ASSESSMENT OF FARMERS' ACCESS TO QUALITY MAIZE SEED IN IMPROVING RURAL LIVELIHOODS: A CASE STUDY OF SOUTHERN HIGHLANDS OF TANZANIA

BY

NICKSON ELIA PETER

A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTERS OF SCIENCE IN AGRICULTURAL ECONOMICS OF SOKOINE UNIVERSITY OF AGRICULTURE. MOROGORO, TANZANIA

2004

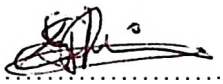
ABSTRACT

The purpose of this study was to identify the current livelihood strategies used by farmers in improving their access to good quality maize seed and livelihoods in general particularly after market liberalization of 1990s in Tanzania. Specifically the study aimed at analysing: the role of maize in the study area and the factors affecting farmers' access to improved maize seed, how farmers managed seed, farmers' knowledge, perception and practices on maize seed/crop. The study was conducted in Mponela, Ibembwa, Mangawe and Ihimbo villages. The villages are among sixteen villages under the Southern Highlands Maize Promotion Project. Focus group discussions, informal discussions with individual farmers and questionnaire interviews were used to collect data. Major tool of analysis was descriptive statistics including cross tabs, means, percentages and frequencies. Logit regression model was used to asses the factors that affect farmers' access to improved maize seed. Results of the study have shown that maize is an important crop in the SHZ used to meet food and cash needs. Both local and improved maize seed are important in the production of maize in the study area. However, observation shows that local maize seed are more cultivated than improved. Farmers perceive local maize the most reliable source of food while improved varieties are perceived good for marketing. Regression analysis results indicated that gender and the distances traveled to acquire the improved maize seed significantly ($p<0.05$) farmers' access to those seed. Among other factors high prices of improved seed and the associated inputs make them less applied. This implies that although liberalization has increased supply of improved maize varieties it has not supplied the varieties, which satisfactorily meet farmers' need. This observation suggests that more efforts are needed such as increasing the budget share to increase the capacity of National Breeding Program so that it meets successfully the needs of farmers. The study recommends that there is a need to i

the breeding programs should come up with maize seed varieties that meet food and cash needs. Similarly it was observed that farmers' local knowledge was the most reliable source of information for seed management. Farmers perceived local knowledge inadequate for seed management particularly management of improved varieties. It is recommended that more trainings of farmers are needed for improving farmers' knowledge of seed management. There is a need also to improve farmers' seed and maize storage structures by supplying them with modern equipment to reduce post harvest losses.

DECLARATION

I, **Nickson Elia Peter**, do hereby declare to the senate of Sokoine University of Agriculture that this dissertation is my own original work and that it has not been submitted for a degree award at any other universities.

Signature.....  .....

Date.....24/11/2004.....

COPYRIGHT

ACKNOWLEDGEMENT

I wish to express my heartfelt thanks and sincere appreciation to my supervisor Dr. Evelyne Lazaro for her motherhood support, guidance, encouragement, advice, suggestion and criticism which lead toward the completion of this study.

I am indebted to the CPP/Southern Highland Maize Promotion Project, based at ARI-Uyole for building the foundation of this research study as well as financial support. I wish to extend my thanks to the staff of this project particularly Dr. Nick Lyimo and Mr. A.E. Temu from ARI-Uyole, and Dr. R. Gibson and R. Lamboll from NRI, UK, for their collaboration and advices during the completion of this study. My thanks are also directed to Mr. Hoza (Mbozi District extension Officer) and to the village/ward extension officers; Miss Mwang'amba (Mponela village), Mr. Mwankemwa (Ibembwa village), Mr. Kiyeyeu (Mangawe village) and Mr. Aristide Nsiima (Ihimbo village) for their transport support and assistance during data collection.

To the department of Agricultural Economics and Agribusiness (DAEA), I wish to express my sincere thanks to all staffs for their educational support which directed my efforts toward the completion of this study. I am also grateful to my fellow M.sc. Classmates: Mr. Venance Mutayoba, Mr. Festo Mhimba and Mr. Abdul Mwankemwa for the moments we shared during our stay at SUA.

My special thanks also go to my brothers who financed my two years study at SUA.

DEDICATION

This work is dedicated to my parents Mr. Peter Mrio Mkiramweni and the late Ester Selemani Igande for their love and care during my childhood, and also to my sisters: Anna, Mary and Eliza, my brothers: Dr. Jerome Mkiramweni (and his family), Fr. Vincent Mrio, Freeman, John and Josephat for jointly laying down the foundation of my education.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ABBREVIATIONS

Actellic EC	Actellic Emulsifiable Concentrate
ADP	Agricultural Development Programme
AEZ	Agro-ecological zones
ARI	Agricultural Research Institute
ASPS	Agricultural Sector Programme Support
CAN	Calcium Ammonium Nitrate
CPP	Crop Protection Programme
DAEA	Department of Agricultural Economics and Agribusiness
DANIDA	Danish International Development Agency
DAP	Diammonium Phosphate
FAO	Food and Agriculture Organisation
INADES	Institut Africain pour le Development Economique et Social.
ITK	Indigenous Technical Knowledge
MAFS	Ministry of Agriculture and Food Security
NGOs	Non Governmental Organisations
NMC	National milling Cooperation
NRI	Natural Resources Institute
OF	Organic Farming
OPV	Open Pollinated Varieties
QDS	Quality Declared Seed
SA	Sulphate of Ammonium
SAPs	Structural Adjustment Programmes
SHZ	Southern Highlands Zone
SNAL	Sokoine National Agricultural Library

SPSS	Statistical Package for Social Sciences
SUA	Sokoine University of Agriculture
TANSEED	Tanzania Seed Company
TFA	Tanganyika Farmers Association
TMV-1	Tanzania Maize Variety one
TMV-2	Tanzania Maize Variety two
TOSCA	Tanzania Official Seed Certification Agency
Tshs	Tanzanian shillings
TSP	Trisuperphosphate
UCA	Ukiriguru Composite
UH	Uyole Hybrids
UK	United Kingdom
URT	United Republic of Tanzania

CHAPTER ONE

INTRODUCTION

1.1 Background Information

Maize was first domesticated in Mexico for use as food as early as 500BC, where it soon became the cornerstone of agriculture and was called "*the golden crop*". The crop was unknown in the outside world until 16th – century when explorers brought seed grains to Europe and Africa (Barbara 1996).

