholder farmers' attitude towards improved maize and rice seeds.
iii. To determine the extents to which improved maize and rice seeds are accessible by smallholder farmers.
iv. To estimate the proportions of households which have adopted and those which have not adopted improved maize and rice seeds.
v. To determine the impacts of some socio-economic factors on the chances of smallholder farmers adopting improved maize and rice seeds.

1.4.3 Research questions

i. To what extent are men and women smallholder farmers aware of improved maize and rice seeds?
ii. Is the attitude of women and men smallholder farmers towards improved maize and rice seeds unfavourable, neutral or favourable?
iii. To what degree are improved maize and rice seeds available and accessible by smallholder men and women farmers?
iv. What are the percentages of households which have adopted improved maize and rice seeds?

1.4.4 Hypothesis

1.4.5 Null hypothesis (H_0)

Farmers' awareness of improved seeds, attitude towards improved seeds and rice acreage do not have significant impact on the chances of adoption of improved seeds.

1.4.6 Alternative (H_1)

Farmers' awareness of improved seeds, attitude towards improved seeds and rice acreage have significant impact on the chances of adoption of improved seeds.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Definition of Key Terms

2.1.1 Smallholder farmer

The definition of the term 'smallholder farmer' varies among countries and ecological zones due to different factors such as crop types, area cultivated and production. Probably, people who participate in the day to day activities by providing labour and management of the farm/livestock can be considered as smallholder farmers (Babu and Sanyal, 2010).In Tanzania a farmer operating less than 50ha or 50 heads of cattle (local breed) is considered to be small depending on the crop. This is according to APSF (2010).Other scholars such as Asuming-Brempong *et al.* (2007) note that different resources and risk conditions better define smallholders than simple measures of landholdings. Due to those arguments above, the research used the definition by Assuming-Brepong *et al*. (2007) of who is a smallholder farmer.

2.1.2 Improved seeds

Improved seeds can be defined as seeds that aim at increasing quality and production of crops by having characteristics such as drought tolerance, high yielding and early maturity (FAO, 2009). Nkonya, (2001), defines an improved variety as any variety that has been bred using formal plant breeding methods. Other scholars such as Cho (2013) define improved seeds by dividing it into pieces as: Open pollinated seeds which are those produced from natural, random pollination. Traditionally, farmers saved the best of these seeds for use from year to year. Hybrid seeds result from cross-breeding two parent plants that have desirable traits. The resulting plants realize their potential in the first season, but lose effectiveness in subsequent generations so farmers must buy new seeds each year and

genetically, modified seeds are created when one or two genes with the desired traits from any living organism are transferred directly into the plant's genome. The research used the previous definition in order to show the relationship between smallholder farmers' adoption and accessibility to improved seeds.

2.2 Informal and Formal Seed Sectors

According to Almekinders (2000), the informal seed sector is usually defined as the total of seed production activities of farmers, mostly small-scale farmers. In contrast, the formal .A seed sector refers to seed production activities by the public and commercial sectors. Synonyms used for informal seed sector are 'local' or 'farmers' seed system(s)'. However, a clear-cut distinction between the informal and formal seed systems does not exist in the situations where public or private institutions are engaged in the production of uncertified, unlabelled or registered seed lots. Also, CGRFA (2011) argues that the formal seed supply system is highly regulated and involves a chain of activities leading to clear products which are certified seeds of verified varieties. The chain usually starts with plant breeding and selection, resulting in different types of varieties, including hybrids, and promotes advanced fixed germplasm materials leading to formal varieties release and maintenance. On the other hand, the informal seed supply system (or informal seed system) refers to the traditional arrangements used by farmers to supply the seeds they need to plant in the following season. Other names given to informal seed supply systems include: farmer-managed seed system: farm-based; local seed production and supply; traditional seed system; and farmers' seed system (CGRFA, 2011).

2.3 Linkages between Formal and Informal Seed Sectors

Functional linkages between the formal and informal seed sectors enhance efficiency in the operation of both sectors and promote evolution of the seed sector in general. The

formal seed sector is the primary source of new crop varieties, and is home to most of the capacity in ‘scientific’ plant breeding, extension services and credit. The informal sector is the primary link to farmers’ traditional knowledge, especially requirements for new varieties, inputs and services. Strong smallholder seed enterprises can play a key role in linking the two sectors, if they have continuous access to improved varieties from public crop breeding programmes (FAO, 2009). The relative importance of these two systems varies depending on the state of development of the agricultural system and the crops. About 80% of food production reportedly comes from farmers with smallholding and the majority of farmers in developing countries use seeds from the informal seed system. Most of the seeds covered by this system fall within crop groups that are not of commercial interest to the private sector but the bulk of which constitute important food security crops. Contrary to conventional views, the formal and informal seed delivery systems coexist in large part in developing countries and in some cases in developed countries; farmers will usually resort to either or both of these systems for different crops and for different seasons (CGRFA,2011).

2.4 Quality of Seed

Among all inputs for agriculture, whether commercial or subsistence, seed has a unique feature, as it is a means for delivering technology to farmers. Value in agricultural genetic resources lies in the diversity within a crop and seed is the vehicle for carrying this genetic diversity over time and space. Regardless of the scale of agriculture, seed quality, particularly its genetic attributes, determines the level of crop productivity in the presence of other crop production inputs. An estimated 50% of the global increase in yields over the past fifty years has been derived from genetic progress and seed quality, in addition to agronomy improvement and phytosanitary product uses (CGRFA, 2011). For the last 20 years, some studies indicate that the percentage link to genetic progress is increasing and

around 90% for wheat and barley with a sustainable agricultural production management. Hence seed security is important for food security. Unlike other agricultural inputs such as fertilizer and pesticides, the specific characteristics of seed make its delivery to farmers complicated. According to CGRFA (2011), seed is a living organism and requires appropriate handling, processing and storage operations in order to ensure that its viability is maintained until it is sown in the field. Seed quality is an essential element of seed systems: when provided to farmers seed should have high germination and vigour, high levels of genetic and physical purity and be free from pests and diseases. Multiple cycles of production are necessary to generate quality seed and in order to obtain the quantities required to meet market demand. Thus, the seed supply chain generally differs greatly from that of other inputs. While the availability of quality seeds is no longer a critical issue for farmers in the developed world, most developing countries still face serious fundamental problems related to farmers' access to quality seed and improved varieties of crops species suited to their needs and adapted to their agro-ecological conditions. There are major constraints, related to a lack of efficient and sustainable conservation and utilization of agricultural biodiversity, for the eventual development of effective seed delivery systems. Consequently, member countries regularly request FAO's technical and policy support to address some of the deficiencies in the complex seed production and supply system.

2.5Maize and Rice Seeds Globally

Seeds were not created once, remaining the same thereafter. They are not things, but part of a constant process of creation. As such, people struggle over them and over different visions of farming and agriculture. About 100 years ago, a process began that aimed to change agriculture according to an industrialized vision of life. This process transformed food production in many areas of the world. The modification of seeds was at the heart of

the transformation, enabling the homogenous and oil-dependent crops that dominate in industrial agriculture today (La via Campesina, 2013). There are thousands of seed banks around the world, and their carefully-stored catalogues are of vital importance to our species and the health of the ecosystems we occupy. As we continue to invade the diminishing wild areas of our planet, we risk biodiversity loss on an unprecedented scale (Sensi seeds, 2013).

Governments are strongly encouraged to implement a predictable, reliable, user friendly and affordable regulatory environment to ensure that farmers have access to high quality seeds at a fair price. In particular, FAO member countries are urged to participate in the internationally harmonized systems of the Organization for Economic Cooperation and Development (OECD), the International Union for the Protection of New Varieties of Plants (UPOV), the International Treaty on Plant and Genetic Resources for Food and Agriculture (ITPGRFA) and the International Seed Testing Association (ISTA). Participation in those systems will facilitate the availability of germ plasm, new plant varieties and high quality seeds for the benefit of their farmers, without which their ability to respond to the challenges ahead will be substantially impaired (FAO, 2009).

Peasants, local, communities, subsistence and family farming still produce 75% of the food that is consumed on the planet, and 90% of non-mechanized non-motorized farmers of the world produce the majority of their seeds by themselves (La via Campesina, 2013). The successful struggles against GMOs have shown that small-scale farmers and citizens of the world can kill this programme. The labelling obligation allows many countries to reject unwanted seeds, but new patents on non-labelled transgenic seeds are conquering our fields. Multinational corporations are using them to take over all of the world’s seeds.

Whoever controls the seeds controls the right to food, food sovereignty, and the political sovereignty of the people (La via Campesina, 2013).

2.6Maize and Rice Seeds in Developing Countries

Over 90% of the crops in developing countries are still planted with farmers' varieties and farm-saved seeds. Private seed companies tend to concentrate on production of hybrid seeds, especially of high-value crops grown by larger farmers in more favourable areas, i.e. targeting those who are best able to pay for the seeds. They tend to avoid self-pollinating crops, including many of those grown by smallholder farmers and on which they depend for their food security. Also for these crops, opportunities for commercial seed production are very limited because the biology makes it easy for farmers to save their own seeds for planting (FAO, 2009).

Farmers everywhere need easy access to high-quality seed of well-adapted, productive crops to allow them to produce the best possible crops, but efforts to encourage the private sector to play a role in ensuring efficient production and distribution of seeds in the developing world have yielded mixed results. The problems are complex as they combine both the reproductive mode of the major food security crops (mostly self-pollinated, open-pollinated and vegetative propagated crops), and the stage of agricultural development of the country (FAO, 2009).