Maize is the major cereal grain in Tanzania and it plays an important role in the country's food security and income to smallholder farmers (Ashimogo, 1994). Maize production is mainly undertaken to meet household consumption and cash needs. Nation-wide it is known to be the most important crop in alleviating hunger. In terms of quantity produced, maize is the most important of all cereal grains grown in Tanzania followed by paddy, sorghum, millet and wheat (Ashimogo, 1994). Maize is a widely cultivated crop in the Southern Highlands Zone (SHZ), which covers 28% of the total land area of Tanzania. Maize grain production in the SHZ accounts for almost 50% of national maize production (URT, 2003).

The SHZ comprise of four regions that is, Rukwa, Ruvuma, Mbeya and Iringa that provide one of Tanzania's most favorable environments for maize production (URT, 2003). Temu *et al.*, (1984) reported that maize is a high potential crop in the Southern Highlands because much of the area exceeds the minimum requirement for growth. In its efforts to promote maize in the SHZ and other parts of Tanzania the government through its parastatal organization called Tanzania Seed Company Ltd (TANSEED) and Co-operative societies, was responsible for the provision of agricultural inputs on credits to

farmers. TANSEED, which, was established in 1973, had a monopoly on seed production, importation, distribution and sale of certified maize and other seeds (Mtenga *et al.*, 1999; Ministry of Agriculture and Co-operative, 1997). However, TANSEED was not able to perform these duties efficiently or effectively resulting in poor performance of the national seed industry (Mtenga *et al.*, 1999).

However, due to the deficiency of TANSEED and other sectors of economy, Tanzania since the mid 1980s, has adopted gradually economic policies which lead to economic reforms characterized by moving away from an economy largely planned and controlled by the government towards a market-based economy. Thus up to 1990s these policies lead to the withdrawal of the state from agricultural marketing and the liberalization of the seed industry (URT, 2001). After liberalization, since 1990, a number of foreign and domestic private seed companies entered the seed sector to produce, distribute and market improved seed. As a result of private sector involvement, an improved rural livelihoods through increased production efficiency was expected. Nevertheless, Ponte (2002) observed that the involvement of private sector has raised the efficiency of import and wholesale distribution of inputs, but most private traders are not interested in distributing inputs in areas with poor transport infrastructures. Thus, the withdrawal of the state from inputs and credits provision has not adequately compensated for by private sector involvement. As such the expected improved rural livelihoods through increased production efficiency as a result of private sector involvement in seed marketing, has not yet been realised. Livelihoods have become increasingly commercialized and rural farmers are restructuring the ways they manage their economic activities and are transforming their social relations (Ponte, 2002). In general policy change has re-shaped the boundaries within which rural livelihoods adapt, diversify and cope with risk and diversity. This study is part of an on-going project, which is based, in Agricultural

Research Institute of Uyole (ARI-Uyole) in collaboration with the Natural Resource Institute (NRI) in UK for the DFID Crop Protection Programme (CPP) project. The project is aiming at improving maize productivity in SHZ following liberalization by addressing issues related to farmers' access to high quality maize seed. Therefore this study is undertaken to assess how farmers have shaped their livelihood strategies after reforms with particular emphasis on access to maize seed. The objectives of this study were formulated as requested in the terms of reference (Appendix 1).

1.2 Problem Statement and Justification

Although maize plays an essential role in the livelihoods of people in the SHZ, significant changes in context have been taking place with major implications for peoples' livelihoods. The relationship between peoples' assets, strategies and outcomes has been influenced by many factors, including institutions (public sector research and private companies) and policies changes (e.g. Structural Adjustment Programmes (SAPs) (URT, 2003). SAPs are generally associated with the removal of subsidies and an increase in input prices (e.g. seed, pesticides and fertilizers), and an expanded role for the private sector. Among these inputs the use of improved maize seed by smallholder farmers seems to have greatly been influenced by the changes in institutions and policies. For instance Bisanda and Mwangi, (1996) reported that most farmers (53 %) used improved varieties before 1990. However, those who have used improved varieties 64% and 74% of male and female- headed households discarded the improved varieties at least once or more after the economic reforms. Discarding of improved varieties is largely due to exorbitant high input prices deteriorated quality of and reduced access to inputs (including quality maize seed) in remote areas (URT, 1997). Lack of confidence from seed companies and many other institutions dealing with seed distribution is perceived to be another constraint

hindering small-scale farmers in accessing seed of high quality (URT/CPP/INADES formation, 2003).

According to URT (2003) for many farmers that are dependent on maize production as the main livelihood option, the return/profitability from the crop, following economic reforms in the country, has declined with implication for capital asset base, for example, less money to purchase inputs, possibly unable to support children going to school. In general policy changes has re-shaped the boundaries within which rural livelihoods adapt, diversify and cope with risk and diversity. With respect to the decline in returns from maize, rural farmers have adapted different livelihood strategies, as far as maize production is concerned. According to Akyoo, (2004) adapting certain copping strategy is influenced by farmers' attitude (perception), objectives and resource base. Understanding these strategies is necessary for improving farmers' access to quality maize seed.

This study tries to understand better the current livelihoods of farmers with regard to maize in SHZ particularly after the economic reform policies have been adopted in Tanzania by: outlining the current relationships between maize and peoples' livelihoods, identifying the strategies laid down by farmers in improving access to and management of maize seed, and finally to draw the implication and recommendations for maize breeding strategies relevant to farmers' needs. Also understanding of farmers' practices on maize seed management will be an important element in identifying farmers' training needs.

1.3 Objectives

1.3.1 General Objective

The main objective of this study is to understand the relationships between maize and peoples' livelihoods, to identify the strategies laid down by farmers in improving their access to and management of maize seeds and to draw recommendation for breeding that relates farmers' livelihood strategies.

1.3.2 Specific Objectives

1. To outline the current roles of maize and their relationships with peoples' livelihoods.

2. To determine the factors that affect farmers' access to improved maize seeds particularly after economic reforms of 1990s and the copping strategies to the declined return from maize.

3 To determine the different types of maize seed management practices used by smallholder farmers and to assess farmers' knowledge and perception on maize crop and maize seed.

4 To draw implications and recommendations for maize breeding in the study area.

1.4 Research Questions

1. What are the current roles of maize in the study area and how these roles influence the choice of variety?

2. What are the factors that affect farmers' access to improved maize seed?

3. What are the seed management strategies used by farmers and the livelihood copping strategies used by farmers in response to declined application of improved maize seed?

4. How do farmers' knowledge and practices affect the quality of maize seed?

1.5 Hypotheses

Farmers' access to improved maize seeds is significantly affected by factors such as age, gender, education, knowledge of improved seed, total area of land allocated for maize production, number of dependants in the household, and income, price, and distance to seed shops.

CHAPTER TWO

LITERATURE REVIEW

This chapter presents a detailed review of the literature related to maize with particular emphasis on maize seed following economic reforms adopted in Tanzania early 1990s. The section begins with the definitions of key concepts applied in this study. The following subjects are covered; Seed and agricultural productivity, Types of maize seeds, Features of seed industry before and after economic reforms in Tanzania, Seed industry and seed systems in Tanzania, Maize production efficiency and marketing after economic reforms, Seed management practices, Seed marketing, and farmers' local knowledge.

2.1 Definition of key concepts

2.1.1 Seed

Seed refer to any plant part which can reproduce the same kind of crop (FAO, 1999) According to the URT, (2003), seed means that part of a plant which is or intended to be used for propagation and includes any true seed, any vegetative material including seedling, corm, cutting, bulb, bulbils, layer, marcot, root, runner, scion, set, split, stem, tock, stamp, sucker or tuber so used or intended to be so used. Seed as an input is defined as a factor in agricultural production which is combined at different levels with other factors of production (land, labour and capital) to produce a given level of agricultural output. Regassa *et al.*, (1998) argued that seed is an engine for agricultural production and improvement of livelihoods of smallscale farmers.

2.1.2 Quality Seed

Quality in seed embraces all the physiological, biological, pathological and genetical attributes which contributes to the final yield of the crop (Basra, 1994). As defined in FAO, (1999) quality seed implies seed of desired variety with the right genetic and sanitary criteria for producing a crop. Both improved Open Pollinated varieties (OPV) or hybrids and landraces can therefore be considered to be quality seed provided they meet these criteria in the definitions.

2.1.3 Access to seed

Access implies that the source of seeds should be within an acceptable distance in timely manner and at an affordable price (Tripp, 2001). According to FAO, (1999) seed access is related to: quality (desired variety with the right genetic and sanitary criteria for producing a crop), equity (reaching all farmers) and finance (ability to have from external sources). In some literatures seed access has been defined synonymously with seed security. Almekinders and Louwaars, (1999) defined seed security as the sustained ability of all farmers to have sufficient quantities of the desired types of seed at the right time. It does not only refer to the quantities and qualities of seed but also to the timing (i.e. availability of seed at planting time), the finance (ability to have or purchase) and equity (access to all farmers in the community).

2.1.4 Variety

A variety is defined as a plant grouping which is distinct in one or more forms or functions from other such groups of plants of the same species and which maintains these distinctions when reproduced (Almekinders and Louwaars, 1999). Improved variety is a term used in different ways by different people. It is a variety which is developed by trained breeders working through targeted generation or diversity through crossing or

other biotechnology tools and selection (Almekinders and Louwaars, 1999). In this study improved variety refers to plant material (material from farmers' variety or from elsewhere) that has been modified such that it bears characteristics superior to those of landraces or local varieties.

2.1.5 Livelihood

Livelihood implies a means of living (set of activities a human being apply to earn everyday life) (Hornby, 1992). According to Chambers and Conway (1992) a livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living. A livelihood is sustainable if it can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in the long and short term. Livelihood strategies are routinised and complex set of activities required for a means of living.

2.1.6 Seed Industry

Seed industry is the entire complex of interlocking operations to ensure a regular supply of high quality seed to farmers (Lazaro, 2003; Cromwell, 1990; and Feistritzer, 1978). It involves the entire complex of organizations, institutions and individuals and the existing seed systems in the society.

2.1.7 Seed systems

Seed systems refer to the group of processes or procedures, which farmers, organisations and institutions use to obtain, maintain, develop and distribute seed resources both from one growing season to the next and in the long-term. According to FAO, (1999) these

processes can be examined from social, technical perspectives and the dynamic ways in which these two perspectives interact.

2.1.8 Participatory plant breeding

Participatory plant breeding refers to the activities in which farmers are involved in the selection of plants or seeds intended for crop improvement or breeding program. Selection is done from and within a genetically variable population or variety. Farmers may also be involved in part of breeding process where genetic diversity is generated; part of the process preceding the selection. They may be involved in the selection of parental materials and/or in the actual crossing. The principle reason for increasing the involvement of farmers in breeding is to come up with plant materials that reflect farmers' environment and preferences.

2.2 Seed and agricultural productivity

Seed is considered to be basic input to agricultural production and a vital to enhancing productivity (Anandajayasekeram *et al.*, 1999). Regasa *et al.*, (1998) noted that seed is an engine of agricultural production and improvement of livelihoods of small-scale farmers. It determines the genetic resistant to pests and diseases and eventually the yield potential. To increase productivity of agriculture farmers need to have access to high quality seed as well as functioning marketing systems. Access by farming households to adequate quantities of good quality seed at all times is required if increases crop productivity is to be achieved. Currently most farmers in SHZ are self-provision in terms of local maize seed. However to be productive and have stable agricultural livelihoods, farmers have to grow a diversity of high quality maize varieties with regard to the crop.

2.3 Types of maize seed

2.3.1 Local seed

Local seed are also called landraces, traditional varieties or farmers' varieties. This is a population of plants resulting from the combination of environmental selection and the cultivation and seed selection practices of the farmers over a period of time (Cromwell, 1996). Local varieties are preferred for their yield stability and less risky in production. They are known to maintain a stable yield. According to Almekinders and Louwaars (1999), stability of yield is sometimes better than yield levels. Since farmers' concern is food security, it is logical to say that a farmer cannot take the risk of producing below the minimum required for the family to survive. For that reason variety which maintains stable yield may be a better option for a resource-poor farmer than a variety, which produces high average yield, but with a greater risk of producing less than the required minimum. Local varieties are also known to cope with variations in climate and soil conditions.

2.3.2 Certified seed

Certified seed forms the class of seed that has been officially guaranteed to conform to the standards for genetic purity established and enforced by the seed certifying authority of the country (Hella *et al.*, 2003). The Tanzania Official Seed Certifying Agency (TOSCA) is the responsible authority for quality control and certification procedures. Quality control and certification procedures include: source verification, field inspection, seed sampling and inspection, seed testing, labeling and quarantine inspections on imported seed (Information obtained informally from TOSCA office in Morogoro).

Before reforms the distribution of certified seed was under the departments or institutions of Ministry of Agriculture and Food Security (MAFS) or the parastatal enterprises.