Most developing countries' seed sectors fall in the aforementioned first two stages (pre-industrial and emergence). These two stages are mainly characterized by subsistence farming and the adoption of improved self- and open-pollinated varieties. The public sector organizations begin with plant breeding and producing seed. Although most seeds are still farm-saved, increasing numbers of farmers buy commercial seeds of their food

crops from nascent smallholder seed enterprises (CGRFA,2011).Therefore, their development and efficiency should be of utmost importance to governments as they better handle self- and open-pollinated crop seed not profitable enough to larger companies.

2.7 Maize and Rice Improved Seeds in Tanzania

The existing potentials for rice production in Tanzania include rain fed upland, lowlands and irrigated lowlands ecosystems; range of small, medium and large scale producers; comparative advantage of rice over other food crops for income generation and enhancing household food security; availability of some improved rice production technologies and dissemination channels, and availability of some programmes for increasing production and productivity of cereals including rice (URT, 2009). In 2009, with favourable growing conditions and improved economic incentives, the global rice cultivated area was forecast to rise by 1.5% from 156.3 million to 158.6 million hectares and the yield by 2.4 percent from 4.2 tons to 4.3 tons of paddy per hectare (FAO, 2008).

According to URT (2009), availability of adequate seed varieties having tolerance to drought, cold weather, major insect pests and diseases are major challenges facing the rice sub-sector in Tanzania. There are hundreds of local/traditional rice varieties grown by farmers in the rain-fed lowland, irrigated low land and upland ecosystems. Most of these varieties have, however, low yield potential, 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% of farmers. The use of self-saving seeds is common among small scale rice farmers, but these seeds are of low quality.

There are active breeding activities implemented by the Research and Development Institutions in Tanzania and in other countries in Eastern and Central Africa (ECA) in the

region where improved seed varieties that are resistant to biotic and abiotic stresses are generated. For example, varieties released in Tanzania such as *kalalu* and *mwangaza* are Rice Yellow Mottle Virus (RYMV) disease resistant, while high yielding variety TXD 306 (SARO 5) which has improved grain quality and aroma is highly preferred by consumers and farmers followed by non-aromatic high yielding varieties such as TXD 85 and TXD 88. At regional level WARDA has introduced 18 upland NERICAs and several lowland varieties that are currently being evaluated in fields (URT, 2009).

In 2008, Agricultural Seed Agency (ASA) produced and marketed about 120, 000 tonnes of improved rice seeds. These efforts are being supported by Development Partners such as Alliance for a Green Revolution in Africa (AGRA) and Bill and Melinda Gates Foundation. Breeder (pre-basic) seeds are multiplied at agricultural research stations such as Kilombero Agricultural Training and Research Institute (KATRIN) at Ifakara and CHOLLIMA at Dakawa. Quality Declared Seeds (QDS) are produced by farmers in groups or individually and sold to ASA, agro-dealers or direct to farmers in the same locality (URT, 2009).

Maize is the third most important cereal crop after wheat and rice. Improving maize production is considered to be one of the most important strategies for food security in developing countries. The diffusion of improved maize varieties (IMV), i.e. hybrids and open pollinated varieties (OPV) can greatly increase maize yield per unit of land. Realizing the importance of the maize crop in Tanzania, the government has been committing human and financial resources to develop the industry. Research and extension efforts on maize started in 1960. The breeding efforts in the 1960s resulted in the release of Ukiriguru Composite A (UCA) and Ilonga Composite White (ICW) (Kaliba *et al.,* 2000). However, farmers' choice on improved varieties is one of the most crucial

factors affecting the productivity of a crop. This is influenced by many factors that affect the farmers' variety adoption decision (Kafle, 2010).

Most economies in sub-Saharan Africa (SSA) are agriculture-based. Consequently, any sluggish growth in agricultural production translates into slow growth and low per capita incomes (ASARECA, 2012). In Eastern and Southern Africa, national average yields of maize (the main staple) are about 1.5 tons per ha compared with a global average of 4.5 tons per ha (ASARECA, 2012). To date, several breeding populations have been developed in Tanzania and are being improved through recurrent selection for specific traits (Moshi *et al.*, 1990). Since 1974, two hybrids and six open-pollinated varieties (OPVS) have been released. In 1976, Tuxpeno was released for the lowland areas. Hybrids H6302 and H614, suitable for the highlands, were released in 1977 and 1978, respectively. In November 1983, three OPVs- Kite, Kilima, and Staha- were released. Staha is characterized by its tolerance to maize streak virus (MSV) disease, where as Kilima was recommended for the intermediate zone. Kito is an early maturing variety adapted to both low and intermediate zones. In 1987 two open-pollinated varieties, TMV1 and TMV2, were released. TMV1 is white flint streak resistant and has intermediate maturity. It is recommended for the lowland and intermediate zones. TMV2 is also white flint, and is recommended for the highlands.

2.8 Rice and Maize Production in Tanzania

2.8.1 Rice production in Tanzania

Rice is the second most important crop in Tanzania after maize and is mostly used as a cash crop by the majority of people. Tanzanian rice productivity is lower compared to most neighbouring countries and one of the lowest in the world. Furthermore, Tanzania hardly meets its own rice demand and therefore imports large quantities of rice, mostly

from South-East Asia. However, Tanzania is the second largest rice producer in Eastern Africa. Tanzania's total rice production is 899000 Mt, from which a small part is exported to neighbouring countries (MMAC, 2010). Around 90% of the rice is produced by subsistence smallholders and production is concentrated in Mbeya, Morogoro, Arusha, Iringa and Dar es Salaam Regions.

2.8.2 Maize production in Tanzania

Maize is the most important staple food in Tanzania and in the East Africa region in general. It is the 5th agricultural commodity in The United Republic of Tanzania by value of production during the period 2005-2010 accounting for 7.5 percent of total production value. Moreover, it represents close to five percent of total agricultural imports in The United Republic of Tanzania for the same period and is the main energy source in the diet accounting for 25 percent of total caloric intake (FAOSTAT, 2013). Maize is considered the most important food crop in The United Republic of Tanzania covering 45 percent of total arable land and generating close to 50 percent of rural cash income, an average of 100 USD per maize producing household in 2008 (USAID, 2010).

Maize market performance therefore has a significant impact on the welfare and food security especially of poor people. It has been ascertained that with growing urbanisation and high rates of poverty that limit dietary upgrading, market demand for food staples will grow steadily to USD 11.2 billion in 2015 and USD 16.7 billion in 2030 (WB Report AFR Sept, 2009). This is a great emerging market opportunity for countries like Tanzania. At present, 65% of approximately 3 million households in The United Republic of Tanzania grow maize, mainly poor smallholder farmers (average 1.2 has) who rely on traditional methods of cultivation under a rainfed regime (USAID, 2010; Nazir, *et al*., 2010).

2.9 Importance of Using Improved Seeds

Increasing agricultural productivity, and hence production using improved agricultural technologies, has been identified as a precondition for achieving food security (Langyintuo *et al*., 2000).Small-scale farmers depending especially on subsistence agriculture have the potential to increase their welfare and food security situation if they adopt improved production technologies.

The majority of rice farmers (females, males and youth) are smallholders who produce rice for home consumption and sale of surplus directly to customers or through a cooperative society where there is a Warehouse Receipt System in operation. Sizes of farms range from 0.5 to 3 hectares, and there are three large scale farms located in Mbeya and Iringa regions. These 10 farms used to be operated by the National Agricultural and Food Company (NAFCO). However, these farms have been privatized (URT, 2009).

Scientists and agronomists are racing to develop seeds that are higher yielding, more nutritious, and drought and climate resilient to meet these challenges. But while some experts believe genetically modified seeds are the only solution to the problem, others claim that small-scale organic agriculture is more effective and sustainable. This is a look at some of the ways seeds are being improved (Cho, 2013). Higher yields are achieved when seed heads produce more seeds per head or bigger seeds, but plants with tall stalks cannot always support the added weight (Cho, 2013).

2.10 Attitude and Knowledge of Smallholder Farmers' towards Improved Seeds

Despite extension recommendations on seed treatment, seed rate, proper seed spacing, and planting depth; the use of improved maize seed is still limited. There are different explanations for the apparent rejection of improved maize seed by farmers, including

negative attitudes toward improved seed, inadequate how-to-knowledge, lack of information on improved seeds, inadequate agro-ecological conditions to grow improved seed, farmers' age, and availability of family labour (Suhane *et al.*, 2008). Knowledge influences adoption; farmers who have adequate knowledge of technology use are likely to adopt it (Abebaw and Belay, 2001; Rogers, 2003). Farmers' attitudes determine adoption of improved technology. Attitudes are evaluative responses towards the technology, and are formed as farmers gain information about it. Adopters tend to hold positive attitudes towards the technology (Chilonda and Van Huylenbroeck, 2001).

2.11 Availability and Accessibility of Improved Seeds

Limited availability of good quality seed is a key constraint repeatedly identified by farmers in rural areas in many countries. A number of initiatives that have addressed this issue through sustainable local seed production have resulted in improved access to appropriate, affordable and timely seeds (ASFG, 2011). Farmers everywhere need easy access to high-quality seed of well-adapted, productive crops to allow them to produce the best possible crops. But efforts to encourage the private sector to play a role in ensuring efficient production and distribution of seed in the developing world have yielded mixed results (FAO, 2009).

2.12 Factors Affecting the Adoption of Improved Maize and Rice Seeds

Farmers' choice on improved varieties is among the most crucial factors affecting the productivity of a crop. This is influenced by many factors that affect the farmers' variety adoption decision such as taste and preference of the smallholder framers (Kafle, 2010). Smallholder farmers' decision to adopt or not to adopt is usually based on the profitability and risks associated with the new technology. Before adoption, farmers have to be assured of the expected marginal gains and associated risks. In a synthesis of 22 adoption studies

in Eastern Africa, availability of information on the technology and profitability of the technology, were identified as the main obstacles to technology adoption (Doss, 2003). Due to this fact, the majority of smallholder farmers tend to ignore the adoption of new technologies.