However, in the beginning of 1990 when the government phased out its responsibilities related to commercial seed production, processing and marketing private companies started to deal with certified seed (Hella *et al.*, 2003). However, the certification activities remained in the hands of TOSCA. By 2000 the largest private seed company operative in Tanzania was Cargill (now known as Monsanto). The company was responsible for production, processing and marketing of hybrid maize seed. Other emerging private seed companies include Alpha Seed, INCOFIN Tanzania Limited, East African Seed Company and Pannar (Mtenga *et al.*, 1999). Currently there are about twenty two private seed companies operating in the country (see appendix2).

2.3.3 Quality Declared Seed (QDS)

QDS is defined as seed produced by a registered seed producer which conforms to the minimum standards for the crop species concerned and has been subjected to the quality control measures. QDS production is a unique semi-formal production approach, which empowers farmers to produce and sell seed to local communities. (URT, 2001; Mwanga *et al.*, 2003). The idea of introducing QDS to developing country came after many of these countries have been unable to introduce and sustain satisfactory seed quality control scheme because of the relatively high level of resources needed for a comprehensive seed certification system. Therefore the FAO/SIDA Technical Conference on Improved Seed Production held in Nairobi, Kenya, in 1981, identified the need for new thinking on seed quality control (URT, 2001). FAO therefore sought to device a system which would be less demanding on government resources but which would nevertheless provide reasonable safeguards that the seed offered for sale would be of a quality satisfactory for crop production (URT, 2001). QDS started in Tanzania during the 1999/2000 cropping season in order to avail quality seed to farmers who could not afford to access the same from the formal system (Lazaro, 2003).

2.3.4 Commercial Seeds

These seeds usually originate from individual entrepreneurs, companies or government agencies, which assemble seed from many sources within or outside the country for distribution and sale in the local market. Such seeds often are of unknown origin, variety superiority and their general qualities. (Hella *et al.*, 2003). TOSCA has mandate to carry out quarantine inspection on these seeds if deemed necessary.

2.4 Features of seed industry before and after economic reforms in Tanzania

2.4.1 Pre- Economic Reforms

Before economic reforms, the Tanzania seed industry has been entirely governmental until 1990 when it was liberalized (URT, 1997). Specifically, during 1970s -- 1980s the government considered its responsibility of providing the inputs to all farmers in all regions of the country at affordable price (URT, 1997). All activities involved in the production as well as distribution of improved (hybrids and OPV) seed were under the state monopoly. Before liberalization research institutes through the National Agricultural Research System were given the mandate to breed improved seed and a state owned parastatal, TANSEED was given mandate to coordinate production and distribution of all improved seed throughout the country (Lazaro, 2003). Three foundation seed farms were also established at Arusha, Kilosa (Msimba) and Dabaga (in Iringa) to bulk breeder seed. During this period (before liberalization) farmers' had good access to good quality seed. According to Bisanda and Mwangi (1996), 53percent of farmers in SHZ used improved seed between 1986 and 1990. However, due to big load of responsibilities TANSEED performance efficiency was ever decreasing. Due (1988) observed that TANSEED suffered from lack of transportation facilities and humidity-controlled warehouses or seed drying equipments. Lack of these facilities resulted into late arrival of seed to the outlet points such as co-operative or primary societies and poor germination of seeds

respectively. In addition, the narrow range of crop varieties that failed to meet farmers' need was a common feature of TANSEED. Similarly, TANSEED faced a very serious financial crisis. By 1990 TANSEED had failed to meet the seed needs of the farmers and was liberalized (Mtenga, 1999).

2.4.2 Post economic reforms

After liberalization the private sector (private companies as well as NGOs) became responsible for most of the production, processing and marketing of seeds. The government is largely responsible for regulatory functions (Lazaro, 2003). According to Mussei *et al.* (2003) liberalization has improved the availability of seed and farmers have a wider choice of seed varieties. However, the distribution system used by private companies is not satisfactory. Private companies were expected to operate competitively resulting into increased distribution efficiency and at prices affordable to farmers. Due to poor conditions of rural roads and increased transaction costs, private companies concentrated in town areas depriving farmers in the remote areas access to improved seed. As a result farmers have to travel long distances to buy improved seed (Wright *et al.*, 1994). According to Bagachwa (1995), the reforms have increased the prices of farm inputs (seed of improved maize varieties, fertilizers, pesticides and herbicides). This has resulted to farmers' poor access to improved seed and other inputs (fertilizers, pesticides) which are to be combined with the seed during crop production.

2.5 Seed industry and seed systems in Tanzania

In general two seed systems characterize the seed industry in Tanzania. These include the: formal seed system and informal seed system (farmer managed system). Both systems are equally important for better supply of high quality seed (Anandajayasekeram *et al.*, 1999). However for quite a long time much emphasis has been on the formal seed system

through the Ministry of Agriculture and Food Security (MAFS) while the informal seed system was left under the control of smallholder farmers. The formal and informal seed systems are linked through the introduction of Quality Declared Seed (QDS).

2.5.1 Formal seed system

Formal seed system refers to a system in which all processes involved in seed selection: seed production and seed exchange are not part of crop production and social processes of farming communities. Through this system certified seed (seed of standard quality, genetic purity and variety identity) is produced and distributed (Cromwell, 1996). In order for any country to succeed in improving crop productivity a well-functioning seed system is required. According to Meredia and Howard (1998), a well-functioning seed system is the one, which uses the appropriate combination of formal, informal, market and non-market channels to efficiently meet farmers' demand for quality seeds.

Although in Tanzania much emphasis has been directed to formal seed system the quantity and quality of seed supplied by formal organizations represent not more than 20% of the total amount planted by smallholder farmers and for a limited range of crops only (Mtenga, 1999).

Formal seed system is composed of the public and private sectors as well as the Non Governmental Organizations (NGOs), each with specialized roles in supplying new varieties (Meredia and Howard, 1998). The public sector is specialized in basic research and regulating the seed systems. Profit making is not the primary objective of the public sector. Currently in SHZ of Tanzania ARI-Uyole and Dabaga Foundation Seed Farm are the public institutions engaged in seed breeding and multiplication respectively. Dabaga foundation seed farm is also responsible for the distribution of foundation seed to the

farming communities. District Agricultural extension offices down to ward and village offices are responsible for providing extension services to farmers and act as a link between farmers and other service providers. Tanzania Official Seed Certifying Agency (TOSCA) is another public institution, which is responsible for quality control and certification procedures countrywide. Since the public institutions are not profit oriented frequent shortage of funds and poor working facilities limit the operations of these institutions.

The private sector is composed of the private seed companies as well as voluntary organizations. Unlike public sector, profitability is an important object for private sector seed organizations. Private seed companies are mainly interested in profit making and hence focus towards those types of seeds for which there is an effective demand and which are profitable to produce (Mtenga, 1999). In this aspect the private sector distribute their seed in areas where there is higher return to the capital invested. In m In most private traders do not distribute seeds to the remote areas because poor roads and poor storage facilities characterize most of these areas. Otherwise prices of seeds from private sectors have to be high in order to meet the objectives of profitability (Cromwell and Wiggins, 1993). The presented features of public and private sectors can be said to reduce the accessibility of improved seed to smallholder farmers as they have to travel long distances and incur transport costs in acquiring seeds. According to FAO, (1999) nearly 70 percent of small scale farmers who rely on local seed systems are to be found in areas with poor and /or inaccessible road and electronic services. This limits interaction between farmers and the service providers.

NGOs provide an alternative to public and private seed companies. NGOs are commonly perceived to have several advantages in working successfully in marginal areas. They

provide access to improved seed and other agricultural inputs as a result of failure of the private seed organizations to reach particular communities or groups (Mtenga, 1999). They are flexible such that they can cope with new situations, that is NGOs can respond to needs quickly and give awareness of smallholder farmers' local conditions compared to public and private formal seed sectors (Cromwell and Wiggins, 1993; Farrington *et al.*, 1993; Kane *et al.*, 1990). NGOs' activities empower grass-roots organizations and resource poor farmers in the long term. NGOS are often more participatory and their efforts have been directed toward the development of sustainable local level capacity in seed production (Tripp, 1995; Sumberg, 1991). However NGOs face limitations such as poor infrastructures, weather fluctuations (drought and unreliable rainfall) and have low capacity compared to the needs.

Examples of NGO currently working in SHZ include: Mbozi District Agricultural Development Programme (ADP-Mbozi) Trust Fund that started in 1980s as an agricultural Development Project. It was funded by the Belgian NGO called COOPIBO. In 1990s it was transformed into a trust fund in order to increase farmers' ownership of the project. The ADP-Mbozi was established to: improve the living standards of farmers, improve household food security through the introduction of good quality seeds, good farming practices and saving and credits to farmers and link farmers to ARI-Uyole to acquire improved seed. Others include CARITAS, INCOMET and Ileje District Rural Development Trust Fund (IRDTF).

2.5.2 Informal Seed systems

The informal seed systems which in some literatures have been used synonymously with local seed systems, can be defined as the systems in which seed system functions (selection, production, storage and seed distribution) are often integrated into crop

production and socioeconomic process of farming communities (Almekinders and Louwaars, 1999). This implies that in informal seed supply system; farmers' seed production activities take place outside the formal system of regulated seed production by registered organizations or institutions.

Broadly informal seed system refers to the process, which farmers use to produce, obtain, maintain, develop and distribute seed resources both from one growing season to the next and in the long term (Longley and Richard, 1998). It is composed of individual farm households carrying out most these seed system functions on its own with little or no specialization. However, it is not all farmers who are capable of producing a crop of the right quality for seed (Musa, 1998). An informal seed system thus forms an integral part of the wider agricultural system and depends largely on the capacity of local farmers to plant crops each season and successfully retain part of the harvested output, or where a farmer decides to plant a different seed variety. Seed is generally acquired from local community or within the farmer's wider social network. Wright *et al.*, (1994); Cromwell, (1996) observed that the informal seed sector offers a wide variety of exchange mechanisms used to transfer seed between individuals and households, not just cash sales but also in-kind seed loans, barter and transfer based on social obligations. The exchange mechanisms are an important means of giving a wide range of socio-economic groups' access to seed, because in many areas cash purchases and transactions using formal seed systems are limited to the better-resources households (Cromwell, 1996).

Mwanga *et al.*, 2003 observed that at present 95% of the seed requirement is provided by the informal/ local seed system. Hence local seed system is the most important supplier of seed to farmers. Almekinders and Louwaars, (1999) emphasized that strengthening local seed systems is the best general approach to increase seed security.

However, Mwanga *et al.*, (2003); Aziz *et al.*, 1994) cautioned that, although the informal seed systems have proved to be dynamic and flexible in many aspects, they have weak points which require improvement. The informal seed systems have been week in that, in certain circumstances some farmers have been conservatives thus reluctant to apply the modern farming techniques. Therefore continuous use of local knowledge without integration to modern technologies has been the case. The weaknesses of the local systems are manifested in low yield potential of the crops produced under local farming practices. Measures to improve the informal seed systems should aim at: analyzing the present situation, identifying strength and weaknesses and defining strategies, which can result in improved seed supply (Almekinders and Louwaars, 1999). Strengthening participatory crop improved stands a better chance in strengthening the informal (local) seed System and consequently the improved rural livelihoods.

2.6 Strengthening local seed system

2.6.1 Participatory crop improvement

If seed security is to be achieved informal seed system is to be combined with formal seed system through participatory plant breeding. According to Almekinders and Louwaars (1999), two types of crop improvement are distinguished: participatory variety selection and participatory plant breeding.

In participatory variety selection, farmers are involved in evaluating and selecting from among released or pre-released or advanced (i.e. nearly finished) varieties. In this case, farmers may be invited to the experimental stations or to district variety trials to select and take seed from the varieties they consider promising. In other way, a group of farmers may grow and evaluate a number of varieties on their own, or may implement a

community evaluation trial. In this aspect selection can be from farmers' evaluated varieties (Almekinders and Louwaars, 1999).

2.6.2 On-farm Seed Production

On-farm seed production is a semi-informal seed system that consists of characteristics, which fall between formal and informal seed system. This system is also known as Community Based seed production. With this system seed of improved varieties, is produced and distributed with some limited enforcement of quality control by the official certifying agency (Lazaro, 2003). Within the household, on-farm seed production is the main source of seed and information flow (Mkuchu *et al.*, 2003). Therefore support on-farm seed production is important. According to Almekinders and Louwaars, (1999) this support has to be preceded by an analysis of constraints. This analysis should yield the most pressing problems and not concentrate on those perceived by a seed technologist, based on the quality standard followed by the formal sector. This is because not all the aspects and indicators used in formal sector are equally relevant for small-scale or low-input agriculture. In Tanzania seed produced under such condition is categorized as Quality Declared Seeds (QDS). On-farm seed production is an approach through which researcher and extension agents do disseminate germplasm to smallholder farmers and others.