2.13. Adoption of Improved Maize and Rice Seeds

Adoption of technology is influenced by physical, socio-economic, and mental factors including, agro-ecological conditions, age, family size, education, how-to-knowledge, source of information, and farmers 'attitudes towards the technology (Feder *et al*., 1985; Neupane *et al*., 2002; Rogers, 2003). Agro-ecological conditions determine adoption. High levels of adoption of improved maize varieties and chemical fertilizers are more likely to be found among farmers located in regions with high rainfall (Kaliba *et al*., 2000; Hintze *et al*., 2003). Young farmers are more likely to adopt a new technology because they have had more schooling and are more susceptible to attitude change than old farmers (CIMMYT, 1993).

Education is expected to enhance the decision making and the adoption of agricultural technologies. Family size plays a role on labour provision. Adoption of new varieties requires more labour inputs (Feder *et al*., 1985). It is assumed that large families provide the labour required for improved maize production practices. Sources of information, including extension, enhance the adoption of technology (Abebaw and Belay, 2001).

2.14Access to and Adoption of Improved Seeds

Limited availability of good quality seed is a key constraint repeatedly identified by farmers in rural areas in many countries. A number of initiatives that have addressed this issue through sustainable local seed production have resulted in improved access to

appropriate, affordable and timely seeds (ASFG, 2011). Farmers' decision to adopt or not to adopt is usually based on the profitability and risk associated with the new technology. Before adoption, farmers have to be assured of the expected marginal gains and associated risks.

2.15 Theoretical Framework

Negatu and Parikh (1999) review three groups of models on the adoption of agricultural technologies by smallholder farmers:

(i) the innovation-diffusion or transfer of technology model, in which technology is transferred from its source to the smallholder farmer through an intermediary such as an extension system, and the diffusion of the technology depends on the characteristics of the farmer;

(ii) the economic constraint model, which takes the view that farmers have different factor endowments and that the distribution of the endowments determines the adoption of technology; and

(iii) the technology characteristics-user's context model, which assumes that the characteristics of the technology and the underlying agro-ecological, socio-economic and institutional circumstances of farmers play a central role in the adoption of technology.

These technology adoption models have been tested empirically using data from developing countries investigating particularly the factors that affect the adoption of fertiliser and improved seed varieties (Negatu and Parikh, 1999; Isham, 2002). The factors influencing technology adoption decisions include farm size, risk exposure and capacity to bear risks, human capital, labour availability, land tenure, access to financial and produce markets, access to information, participation in off-farm activities, social capital,

household characteristics and ecological and environmental factors which are similar to the factors result in poor adoption and accessibility of the study.

2.16Empirical Information

A study conducted by Langyintuo, *et al.*(2008) shows that surveys of maize seed systems in a number of countries revealed that adoption rates of improved varieties ranged from less than 10 % in Angola, 10 to 25 % in Ethiopia, Malawi, Mozambique and Tanzania, to > 70 % in Kenya, Zambia and Zimbabwe in 2007. Also IFDC (2013), noted that, in order to increase local production of quality seeds, NAFAKA staff identified and supported local production farms and associations and assessed their performance in producing quality declared seed (QDS). Quality standards were developed for seed production, processing and storage to train farmers to meet national and international standards. IFDC staff then facilitated linkages between fertilizer suppliers, agro-dealers and association and extension officers.

Also a study conducted by Westengen *et al*. (2014) shows that farmer-recycling of improved varieties and seed selection are common on-farm seed management practices. Drought tolerance and high yield are the most important characteristics reported as reason for growing the current varieties as well as the most important criteria for farmers' seed selection. Seeds must be available; farmers must to be able to access them; and the seeds must be of a satisfactory quality in order to get easy access and adoption. This is similar to results of a study by Westengen*et al*. (2014) which showed that access to improved maize and rice seeds to smallholder farmers is very important for agricultural productivity. High costs of improved seeds, poor availability and lack of knowledge were some of the reasons why farmers did not use improved seeds. Westengen *et al*. (2014) continue to argue that the major strategies farmers use to obtain improved seed were purchase from agro-dealers,

recycling of their own seeds, and the formation of Savings and Credit Cooperative Societies (SACCOs).

URT (2009) argues that seeds of improved rice varieties are still poorly accessed by smallholder farmers in Tanzania. Liberalization of the seed sub-sector has enabled the emergence of private seed companies, which are already taking up production and sale of improved rice seeds such as SARO 5 (TXD 306) being multiplied and marketed by the Agricultural Seed Agency (ASA).Modern maize varieties represented less than 5% of the maize area in the 1970s, but accounted for about 60% in 2005 (Alene *et al.*, 2010).

2.17 Gaps in Literature

Although there have been a number of studies to assess the adoption and accessibility of maize and rice seeds by smallholder farmers, a high proportion of them have been focusing on adoption of improved seeds rather than access, e.g. adoption rates based on both certified seeds and recycled seeds from improved varieties was estimated at 94% (Nkonya *et al.*, 1998).Some studies have argued that, for widespread adoption of improved varieties and chemical fertilizer by farmers, extension educators need to understand the factors affecting technology adoption (Abebaw and Belay, 2001).

The above reviewed literature shows that even though adoption and accessibility of maize and rice improved seeds by smallholder farmers have been studied, accessibility of these improved seeds, especially in Mbeya rural and Morogoro regions in Tanzania, have not been adequately addressed. This is the gap that this study intended to fill.

2.18 Conceptual Framework

The conceptual framework presented in Fig. 1 was used in the research on which this dissertation is based. It shows the inter-link and relationships between background, independent and dependent variables. The independent variables are presumed to influence the dependent variable (adoption of improve maize and rice seeds) among smallholder farmers. The independent variables include profitability and risks associated with new technologies, farmers' awareness, price of input and output, taste and preference of individual households, availability of extension services, on-farm field trials and varieties' characteristics. However, this study assumed that the chances of change in the dependent variable (adoption of improved maize and rice improved seeds) are highly dependent on changes in the independent variables, which are listed in Fig. 1.

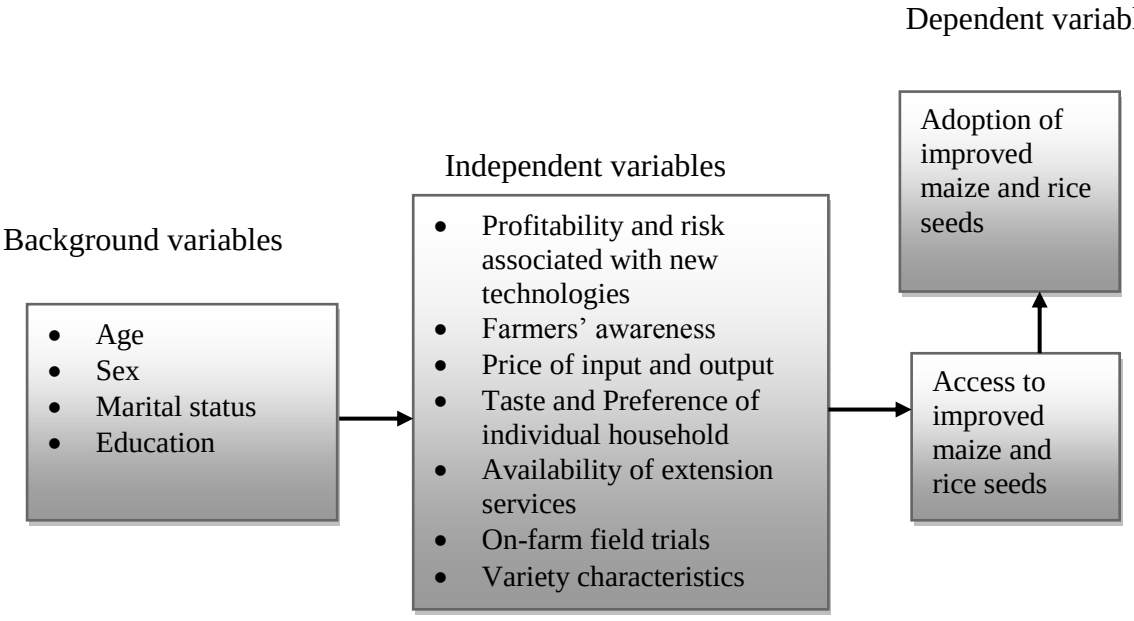

Figure 1: Conceptual Framework.

CHAPTER THREE

3.0. RESEARCH METHODOLOGY

3.1 Description of the Study Area

The research was conducted in Morogoro and Mbeya Regions. They were purposively selected due to the fact that 25% of the national rice production comes from them. The selected villages within these two regions were Mshewe, Shamwengo and Darajani for the case of Mbeya Rural District; Ibuti village in Gairo District; and Ilonga, Mvumi and Chanzuru villages in Kilosa District. Both Gairo and Kilosa Districts are located in Morogoro Region. Also, maize is grown all over the country, especially in Iringa, Mbeya, Ruvuma, Rukwa, Tanga, Kilimanjaro, Kagera (Biharamulo), Morogoro and in Arusha/Manyara Regions. Two-fifths (40%) of the national maize production comes from 4 regions: Iringa, Mbeya, Ruvuma, Rukwa (PASS Trust, 2013).The main economic activity of these three districts is agricultural production. The data were collected during the rainy season of March and April, 2014.

3.1.1 Location of Morogoro Region

Morogoro Region is one of the thirty regions of Tanzania (Mainland 25 and Zanzibar 5) and is the largest. The region lies between latitudes 5^0 58" and 10^0 0" South of the Equator, and longitudes 35^0 25" and 30^0 30" to the East. Morogoro headquarters are found about 200 kilometres West of Dar es Salaam. Its climate is highly influenced by the Indian Ocean. The Nguru, Uluguru and Udzungwa Mountains as well as the Mahenge Hills found in the region form part of the Eastern Arc Mountains.

Morogoro Region has 143 rivers, which traverse very large plains in the lowland consisting of fertile alluvial soils. The major rivers include Kilombero, Ruaha, Luwegu,

Ruvu, Wami, Ngerengere, Mkondoa and Mkindo. The region is occupied by 2 108 071people as per population Census 2012 (URT, 2013).

Morogoro Region occupies a total area of 73 039 square kilometres, which is equivalent to 8.2% of the total area of 942 784 square kilometres Tanzania Mainland. In addition, it is the only region that is surrounded by the biggest number of regions in Tanzania: Manyara and Tanga to the North, Dodoma and Iringa to the West, Coast and Lindi to the East and Ruvuma to the South.

Morogoro region is composed of 6 administrative districts namely Morogoro, Mvomero, Kilosa, Kilombero, Gairo and Ulanga; and six Local Government Authorities (LGAs) namely Kilombero, Kilosa, Ulanga, Morogoro, Morogoro Municipality and Mvomero. Among the six districts, two districts were selected for this study which are Kilosa and Gairo.

In terms of climate the region has two rain seasons: the short rain season which normally starts in October and ends in January and the long rains season which commences in Mid-February and ends in May. The annual rainfall ranges between 600 mm and 1 800 mm. Morogoro Region has natural resources that provide for a wide range of economic activities, which include agriculture (crop production), livestock keeping, forestry, beekeeping, fishing, mining, tourism as well as small and medium-scale industries. About 85% of the region's population derives their livelihoods from agricultural production.

3.1.2 Location of Mbeya Region

Mbeya Region originally belonged to the Southern Highland Province. In 1963, the Southern Highland province was split into two regions namely, Mbeya and Iringa. In

1972, Mbeya Region was extended to incorporate Sumbawanga District, which, before then belonged to the Western Province. However, the inclusion of Sumbawanga District into Mbeya Region did not last long; in 1974 Sumbawanga District was separated and accorded full regional status called Rukwa Region.

Mbeya Region is located in the South Western Corner of the Southern Highlands of Tanzania. The region lies between latitudes 70 and 90 South of Equator, and between longitudes 32^0 and 35^0east of the Greenwich Meridian. Mbeya Region lies at an altitude of 375 to 2981 metres above sea level. Its highest point is at the top of Mount Rungwe.

Mbeya Region sharers borders with countries of Zambia and Malawi to the immediate South, Rukwa Region to West, Tabora and Singida Regions to the North, while Iringa Region lies to its East, with Tunduma and Kasumulu in Mbozi and Kyela districts respectively being the main entries of Northern shores of Lake Nyasa District and highlands of Rungwe and Southern parts of Ileje District. The rains normally start in October and go on through to May with dry and cold spells between June and September. The crop growing season, in most parts of the region is in November to March.

3.2 Research Design

The study employed a cross-sectional survey which allowed data to be collected at a single point in time. The design was chosen because it entails collection of data on more than one case (usually quite a lot more than one) at a single point in time in order to collect a body of quantitative and/or qualitative data about two or more variables (usually many more than two), which were then examined to detect patterns of association (Bryman, 2004). The adoption of the design was justifiable on the basis that it is the

commonest design used in research to compare extents to which at least two groups of people differ on the dependent variable (de Vaus, 1993).

3.3 Study Population

According to Investors Words (2014), population can be defined as a group of individuals or items that share one or more characteristics from which data can be gathered and analysed. In view of that, the population for the research comprised all households producing rice and maize in selected villages of Mbeya and Morogoro regions.

3.4 Sample Size

The sampling unit was the household, and a sample of 200 households was selected, including male-headed and female-headed households in the same proportions as they were in the three districts for the research which were Kilosa, Gairo and Mbeya Rural. The sample size was selected using the formula developed by Cochran 1977. The procedure through which the sample size was determined as summarised below. The sample size was justified on the fact that too large a sample implies a waste of resources, and too small a sample diminishes the utility of the results (Cochran, 1977, cited by Bartlett *et al.*, 2001).

Sample size calculation

Formula (Cochran, 1977, cited by Bartlett *et al.* 2001)

n = sample size;

$n = \frac{Z^2 * p (1 - p)}{d^2}$, where:

Z = a value on the abscissa of a standard normal distribution (from an assumption that the sample elements are normally distributed), which is 1.96 or approximately 2.0 and corresponds to 95% confidence interval;

p = estimated variance in the population from which the sample is drawn, which is normally 0.5 probability for adoption rate;

d = acceptable margin of error (or precision), whereby the general rule is that in social research d should be 5% for categorical data and 3% for continuous data (Krejcie and Morgan, 1970, cited by Bartlett *et al*. (2001). In this research, 5% was used since substantial categorical data were collected.

Using a Z-value of 2.0, a p-value of 0.5, a q-value of 0.5, and a d-value of 0.5% (which is equivalent to 0.05), the sample size (n) has been determined to be 400.

$$n = \frac{2^2 * 0.5\ (1 - 0.5)}{0.05^2} = (4 \times 0.25)/0.0025 = 1/0.0025 = 400.$$

However, half of that sample was taken because of financial and manpower constraints. This means 200 households were selected.

3.5 Sampling Procedures

Multistage sampling was employed to select households whose members had access to improved seeds and those whose members had no access to such seeds. Also, it was a technique which was very suitable for knowing the number of adopters and non-adopters of improved seeds. The technique was preferred because it allows the use of both probability and non-probability sampling techniques. Purposive sampling was used to select three districts which are Mbeya Rural District in Mbeya Region, and Gairo and Kilosa Districts in Morogoro Region. Since the population of the study was not homogenous, stratified sampling design was used to create strata which were obtained from respective districts. Then simple random sampling was used to select 100 households in Mbeya Region and 100 households in Morogoro Region to make a total of 200

households. The 200 households were selected using the lottery method whereby names of farmers were obtained from leaders and every farmer was written on a piece of paper. All the paper pieces were mixed, and the number of pieces corresponding to the number of respondents required (the sample size) was chosen. This was done at the village level. The numbers of the respondents selected in each of the survey villages are presented in Table 1.

Table 1: Number of Respondents Selected in each of the Survey Villages

District	Ward	Village	Respondents Selected	
			Number	%
Mbeya Rural	Inyala	1. Mshewe	32	16.0
		2. Darajani	36	18.0
		3. Shamwengo	32	16.0
Gairo	Kibedya	4. Ibuti	23	11.5
Kilosa	Chanzuru	5. Ilonga	30	15.0
	Chanzuru	6. Chanzuru	34	17.0
	Msowelo	7. Mvumi.	13	6.5
Total	-	-	**200**	**100.0**

3.6 Data Collection Methods and Tools

Both quantitative and qualitative methods of data collection were used in connection with all the information needed to answer the research questions. A structured interview was conducted using a structured questionnaire with both open and closed ended questions. One type of qualitative methods was used which was key Informant Interviews. Key informants interviews were done using a checklist of items for discussion with District Agricultural Officers of different places, and they gave information on access to and

adoption of improved seeds. Additionally, documentary review from the internet were used to collect secondary information necessary to supplement primary data. Moreover, reference materials from Sokoine National of Agriculture Library (SNAL) in Morogoro region were used including books, journals and various research reports.

3.7 Data Processing and Analysis

3.7.1 Quantitative data analysis

Quantitative data were collected and checked for correctness, coded and improved, including recording variables in SI Units, e.g. kg for weight, ha for acreage, etc. before being entered into SPSS. After entry, the data were checked again for accuracy, and any anomalies that were found were corrected. Then the data were analysed by computing descriptive statistics; including frequencies, percentages, minimum and maximum values, and averages. Moreover, inferential analysis was done using binary logistic regression to determine the impacts of various covariates on the chances of farmers adopting improved maize and rice seeds. By doing so, the hypothesis of the research was tested. The statistical model and the variables that were used are presented below.

The binary logistic regression model was specified as follows:

Logit $(p_i) = \log (p_i/1-p_i) = b_0 + b_1x_1 + b_2x_2 + \ldots + b_kx_k$ (Agresti, 2002; Powers and Xie, 2000), whereby:

Logit (pi) = ln (odds (event), that is the natural log of the odds of an event (adoption of improved maize and seeds in this research) occurring

p_i = prob (event), that is the probability that the event will occur

$1-p_i$ = prob (non-event), that is the probability that the event will not occur

b_0 = constant of the equation

b_1 to b_k = coefficients of the independent (predictor, response) variables

k = number of independent variables

x_1 to x_i = independent variables entered in the model, which were:

x_1 = Acreage for maize

x_2 = Acreage for rice

x_3 = Taste and preference

x_4 = Profitability and risk associated with new technology

x_5 = Farmer awareness on improved seeds.

X_6 = On-farm field trials

X_7 = Variety characteristics

3.7.2 Qualitative data analysis

Qualitative data we reanalysed through content analysis by coding responses given by various interviewees and assessing them for differences and similarities. The results were interpreted in comparison with the results obtained from the household questionnaire. Below is a brief description of how data were analysed for each of the specific objectives.

3.8Limitations of the Study

It was difficult to get some relevant information due to language barriers, because some of the villagers were not familiar with the national language; they spoke native languages. This limitation was mitigated by requesting local agricultural extension officers who were conversant with the local languages to interpret the languages to the researcher.