2.7 Maize Production Efficiency and Marketing after Reforms

After the TANSEED monopoly been replaced by the private seed companies there are indication that in SHZ the number of seed varieties present in the market has increased (Hella, et al., 2003). However, despite this increase, the proportion of smallholder farmers using improved maize seed decreased. According to URT (1997), the most fundamental reason for the decline in the use of modern maize seed is the low return from the crop due

to lack of purchasing power of producers which is caused by low productivity and depressed producer price. Grain liberalization has improved marketing efficiency by ending the monopoly of the National Milling Cooperation (NMC) and also eliminated the difference between official and parallel markets (Msambichaka, 1995). NMC was a government parastatal charged with the marketing of grains all over the country. Regardless these achievements liberalization failed to improve the farm-gate prices and in some cases private traders have been reluctant to serve remote grain-deficit areas. Msambichaka, (1995) reported that the withdrawal of NMC from marketing operations and the expansion of private trading have consistently reduced producer prices in remote surplus regions, where maize production was, before liberalization, heavily subsidized. It was expected that further falls in real maize producer price in the SHZ may create comparative advantage for the production of other crops. But this advantage has not yet been realized. It was observed also that the profit margins on trading operations from the SHZ to Coastal or Northern regions were much lower than trading from other areas due to higher transport costs. However, in 2001/02 the government reacted on this by opening the country boarders for farmers to export maize and traders from other countries to come and buy maize in the country. Boarder trading of maize and other crops was regarded as a means for improving prices of these crops in the SHZ and other parts of Tanzania.

2.7.1 Rural livelihoods after economic reforms

The Macro-economic reforms adopted in Tanzania in the mid 1980s resulted into the implementation of the Structural Adjustment Programmes (SAPs). The major concern of SAPs was the liberalization of the agricultural marketing activities with the aim of increasing agricultural outputs and productivity for betterment of rural livelihoods. The realization of this objective was expected to enhance country's food security, strengthen export growth and finally improve people's welfare especially in rural areas. However,

where liberalization has taken place, agricultural productivity has remained low and the rural population has remained poorer than it was before SAPs due to poor access to high quality seed (Msambichaka *et al.*, 1994). This argument suggests the need to improve rural livelihoods by improving seed accessibility. According to Regassa *et al.*, (1998) improving farmers' access to quality seed should make a significant contribution towards improving rural livelihoods.

2.8 Seed Management Practices

Seed management comprises of all activities of farming family that influence their seed stock. These activities include: introgression of improved cultivars (open pollinated varieties or hybrids), seed selection, processing, storage, exchange and procurement (FAO 1999). The pre and post harvest protection of seeds also determines whether it carries inocula of various pests and diseases and seedling vigour essential for good establishment in the face of weeds and other adverse biotic and abiotic factors.

Although seed growth follows predictable patterns of nature, it is also affected by the intervention of human management practices. These management practices may, over, many years lead to the changes in the genetic make-up of the seed itself (FAO, 1999). The genetic potential of seed largely dictates crop yield and the productivity of other agricultural inputs and cultural practices (Mumby, 1994). Therefore the yield potential of a plant is an outcome of careful planning of the seed management practices.

2.8.1 Seed harvesting and processing

Harvesting and processing are important seed management practices that can change the quality of the seed. The quality of seed is improved during processing in two ways: First, separation of contaminating seeds of other crops, weeds and inert matter, and second, by upgrading or the elimination of poor quality seeds. The ultimate goal of seed processing is

to obtain the maximum percentage of pure crop seed with maximum germination potential. A good seed processing job can assure that the previous efforts of plant breeding in developing superior varieties, and of seed producers in growing them, can result in maximum quality seed (Almekinders and Louwaars, 1999).

2.8.2 Seed Selection

Seed selection involves selecting a certain amount of planting materials of each cultivar for planting in the next season (Lazaro, 2003). Farmers can save seed for the following season. In some cases no distinction is made between stored grain and seed, but farmers often select their seed carefully and store it separately (Tripp, 2001). Farmer selection aims at improvement of crop varieties. For instance local varieties have been reported to be genetically degraded through seed mixture, genetic drift or inbreeding. In such situations, therefore, careful planned seed selection practices can significantly improve the genetic quality of local seed (Meredia and Howard, 1998).

Location and time can determine farmers' intention to select seed. Selection according to location occurs when a farmer chose a particular field or part of that field that performs well. The advantage of this selection determinant is that seed from well developed plant with fewer disease symptoms are expected to have better vigour and higher sanitary quality. Timely, farmer can select seed during different phases of crop production. That is, during or at the end of the season, after harvesting or a period prior to sowing (Almekinders and Louwaars, 1999). Selection prior to sowing enables farmer to select a healthy and true-to-type seed (that is seed that resemble the mother crop) from the bulk of the stored grain. Similarly, selection after harvesting enables farmers to obtain healthy seed that is not visibly damaged (Lazaro, 2003). It enables farmers to identify a new seed type that has been arisen due to hybridization. Also it is advantageous in that, for small

amount of seed, drying and storage conditions can be given more attention (Almekinders and Louwaars, 1999). Selection methods include: picking individual plants before the harvesting of the whole field or by marking particular healthy and good-looking individual plants during the season.

2.8.3 Seed Storage

Once seed has been harvested, its quality can be maintained but not improved. Practices used in the storage of seed will directly affect quality maintenance as the environment in which seed is kept influences quality more than the actual age of the seed (Cromwell, 1996) High temperature and moisture are major enemies in seed storage. They affect the maintenance of seed quality in storage (Almekinders and Louwaars, 1999). High temperature and moisture favours the development of insect, bacteria and fungi. Because seed is a living organism, care must be taken to guard against extremes of humidity or temperature as well as to protect it from pests and insects (Tripp, 2001). This first means that seeds should be harvested early, dried well and stored under dry conditions. Also seed should be protected from over-heating during drying and should be stored in as cool place as possible (Almekinder and Louwaars, 1999).Loss of viability of seed is reported even from countries blessed with conditions favorable for production and storage of seeds because of unforeseen pre- and post harvest conditions (Basra, 1994).

Seed storage facilities are an important concern in seed production that determines the quality of seed and its viability (Mtenga, 1999). Storage structure and facilities should also protect the seed against damage of rats and other rodents (Almekinders and Louwaars, 1999). From economic standpoint, seed companies would have a difficult time balancing supply and demand if they could not carry-over some seed lots for a second

season. Similarly, plant breeders desire longer term storage so that they can maintain breeding materials for up to ten years or longer (Mumby, 1994).