Lack of some information because of previous researchers' promises to the community also constrained this research. Some previous researchers had made a lot of promises, including initiation of development projects in the research areas on the bases of their researches in the areas; hence it was difficult to convince them to participate in the

research. This limitation was mitigated by using agricultural extension officers to mobilise potential respondent households to participate in the research.

It was during a rainy season; hence the majority of the farmers were not around. Therefore, it became difficult to get them. Due to the assistance of extension officers, the researcher was able to find them.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Socio-Demographic Characteristics of the Respondents

The socio-demographic characteristics of the households surveyed are presented in Table 1 and show that the majority (71%) of the households were male-headed while 29% were female-headed. This indicates that most of the men are involved themselves in the hard works and job risks such as farming production. Also, due to the poverty, most of the male household heads are involved in agriculture in order to improve the economic conditions of their households. This can be evidenced by Mdoe and Mach a (2002), who said that in most rural areas, families gain a living by producing both cash and food crops. Although there is a tendency of male members of the family to engage themselves in cash crops and female members in food crops, the latter are mainly for household or family consumption unless when excess outputs are realized and exchanged for cash.

The majority of the household heads had ages ranging from 31 to 40 as seen in Table 1,that is 28% of the respondents were in that economically active group. This indicates that the majority were capable to do some farming practices hence improving economic status of their households. This is supported by Adeogun *et al*. (2010) who argues that younger farmers would most likely be willing to spend more time to obtain information on improved technologies compared to older farmers. Slightly more than three-fifths (61.5%) of the household heads had primary education level, while only 7% among the household heads had attended standard 1 to 4. This shows that literacy rate was high hence easy to influence any programme or training dealing with adoption of maize and rice improved seeds within the areas.

Table 2: Demographic and Social economic characteristics (n=200).

Variable	Category	Frequency	Percentage
Sex	Male	142	71
	Female	58	29
Age	11-20	7	3.5
	21-30	29	14.5
	31-40	56	28
	41-50	55	27.5
	51-60	17	8.5
	>60	36	18
Education level	No formal education	39	19.5
	Standard 1 to 4	14	7
	Primary education	123	61.5
	Secondary education	23	11.5
	Tertiary	1	0.5
Marital status	Married	150	75
	Widow	28	14
	Widower	4	2
	Separated	7	3.5
	Never married	11	5.5
Main occupation	Crop production	193	96.5
	Off-farm	1	0.5
	Both crop and livestock	3	1.5
	Both crop production and self-employment	3	1.5

The results in Table 2 show that 75% of the households who were interviewed were married. This shows that the majority were engaged in agriculture so that they could improve household income and overcome poverty due to the fact that most of the households in developing countries have large families with many mouths to feed. The study also shows that 96.6% were involved in crop production while 0.5% had off-farm activities. This implies that agriculture is the backbone of the economy of most of the rural people. This is also evidenced by a study by URT (2012), which showed that the agricultural sector in Tanzania is a key driver of social and economic development in the country. It generates 25% of the GDP, 24% of exports, employs over 75% of the population, and rural areas are where the majority of the poor reside.

4.2 Smallholder Farmers' Knowledge about Improved Maize and Rice Seeds

4.2.1 Awareness of existence of improved maize and rice seeds

The first objective of the research was analysed through descriptive statistics, and it was found that the proportion of household heads with awareness of improved maize seeds was (66%) compared to household heads without awareness of improved maize seeds who were 34%. This was due to different sources of information such as radio, extension officers, seed producers, relatives, project organizations and children which were obtained around the villages. The majority of the household heads were getting information from extension officers due to the fact that most of the households were living together with these people. According to the study, the majority of the extension officers were helping smallholder farmers in various ways, including giving them information concerning subsidies and prices of improved seeds. Awareness is an important stage on technology adoption. Table 3shows that the majority (81%) of the household heads were aware of the existence of rice improved seeds, compared to those who were not aware of the existence of improved rice seeds in their areas (19%). This shows that awareness is a very important factor for access and adoption of improved seeds. This finding is similar to findings of a study conducted by Babu *et al*. (2011) which found that the major constraints facing farmers in accessing information were poor availability, poor reliability, lack of awareness of information sources available among farmers and untimely provision of information. Further, farmers still lack awareness about improved seed and their higher yields.

Table 3: Awareness of improved maize and rice seeds (n=200).

Whether the HH head is aware of the existence of improved maize seeds (n=100)	**Frequency**	**Percent**
Yes	66	66
No	34	34
Total	**100**	**100**
Whether the HH head was aware of the existence of improved rice seeds (n=100)		
Yes	81	81
No	19	19
Total	**100**	**100**

4.3Attitude of Smallholder Farmers towards Improved Rice and Maize Rice Seeds

The second objective was about assessing smallholder farmers' attitude towards improved maize and rice seeds. The attitude was determined using a Likert Scale (Table 4), which comprised a total of 12 statements. The respondents were asked to indicate if they strongly agreed (1), agreed (2), were undecided (3), disagreed (4) or strongly disagreed (5) with each of the statements. The responses were then grouped into three categories as follows: strongly agree and agree were grouped into agree; strongly disagree and disagree were grouped into disagree and undecided was left to stand alone. To find general responses whether respondents had favourable attitude, unfavourable attitude or indifferent attitude the cut of points were created. The highest possible score was 60 points (i.e. 12x5); 36 was the mid score (12x3=36); and the lowest possible score was 12 (i.e. 1 x 12). Therefore, the range of scores for unfavourable attitude was from 12 to 35; the score of 36 indicated neutral attitude, and the range of scores for favourable attitude was from 37 to 60.

The results in Table 5 show the overall attitude of farmers on improved maize and rice seeds. Of all the respondents interviewed, 127 (63.5%) had favourable attitude; 15 (7.5%) had indifferent attitude while 58 (29%) had unfavourable attitude towards improved maize and rice seeds. The overall attitude means score for all the statements was42.3 out of 60.0, which implies that farmers had an overall favourable attitude towards improved rice and maize improved seeds in the study area. The responses to the individual statements of the Likert scale are presented in Table 3.

Table 4: Overall attitudes on improved maize and rice seeds in the study areas

Overall attitudes	Frequency	Percentage (%)
Unfavourable	58	29.0
Undecided	15	7.5
Favourable	127	63.5
Total	**200**	**100.0**

Table 5: Attitude of smallholder farmers on improved rice and maize seeds

Statements	Disagree n(%)	Undecided n(%)	Agree n(%)
1. Yields are important when choosing improved rice and maize seed varieties	18 (9.0)	10 (5.0)	172 (86.0)
2. Taste and grain quality are more important when choosing rice and maize seed varieties than the yields obtained	47 (23.5)	11 (5.5)	142 (71.0)
3. Early maturity is a more important factor when choosing maize and rice improved varieties than yield	45 (22.5)	9 (4.5)	146 (73)
4. Price is not a limiting factor for adoption of improved maize and rice seed varies	129 (64.5)	9 (4.5)	62 (31.0)
5. Smallholder farmers access improved maize and rice seeds because of the availability of information in their area	35 (17.5)	15 (7.5)	150 (75.5)
6. High rate of adoption of improved maize and rice seeds among smallholder farmers is attributed to availability of agro-inputs dealers in farmers' areas	40 (20.0)	19 (9.5)	141 (70.5)
7. Smallholder farmers adopt improved rice and maize seeds because of their value markets	58 (29.0)	31 (15.5)	111 (55.5)
8. Improved rice and maize seeds reach smallholder farmers in time; that is why there is high adoption rate	86 (43.0)	39 (19.5)	75 (37.5)
9. Improved maize and rice seeds present too complex task to implement on the farm	105 (52.5)	21 (10.5)	74 (37.0)
10. Improved rice and maize improved seeds present the superiority in terms of yield than local variety	18 (9.0)	6 (3.0)	176 (88.0)
11. Improved maize and rice seeds are a technology which is more profitable than local seed varieties	16 (8.0)	7 (3.5)	177 (88.5)
12. Smallholder farmers prefer local maize and rice seeds because of their accessibility and availability	97 (48.7)	10 (5.0)	92.5 (46.5)

Number 1 to 6 of the statements in Table 5 had negative connotations while statements 7 to 12 had positive connotations. Of the 6 statements with positive connotations, the greatest proportions of the respondents (86.0%) agreed with the statement that yields are important when choosing improved rice and maize seed varieties. Of the 6 statements with negative connotations, the greatest proportions of the respondents (52.5%) had correct knowledge that improved maize and rice seeds do not present too complex task to implement on the farm.

4.4 Extents to which Improved Maize and Rice Seeds Are Accessible

As it is shown in Table 5, 59.5% of the households did not have access to maize improved seeds due to long distance from the main source of the seeds to their homes. Although distance was a major constrain, the majority of the household farmers were able to adopt improved seeds due to some various sources of information such as radio, extension officers and seed dealers. Most of the villages where the research was conducted; such as Inyala, Shamwengo and Ibuti; were not getting improved seeds in time due to poor accessibility. Smallholders were supposed to travel to the nearby towns and districts in order to get maize and rice improved seeds. For example in Ibuti village which is located in Gairo District, most of the households were getting their maize and rice improved seeds from their extension officer and from agro-dealers at the district headquarters. They had to travel 1km up to the district in order to get the seeds. This is a constrain to the majority of smallholder farmers in Tanzania and it can be supported by the statement that access to seed is a necessary condition for improved seed adoption (Dontsop-Nguezet *et al*., 2011) and the adoption of improved seeds is an important component of agricultural productivity, food security and sustainable economic growth (Faltermeier and Abdulai, 2009).Another constrain was fake seeds; one of the extension officer argued that “It is true that fake seeds is a big problem in Tanzania. Smallholder farmers have been cheated and

cannot differentiate between genuine ones and fake products".This was a big problem especially in the study area which were Mbeya and Morogoro regions.