2.8.4 Seed sources and procurement

Seed can be available to farmers through own saved, exchange, markets and gifts. Own saving is regarded as the most reliable and popular source of seed among smallholder farmers. Majority of resource-poor farmers have been self-provisioning in terms of seed through this source. However, irrespective of the reliability and popularity of own-saving as source of seed, circumstances such as; need to increase seed diversity, need to test new technology and seed shortages (due drought or social problems) cause farmers to seek seed from outside their households or farms (Tripp, 2001). These circumstances are the basis for the movement of seeds within and between farming communities and the development of informal seed trade. On the other hand seed exchange is a traditional system of maintaining, extending and strengthening social ties between and within household communities – social capital (Lazaro, 2003).

Gift or free seed is another popular seed acquisition system especially among the poor who cannot afford to buy or keep own seed because of the circumstances such as seed shortage due to poor harvest in the previous season (Lazaro, 2003).

Similarly, local markets and stockists are considered another important, though not very dependable source of seed. Markets are not very much dependable because only farmers with cash can access seed from markets or shops (Lazaro, 2003) The market or shops become important source when farmers want to acquire newly released seed.

2.9 Seed Marketing

Marketing is one of the most important activities in agriculture as it assures customers to get the right product at the right place, time and at the right price. It is about identifying, anticipating and satisfying the needs of the farmer, as well as realizing the objectives of the supplier (FAO, 1994). Seed marketing should aim to satisfy the farmer's demand for a reliable supply of range of improved seed varieties of assured quality at an acceptable price (Mumby, 1994).

In considering the needs of their customers, seed companies must think in terms of the product itself, the price of the product and the place where the farmer needs it, while making sure that the existence of the product is known through effective promotion. This constitute what is called *marketing mix* (Mumby, 1994).

The product is the focus of marketing. Although many aspects of the product are not marketing responsibilities (such as plant breeding, seed production and processing) marketing is concerned with the product's attributes and what these mean to farmer. Such factors include quality appearance and performance.

The place aspect deals with the various methods of transporting and storing seeds and then making them available to the farmer. Getting the product to right place at the right time depends on the distribution system (Mumby, 1994). Failure of making seed available to farmers at required time has been explained as one of the reasons which make farmers continue using local seeds (Cromwell, 1996). Seed must reach farmers in time for the next season (Hella *et al.*, 2003). Choice of distribution method will depend on market circumstances and the nature of both the seed and the farmer (Mumby, 1994).

Price is really determined by what farmers perceive as the value of seed of a particular variety. It is important to understand how farmers value seed as well as how much they are prepared to pay in relation to the benefit they expect to earn.

Promotion is another element of marketing mix, which implies the business of communicating with and influencing the customer. Although the cost associated with promotion can be a significant element in the overall cost of a product, successful seed promotion increases sales so that costs are spread over a large output (FAO, 1994). Seed sales promotion is directed to influence consumers (farmers) to use good quality improved seed. It is through sales promotion that will increase seed sale by making farmers change from using local to improve seeds (Hella *et al.*, 2003).

2.9.1 Seed Distribution

Distribution is the process of moving package seed from the stores where it is held following processing and packaging to the farmer. It is a key area of marketing and is a vital part of meeting the customers' needs and requirements. Distribution therefore covers the place element in the marketing mix and relates to getting: the right products, in the right mix, in the right quantity, at the right time in the right place, in the right condition, and at the right price under the right contractual terms (Mumby, 1994).

Success in seed marketing depends on the establishment of effective distribution system. In liberalized market economy seed companies or their agents operated in many towns, which make farmers travel long distances from villages to towns to buy seeds. In additions, evidence shows that private agents are in most cases relatively bias with respect to accessibility by roads. Farmers located in remote areas or regions located far from seed multiplication farms have little or no access to improved seeds (Hella *et al.*, 2003).

Therefore in arranging for effective seed distribution, Mumby (1994) suggested that farmers should be considered in terms of:

-The period when seeds are required and whether there is a single sowing period;

-When seed is purchased and in what quantity;

-The most popular package sizes;

-The distance normally traveled between farm and retail outlet;

-The transport normally used by farmers to move seeds to their farms and;

-Farmers' credit needs

2.9.2 Seed demand

In seed marketing the most useful task is assessment of effective demand.

Demand to the seed seller, is the quantity that buyers (in this case farmers) are willing and able to purchase at a particular price (Mumby, 1994). This is called effective demand and is not the same as seed requirement. It is important to distinguish between the amounts of seed farmers will actually buy and how much they would like to buy, or indeed how much the government would like them to buy (Mumby, 1994). Seed requirement is the amount of seed consumed in establishing the total crop area while seed demand is the amount of commercial seed that is purchased by farmers (Mumby, 1994).

By not adequately estimating demand the consequence may be 'overproduction or underproduction', both of which can cause serious financial consequence for a seed company (FAO, 1994). Overproduction leads to excessive un-intentional seed carry-over which is very expensive due to storage costs, and losses of seed quality. To compensate for increased cost, companies may be subjected to increase price of seed, for which farmers may not be willing or able to bear. Conversely since over production above required quantity is expensive, most these companies deliberately offer for sale market

clearing quantities. This leads to scarcity of seed in the country especially when disaster like drought or flood strike and replanting is necessary (Hella *et al.*, 2003). With reforms and presence of private seed companies, nothing much has changed with respect to estimating effective seed demand per planting season (Hella, *et al.*, 2003). Multiplying the percent of seed bought and seed requirement calculate seed demand, while seed requirement is calculated by multiplying the crop area and seed rate (Mumby, 1994).

2.10 Farmers' local knowledge

In the past farmers' knowledge have been more widely recognized and valued as resources for development (Almekinders and Louwaars 1999). Local knowledge is the knowledge of the local people of a particular area based on their interactions and experiences within the area and their traditions (de Boef *et al.*, 1993; Lazaro 2003). It is noted that persistence of rural livelihood systems is grounded in indigenous knowledge on management of natural resources. This is the kind of knowledge, which the local people have used to sustain their environment and livelihoods. Farmers have particular knowledge of their seeds and varieties. They are good selectors of varieties for their own use because they can weigh the different requirements at the same time: they can consider the needs of the household, how the variety fits into the total production system and how it adopts to the environment (Almekinders and Louwaars 1999). For many years farmers in the SHZ of Tanzania have been using local knowledge in maintaining crop diversity within the farm to ensure food and seed security at the household (Mkuchu *et al.*, 2003). Lazaro (2003) observed that through trial and error, farmers have developed some experience and knowledge for seed management. Knowledge to manipulate plants to suit farming systems is well developed as may be evident from the development of crop varieties out of wild species (FAO, 1999). However, farmers do not express their views in terms of plant genetics and cannot describe why a particular variety is good thus, group

discussion serve often to bring out such experiences and are good starting-point for analyzing the present situation and identifying problems (Almekinders and Louwaars, 1999).