Faltermeier and Abdulai (2009) argue that the persistence or lack of access to certified improved rice seeds can jeopardize the efforts to achieve self-sufficiency in rice production, and dependence on import 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. Also other studies suggest that most of the rice farmers lack information on the improved seeds; hence they stick to traditionally preferred varieties which are not economically efficient, but have prominent aromatic and palatability characteristics (RLDC, 2009).The results of that study are similar to the results shown in Table 4, which show that 69.5% of the households were not accessing rice improved seeds in their areas. This can lead to low production of rice in the country; for example in the study area one among the three districts which is Mbeya rural where most of the smallholders were using a local seed variety which is called India *rangi* in order to overcome the problem of accessibility. This resulted in low adoption of improved seeds. It is easier for members of the community to receive new ideas, if they have access to a variety of information sources, such as newspapers, radio, books, the Internet, and training workshops. It is more difficult to receive new ideas, if the community does not have access to such information sources.

Table 6: Accessibility to improved maize and rice seeds (n=200)

Access to improved maize seeds in the village (n=100)	**Frequency**	**Percent**
Accessed	81	40.5
Did not access	119	59.5
Total	**200**	**100.0**
Access to improved rice seeds in the village (n=100)		
Accessed	69	34.5
Did not access	131	65.5
Total	**200**	**100.0**

The results in Table 5 show that accessibility to improved maize and rice seeds was very small by the percentages shown which are 59.5% and 65.5% for maize and rice improved seeds respectively. Therefore, further analysis was done to determine the extents of unavailability of improved maize and rice seeds, which constrained the adoption of the seeds.

4.4.1 Constrains which smallholder farmers get in accessing improved maize and rice seeds

The results showed that 53.5% of smallholder farmers were not accessing improved seeds in their areas. This indicates that the improved rice and maize seeds were not easily available in the study area. Even if they had been available, they would not been easily accessible to farmers. In the study area, the majority of the smallholder farmers were blaming the government on the issue of poor accessibility to improved seeds; they were walking for long hours to seek improved seeds. For example, some of the villages at Mshewe in Mbeya rural were travelling 16 km to get improved maize and rice seeds. This can be evidenced by FAO (2009) that suggests that availability of improved varieties from public sector breeding programmes is one of the key success factors for the growth of smallholder seed enterprises in many countries. It is common for small- and medium-scale enterprises to depend on the public sector, government institutes and universities, for new varieties and even source seed (breeder and foundation seeds), and continuing public sector investment in these activities is required for self-pollinated, open-pollinated and vegetatively propagated crops. The proportions of the respondents who had various levels of access to improved seeds are summarised in Fig. 2.

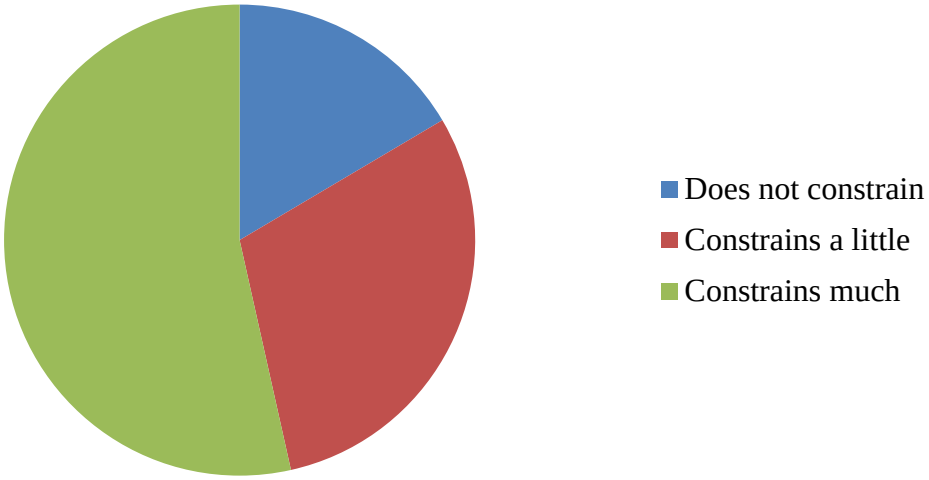

Figure 2: Constrains on availability of improved maize and rice seeds.

4.5 Proportions of Households Which Had Adopted Improved Maize and Rice Seeds

The fourth objective was to estimate the proportions of households which had adopted and those which had not adopted improved maize and rice seeds. This section gives the results which meet this objective. The study findings in Table 5 reveal that more than a half (56%) and almost three-quarters (71%) of the respondents were found to have adopted maize and rice improved seeds respectively in their farms. This implies that the majority of smallholder farmers in Mbeya, Kilosa and Gairo Districts have adopted maize and rice improved seeds in their farms. The adoption was probably attributed to existence of interventions that are being done by SUA, and Ilonga and Uyole Agricultural Research Institutes to smallholder farmers on improved cereal seeds. These findings are congruent to those of a study done by Seck (2007) whereby it was found that one of the biggest constraints to successful adoption of improved seed varieties was poor availability of the seeds. Meanwhile, access to seeds is a necessary condition for adoption of improved seeds (Dontsop-Nguezet *et al.*, 2011), and the adoption of improved seed is an important component of agricultural productivity, food security and sustainable economic growth (Faltermeier and Abdulai, 2009).

Table 7: Adoption of maize and rice improved seeds (n=200)

Adopted maize improved seeds in the farm (n=100)	Frequency	Percent
Had adopted	56	56.0
Had not adopted	44	44.0
Total	**100**	**100.0**
Adopted rice improved seeds in the farm (n=100)		
Had adopted	71	71
Had not adopted	29	29
Total	**100**	**100**

4.6 Impacts of Socio-Economic Factors on Adoption of Improved Maize and Rice Seeds

Impacts of some socio-economic factors on the chances of smallholder farmers adopting improved maize and rice seeds was addressed in the fifth objective of the research. The objective was analysed using binary logistic regression, which is described below.

4.6.1 General knowledge of binary logistic regression model

Binary logistic regression is a form of regression which is used when the dependent variable is a dichotomy and the independent variables (covariates) are of any type(nominal, ordinal, or scale variables). Logistic regression can be used to predict a categorical dependent variable on the basis of continuous and/or categorical independent variables to determine the effect size of the independent variables on the dependent variable, to rank the relative importance of independent variables, to assess interaction effects and to understand the impact of covariate control variables. The impact of predictor variables is usually clarified in terms of odds ratios (Garson, 2008).

Binary logistic regression was the model of choice for determining the impact of some of socio-economic factors on the chances of smallholder farmers adopting improved maize and rice seeds. The model was used due to the fact that it is powerful and a popular one in

social sciences at predicting a dummy dependent variable on the basis of continuous and or categorical independent variables, determining the percent of variance in the dependent variable explained by the independent variables, estimating the impact of covariate control variables (which are otherwise called independent variables), and ranking the relative importance of independent variables.

4.6.2 Tests of goodness of fit

In the first step, a classification table had results with only the constant included before any independent variables were entered in the model. This helped to determine the appropriateness of the model. The results of the model suggest that if we knew nothing about our variables and guessed that smallholder farmers (household head) would not adopt improved maize and rice seeds, we would be correct by 50% of the time. The second step used a Block 1 Method = Enter, to measure the goodness of fit of the model. The goodness of fit of the model was measured, and it involved only constants (step 1). The results showed that the model comprised predictors which had significant effects since the p-value was ≤ 0.001 ($p = 0.000$).

Another test of goodness of fit that was used was the Hosmer and Lemeshow test. This test value was 0.196. This is greater than 0.05 indicating statistical insignificance. The Hosmer and Lemeshow goodness-of-fit test divides subjects into deciles based on predicted probabilities, then computes a chi-square from observed and expected frequencies. Finding of non-significance means that the model adequately fits the data (Hosmer and Lemeshow, 1980, cited by Agresti, 2002).

4.6.3 Impact determination

Gauging the impact of independent variables on the dependent variable is done by observing the signs of the logistic regression coefficients (B values), which bear negative or positive signs meaning negative or positive impact, respectively, on the dependent variable. The relative importance of independent variables is determined by observing the magnitudes of Wald statistics and their concomitant levels of significance, which test the significance of the B value for each individual variable (Garson, 2008). Considering the summary in Table 7, Cox and Snell R^2 suggests that 64.9% of the variation in the dependent variable was explained by the logistic regression model. The NagelkerkeR^2 value was 0.865%, which means that the independent variables entered in the model explained 86.5% of variance in the dependent variable. Garson (2008) notes that Nagelkerke R^2 is normally higher than Cox-Snell R^2 and is the most-reported of the pseudo R^2 estimates.

The Wald test is an alternative test which is commonly used to test the significance of individual logistic regression coefficients for each independent variable (that is, to test the null hypothesis in logistic regression that a particular effect coefficient is zero).Wald coefficients associated with individual independent variables help us realise the relative importance of each independent variable. In additional, a Wald coefficient is a measure of the unique impact of each independent variable in the context of the other independent variables and holding constant other independent variables. A greater Wald statistic implies that the independent variable associated with it has a higher contribution to the happening of the dependent variable.

In Table 8, the Wald statistic value of Land rice (X_2) that is 51.772 was the highest and statistically significant at the 0.1% level (p =0.000).The implication of this finding is that

farmers who have big size of rice land are much likely to adopt improved maize and rice seeds compared to those with small pieces of land. This is mainly because they are profit oriented. Farmers' awareness(X_5) was the second predictor of the dependent variable with a Wald statistic of 8.515,which was statistically significant at the 1% level (p =0.004).This shows that farmers' awareness of improved seeds was the second most important factor influencing positively adoption of improved maize and rice seeds. This can be supported by a study conducted by Adhiguru *et al*. (2009) who reported that small farmers have less access to public extension compared to large farmers.In order to be sure that the explanatory variables are significantly important in affecting the variance of the response variable, both the B values and the correlations should be significant (Garson, 2008).

Table 8: Logistic regression results on factors for household head adoption of maize and rice seeds

Variables in the Equation	B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
							Lower	Upper
Age	0.004	0.026	0.028	1	0.868	1.004	0.954	1.057
Education level	0.543	0.460	1.390	1	0.238	1.720	0.698	4.240
Marital status	0.194	0.287	0.456	1	0.500	1.214	0.692	2.129
Land maize	-0.582	1.169	0.248	1	0.619	0.559	0.056	5.528
Land rice	6.722	0.934	51.772	1	0.000	0.001	0.000	0.008
Test preference	1.397	.934	2.237	1	0.135	40.044	0.648	25.239
Profit	-0.290	1.152	0.063	1	0.801	0.748	0.078	7.158
Farmers' awareness	2.566	0.879	8.515	1	0.004	13.008	2.322	72.879
Off farm trial	-0.844	0.935	0.815	1	0.367	0.430	0.069	2.689
Constant	-1.537	2.710	0.322	1	0.571	0.215		

a. Variable(s) entered on step 1: age, edulevel, mstatus, Landmaiz2, landrice2, testpref, profit, farmawar, offfarmtrial

MODEL SUMMARY Cox& Snell R^2= 0.646,Nagelkerke R^2= 0.862,Hosmer and Lemeshow Test, Chi-square 7.293(Sig.0.505), Model Chi-square 206.788 (p < .000), -2 Log likelihood = 69.080

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

On the basis of the findings, the conclusions are given in Section 5.1 in the same chronology as that of the specific objectives in terms of implications of the findings. Moreover, recommendations for improvement of access to and adoption of improved maize and rice seeds so as to increase agricultural productivity are given in Section 5.2.

5.1 Conclusions

The findings which showed that only 66% of the household heads were aware of improved maize and rice seeds imply that there is still a lot to be done to get all farmers to know about such seeds.

The proportion of the household heads who had unfavourable attitude (29.0%) and that of those who had indifferent attitude (7.5%) towards improved maize and rice seeds add up to more than one-third of the surveyed people (36.5%). This proportion is high; if it is not reduced, there will still be many people who neglect using improved seeds, even if they are available.

The proportions of people with access to improved maize and rice seeds, which were 40.5%and 34.5% respectively show that the extents to which improved maize and rice seeds are accessible by smallholder farmers were small. If the access is not improved, maize and rice productivity will not improve.

The proportions of people who had adopted improved maize and rice seeds, which were 56.0%and 71.0% respectively, show that; although more people had adopted improved

rice seeds; a lot is still to be done to get all farmers using improved maize and rice varieties

On the basis of the findings that acreage for rice and farmers' awareness of improved maize and rice were the factors with the highest impact on the chances of farmers adopting improved maize and rice seeds, it is concluded that improvement in these factors would increase the adoption of the seeds.

5.2 Recommendations

i. Since many household heads did not know about improved maize and rice seeds, the government is urged to educate all farmers about such seeds. It is through awareness of those seeds, particularly their merits that farmers will budget for and buy them for higher agricultural productivity.

ii. In order to increase the proportion of people using improved seeds, the government should urge all people to use such seeds. This will change attitudes of some, if not all famers, to the right direction and result into greater proportions of people using improved maize and rice seeds.

iii. As Tanzania is implementing the programme Agriculture First, with a view to bringing about a green revolution, the government should have enough budget to increase farmers' access to improved maize and rice seeds, among other things, so as to help them increase agricultural productivity.

iv. Since more many household heads had not adopted improved maize and rice seed varieties, it is high time more emphasis were put on using improved

maize and rice seeds by all farmers. The government should consider granting incentives and subsidies to the agricultural sector and to the farmers in the form of credits as these would allow them take action to use sustainable agricultural practices, including uses of improved maize and rice seeds.

v. In order to increase adoption of improved maize and rice seed varieties, the government is urged to increase support to farmers so that they can increase acreage for rice and increase their access to information about improved maize and rice seed varieties. In line with this, farmers are urged to strive to increase acreage for rice, use of improved rice seeds and apply technical information they get about rice production.

5.3 Suggestions for Further Research

(i) There is a need for research concerning education to smallholder farmers on the importance of using improved seeds. The majority of rural people are using local seeds due to unavailability of improved seeds and low education they have on improved seeds. This has become a big challenge to the government, researchers and donors. Despite the approval of the new Seeds Act, the certification and release of new seed varieties is still slow, which indicates that seed regulation is still weak in Tanzania and that monitoring seed use is inadequate; fake seeds can be found in the market.

(ii) How to solve the problem of poor accessibility of improved seeds is an important factor on which researchers can conduct some research in order to contribute to solving the problem of poor accessibility to improved seeds among smallholder farmers in Tanzania.

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APPENDICES

Appendix 1: A Copy of the Household Questionnaire Used for Data Collection

Questionnaire Number

SOKOINE UNIVERSITY OF AGRICULTURE

DEVELOPMENT STUDIES INSTITUTE

A Household Questionnaire for Research on:

ACCESS TO AND ADOPTION OF MAIZE AND RICE IMPROVED SEEDS IN MBEYA AND MOROGORO REGIONS, TANZANIA

BY

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A. General Instructions to Enumerators

(i) Make brief introduction to each farmer before starting the interview, get introduced to the farmers, and (greet them in the local way). Get her name; tell them yours, the institution you are working for, and make clear the purpose and objective of the study.

(ii) Please ask each question clearly and patiently until the farmer understands (gets your point).

(iii) Please fill up the questionnaire according to the farmers reply (do not put your own opinion).

(iv) Please do not try to use technical terms while discussing with farmers and do not forget to record the local unit.

A. BACKGROUND INFORMATION

1. Name of interviewer ……Date …….....
2. Name of respondent …….....…….....
3. Region …….....…….....
4. District …….....…….....
5. Division …….....…….....
6. Ward .....…….....
7. Village …….....…….....

B. HOUSEHOLD COMPOSITION

8. Please let me ask you about all members of your household including marital status and occupation

Particulars	**P1 H'hold head**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**
Name (Optional)										
Age										
Sex										
Year of birth										
Years of schooling										
Marital status										
Main occupation										

Key to Question 8

Sex	**Marital status**	**Household head**	**Main occupation**
1. Male	1.Married	1. Adult male	1. Crop production
2. Female	2.Never married	2. Adult female	2. Livestock keeping
	3.Widower	3. Orphan male	3. Salaried employment
	4.Widow	4. Orphan female	4. Self-employed off-farm
	5.Divorced		5. Casual labour on/ off-farm
	6.Separated		6. Student/pupil
	7.Too young to be married		7. Non school child

B. GENERAL INFORMATION QUESTIONS

9. What is the main source of income in your household?

    1. Agricultural production

    2. Livestock production

    2. Salaried employment

    3. Business

    4. Others (specify) _____

10. Do you own land in your village? 1. Yes 2. No

11. How have you obtained the land you own?

    1. Inheritance

    2. Buying

    3. Others (specify)

12. What is the size of your land? …….. acres/ha

13. What size of your farm land (in acres) did you use to grow maize and rice during the agricultural season 2013/14 (July 2013 to June 2014)?

Land areas used for various agricultural activities	**(Acres/ha)**
Total land owned (acres/ha)	
Part of the land you cultivated in 2013/14(acres/ha)	
Land area you hired from other people in 2013/14(acres/ha)	
Land area you lent to other people in 2013/14(acres/ha)	
Land area on which you grew maize in 2013/14 (acres/ha)	
Land area on which you grew rice in 2013/14 (acres/ha)	
Land area on which you grew other crops in 2013/14 (acres/ha)	

C: KNOWLEDGE ABOUT MAIZE AND RICE IMPROVED SEEDS

14. Are you aware of the existence of improved seeds in your area? 1. Yes 2. No

15. (a) Is there a seed producer in your area? 1. Yes 2. No

(b) If yes, what is the quality of their seeds vis-à-vis seeds from other places? **1. As** good as seeds from other places 2. Inferior to seeds from other places 3. Superior to seeds from other places

D: ATTITUDE OF SMALLHOLDER FARMERS ON IMPROVED RICE AND MAIZE SEEDS

16. The following statements will be used to measure attitudes of the smallholder farmers on improved rice and maize improved seeds. Please indicate your answer in all the statements by ticking the appropriate box and scale them. 1. Strongly agree, 2. Agree, 3. Undecided, 4. Disagree and 5. Strongly disagree

No.	Attitudinal statement	(1)	(2)	(3)	(4)	(5)
1.	Yields are important when choosing improved rice and maize seed varieties (+)					
2.	Taste and grain quality are more important when choosing rice and maize seed varieties than the yields obtained (+)					
3.	Early maturity is a more important factor when choosing maize and rice improved varieties than yield (+)					
4.	Price is not a limiting factor for adoption of improved maize and rice seed varies (+)					
5.	Smallholder farmers access improved maize and rice seeds because of the availability of information in their area (+)					
6.	High rate of adoption of improved maize and rice seeds among smallholder farmers is attributed to availability of agro-inputs dealers in farmers' areas (+)					
7.	Smallholder farmers adopt improved rice and maize seeds because of their value markets (-)					
8.	Improved rice and maize seeds reach smallholder farmers in time; that is why there is high adoption rate (-)					
9.	Improved maize and rice seeds present too complex task to implement in the farm (-)					
10.	Improved rice and maize improved seeds present the superiority in terms of yield than local variety (-)					
11.	Improved maize and rice seeds are technologies which are more profitable than local seed varieties (-)					
12.	Smallholder farmers prefer local maize and rice seeds because of their accessibility and availability (-)					

17. Apart from maize and rice, which other crops do you grow?

……

E: ACCESSIBILITY OF MAIZE AND RICE IMPROVED SEEDS

18. Do you have access to improved maize seeds in your village?

    1. Yes

    2. No

19. Do you have access to improved rice seeds in your village?

    1. Yes

    2. No

20. (a) If no, what are the reasons for not accessing maize and/or rice improved seeds in your village? Tick appropriate answer

Code	**Reason for not accessing improved maize seeds**	**1 = Yes 2 = No**	**Reason for not accessing improved rice seeds**	**1 = Yes 2 = No**
1.	It is expensive		It is expensive	
2.	It is unavailable		It is unavailable	
3.	It is not profitable		It is not profitable	
4	Its utilization is complex		Its utilization is complex	
5.	Any other reason (Specify)		Any other reason (Specify)	

(b) If yes, where do you get information on maize and rice improved seeds in your area?

Code	**Sources of information of maize and rice improved seed**	**1 = Yes** **2 = No**
1.	Seeds producers	
2.	Relative or neighbors	
3.	Extension officer	
4.	Seed dealers or shop	
5.	Project or organization	
6.	Radio	
6.	Others (specify)	

21. Where do you get maize and rice improved seeds in your area?

Code	**Sources of maize and rice improved seeds**	**1 = Yes, 2 = No**
1.	Seeds producers	
2.	Relative or neighbors	
3.	Extension officer	
4.	Seed dealers or shop	
5.	Project or organization	
6.	Others (specify)	

22. What approximate distance do you travel to get improved maize and rice seeds?

Crop	**Approximate distance (km)**
Maize	
Rice	

23. What type of improved maize and rice seeds do you usually plant in your farm? Also indicate the sources of that improved seed as they appear in the table below

Type of Maize Improved seeds	**Sources**	**Type of Rice Improved seed**	**Sources**
1.Stuka		1.	
2.Kilima		2.	
3.Staha		3.	
4.Pannar		4.	
5.		5.	
6.		6.	
7.		7.	

24. Do you face any challenges in access to maize and rice improved seeds in your area? Please indicate the appropriate answer

Code	**Challenges in access to maize and rice improved seeds**	**1 = Yes, 2 = No**
1.	Delays	
2.	Distance from seeds dealers	
3.	Capital	
4.	Information	
5.	Others (specify)	

F: ADOPTION OF IMPROVED MAIZE AND RICE SEEEDS

25. Have you adopted rice and maize improved seeds and using them in your farm?

Crop	**1. Adopted** **2. Not adopted**	**Whether in his/her household they planted improved seeds in the season 2013/14** **(1= Yes, 2 = No)**
Maize		
Rice		

26. ***For improved seeds adopters***

(a) Where did you obtain maize and rice seeds which you planted during the agricultural season 2013/14:

Crop	**Source [1=Seed shops at the district level, 2=Stockist at the village level, 3 = Market place, 4=Individual farmers/Farmers' groups, 5=Seeds produced/ conserved by household members, 6=Friends, 7=Others (Specify)]**	**Approximate distance from home to the source (km)**
Maize		
Rice		

27. If the answer to Question 24 is 1 or 2, please fill in the following table

Crop	**Supplier of the seeds**	**Place**	**Cost (TZS)**	**Quality of the seeds** **1=Good** **2=Neither good nor bad** **3=Poor**

(b) What advantage(s) do you consider when deciding to adopt improved maize and rice in your farm? Please rank

Crop	**Advantages of adopting improved seeds for the crop**
Maize	1. High yielding capacity of improved seeds (1 = Yes, 2 = No) 2. Good quality grains (1 = Yes, 2 = No) 3. Good texture of stiff porridge (1 = Yes, 2 = No) 4. Other advantages (Specify)
Rice	1. High yielding capacity of improved seeds (1 = Yes, 2 = No) 2. Good quality grains (1 = Yes, 2 = No) 3. Good aroma (1 = Yes, 2 = No) 4. Good flavour (1 = Yes, 2 = No) 5. Other advantages (Specify)

28. If you have not adopted improved seeds, would you kindly tell me the reasons?

Crop	**Disadvantages of using improved seeds (Reasons for having not adopted improved seeds)**
Maize	1. Poor availability of improved seeds 2. 3.
Rice	1. Poor availability of improved seeds 2. 3.

29. To what extent does unavailability of improved seeds in your village constrain adoption of the seeds? 1. Does not constrain, 2. Constrains a little, 3. Constrains much

30. Did you use improved seeds in previous agricultural seasons?

Type of improved seeds planted	**Maize (1=Yes, 2=No)**	**Amount planted**	**Rice (1=Yes, 2=No)**	**Amount planted**
2013/14				
2012/13				
2011/12				

31. What are your views on improved maize seeds with respect to the items listed below?

Most negative attributes	**Scores by interviewees**							**Most positive attribute**
	1	**2**	**3**	**4**	**5**	**6**	**7**	
1. Poor yielding								1. High yielding
2. Late maturity								2. Early maturity
3. Pest and diseases								3. Low rate of pest and diseases
4. No sprouting resistance								4. Sprouting resistance
5. No lodging resistance								5. Lodging resistance
6. Taste and preference								6. Taste and preference
7. Unavailability of the markets								7. Availability of the markets
8. Low frequency of contacting extension officer								8. Frequency of contacting extension officer
9. Low profitability								9. Profitability
10. High price of seeds								10. Low price of seeds
11. Low farmers' awareness								11. Farmers' awareness
12. Off farm field trials								12. On farm field trials
Total								---

32. What are your views on improved rice seeds with respect to the items listed below?

Most negative attributes	**Scores by interviewees**							**Most positive attribute**
	1	**2**	**3**	**4**	**5**	**6**	**7**	
1. Poor yielding								1. High yielding
2. Late maturity								2. Early maturity
3. No pest and disease resistance								3. Low rate of pest and diseases
4. No sprouting resistance								4. Sprouting resistance
5. No lodging resistance								5. Lodging resistance
6. No taste and preference								6. Taste and preference
7. Unavailability of the markets								7. Availability of markets
8. Low frequency of contacting extension officer								8. Frequency of contacting extension officer
9. No profit								9. Profitable
10. High prices of seeds								10. Low prices of seeds
11. Low farmers' awareness								11. High farmers' awareness
12. Off farm field trials								12. On farm field trials
Total								---

33. To what extent have improved maize and rice seeds been available at your nearest stockiest whenever you need them for the last two years?

Extent	**1 = Yes, 2 = No**
1. Always available	
2. Sometimes available	
3. Rarely available	
4. Never available	

G: SOCIO-ECONOMIC FACTORS OF SMALLHOLDER FARMERS ON CHANCES OF ADOPTING IMPROVED MAIZE AND RICE SEEDS

34. Have you attended any training on improved rice and maize seeds?

1. Yes
2. No

35. If yes, who offered that training on improved maize and rice seeds? Please indicate the appropriate institution/organization responsible

	Seeds Agency		**Scores**
	Government agency	**Private agencies**	
1.	Agro dealers	Project or organization	
2.	Village extension officer (s)	Individual seed agencies	
3.	Seed producers	Farmers group	

36. Do you receive any extension services in your locality?

1. Yes
2. No

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

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

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

1. Yes

2. No

39. If yes, which one?

Organization	1 = Yes, 2 = No
1. Self help group	
2. Co-operative	
3. Others	

40. . If no, give

reason_____

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

Advantages	1 = Yes, 2 = No
1. Easily access to improved maize and rice seeds	
2. Knowledge on the use of improved maize and rice improved seeds	

THANKS FOR YOUR COOPERATION

Appendix 2: A Checklist of Items for Discussion Used for Data Collection

SOKOINE UNIVERSITY OF AGRICULTURE

DEVELOPMENT STUDIES INSTITUTE

A Checklist of Items for Discussion with DALDOs, VEOs, WEOs, Commercial Seed Producers, Commercial Seed Suppliers, Extension and District Agro-Inputs Dealers for Research on:

ACCESS TO AND ADOPTION OF MAIZE AND RICE IMPROVED SEEDS IN MBEYA AND MOROGORO REGIONS, TANZANIA

BY

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A. GENERAL INFORMATION

1. Region	
2. District	
3. Division	
4. Ward	
5. Village	
6. Position	

B. ITEMS FOR DISCUSSION

1. Types of improved maize and rice seeds which are available and accessible to smallholder farmers in your area
2. Whether the smallholders farmers get access to maize and rice improved seeds at the right time
3. Percentages of maize and rice farmers who have adopted improved maize and rice seeds
4. Challenges in access to maize and rice improved seeds in your area.
5. Whether there is any government initiative to ensure both men and women (also male-headed households and female-headed households) get good rice and maize improved seeds at the right time
6. Factors which affect adoption of maize and rice improved seeds in the area
7. Strategies that the DALDO's Office use to ensure the smallholder farmers get access to maize and improved seeds
8. Whether there any capacity building initiatives in the area to ensure both men and women participate fully in the adoption of improved seeds
9. Whether there is any type of training provided to smallholder farmers on maize and rice improved seeds
10. Any constraints related to extension services that affect adoption of improved maize and rice seeds
11. Any other types of constraints related that affect adoption of improved maize and rice seeds

THANK YOU FOR COOPERATION