The main aim of local knowledge system is to empower the members of local community to meet their economic, social and cultural needs (Mwanga *et al.*, 2003). This knowledge has been accumulated over centuries and generations of farming in related environments and has contributed immensely to the resilience of seed systems to periodic aberrations in the crop production conditions which at times impact negatively on farming systems (FAO, 1999). Although there are some farmers in the villages who are said to be seed experts, this knowledge is held by individual farmers and is usually transferred from one generation to another through experimentation with new genetic resources. Seed experts are generally regarded as farmers who usually maintain a rich diversity of germplasm-seed types (Lazaro, 2003).

Farmers' knowledge is not always apparent; it is often influenced by socio-cultural parameters, not easily comprehensible to most researchers and often seemingly incongruous with modern "scientific" type of crop development (FAO, 1999). The local knowledge, also known as Indigenous Technical Knowledge (ITK), is not static but grows as new knowledge enters the system through promotion, project interventions, media, education, extensions and experimentations.

Knowledge is measured in four ways; by Asking people to self report what they know, true-false questions, multiple choice questions and open-ended short answers questions. The most common goal of knowledge questions in survey is to identify those who think they are familiar enough with a topic to answer questions about it (Fowler 1996). A

related common goal is to analyse whether those who feel informed about a topic think or behave differently from those who feel less informed. For those purposes Fowler (1996) suggested that self-described knowledge is a reasonable approach to measurement.

CHAPTER THREE

METHODOLOGY

This chapter presents the methodology used in this study. It covers the description of the study area, research design, data sources, sampling procedures and the method used in data analysis.

3.1 Description of the study area

The study was conducted in four villages: Mponela and Ibembwa in Mbozi district, Mangawe (Iringa rural district) and Ihimbo (Kilolo district). Mbozi district is in Mbeya region, while Iringa and Kilolo districts are located in Iringa region. During the initiation of the Southern Highlands Maize Promotion Project, which formed the foundation of this study, Kilolo was a division belonged to Iringa district. Later the government announced Kilolo to be an independent district. Mbeya, Iringa, Rukwa and Ruvuma together form the Southern Highlands zone (SHZ). The four regions are consequently referred to as 'the big four' in terms of food crop production (Bisanda, 1998; in Lazaro, 2003). According to Mussei *et al.*, (1999); in Lazaro, (2003) the SHZ is ecologically very diverse. The altitude varies from low (400masl in Kyela) to high (3000masl in Rungwe highlands and Livingston ranges). Climatically, the zone is also highly diverse because of the diversity in landscapes. Temperatures vary from warm tropical in areas lower than 700m to cool temperatures in areas higher than 2000m. Annual rainfall ranges from 700mm to over 2600mm and comes as bimodal rainfall between November and June (Lazaro, 2003). The districts and villages under study are shown according to administration and distances from main towns in Table 1.

Table 1: Study districts and villages

District	Village	Distance* (Km)	Landform	Altitude (m)	Rainfall (mm)
Mbozi	Mponela	13	Undulating, rolling with rift benches	1200	600-800
	Ibembwa	22	Undulating, rolling with rift benches	1500	800-1200
Iringa	Mangawe	47	Undulating with flats	1250-13000	500-700
Kilolo	Ihimbo	17	Undulating with inselbergs	1500-1700	900-1100

Source: URT (2003) * Distance from the village to the nearest town

3.1.1 Mbozi district

3.1.1.1 Location

Mbozi district is located in the South Western of Mbeya Region, between latitudes 8° and 9° 12 South of the Equator and Longitudes 37° 7′ 30″and 33° 2′0″ East of Greenwich Meridian. To the south the district is bordered by Illeje district, to the east by Mbeya rural district at the mark of Songwe river. To the North Mbozi district extends to the lake Rukwa where it js bordered by Chunya district, whereas to the West it shares borders with Rukwa Region and Republic of Zambia. The district covers an area of 9679 square kilometers (967,900 ha) (URT, 1997). The ethnic groups of people in Mbozi district include *Wanyiha, Wandali* and *Wanyakyusa.*

3.1.1.2 Demography

According to 2002 census, the district total population was 513,600 people consisted of 269,652 females and 243,948 males. Out of this figure; 242237 females and 219330 males are found in rural areas, while only 27,415 females and 24,618 males reside in urban areas (URT, 2002). This indicates that a higher proportion of people in Mbozi live in rural areas where main activity is agriculture.

3.1.2 Iringa district

3.1.2.1 Location

Iringa district is located in Iringa region. The district lies between latitude 34° 15' 0" and 37° 0' 0"E and between 8° 30' 0" and 7° 0' 0"E. Iringa district covers a total area of 2 862 000 ha. Fifty percent (95 4030ha) of the utilized agricultural land is used for maize production (URT, 2003).

3.1.2.2 Demography

According to 2002 Tanzanian census, a total of 245033 individuals consisting of 119082 males and 125951 females are found in Iringa district, and a total of 204372 individuals composed of 99756 males and 104616 females are found in Kilolo district (URT, 2002). *Wahehe* is the main ethnic group of people in Iringa and Kilolo districts. However, in Mangawe village *Wabena* who migrated from Njombe district is the main ethnic group.

3.1.3 Wealth Ranking

During discussions in the survey villages, wealth status was determined by asking farmers to state how they distinguish themselves according to wealth. High, intermediate (medium) and low status were the categories of wealth identified. Informal discussion with individual farmers indicated that: type of houses, type of housing materials, amount of land owned, level of food security, number of cattle, quality of other material assets and ability to send children to school, were used as indicators of wealth (Table 2). This information is the indication of the diversity in peoples' livelihood outcomes. Wealth ranking was determined to obtain information on the diversity in wealth of households in the study area so as to reduce biases in selecting respondents.

Table 2: Wealth indicators of respondents

Village	Wealth Status	Wealth indicators
Mponela	High	-Food secured throughought the year -Own modern house (Cemented walls, floors and iron sheet -Able to send children to higher level schools -Own more than 10 acres of land and kiosks
	Intermediate (Medium)	-Own more than 5 acres of land -Able to send children to schools -Food secured though not all the time in a year -Own brick wall houses (Uncemented and iron sheet roofed)
	Low	-Food insecure most of the time -Own poor house (Thatched roof and mud brick walls) - Cannot send children to primary school - own only two acres of land
Ibembwa	High	-Own more than 10 acres of land and shop -Food secured throughought the year -Own more than 10 cattle -Own Car or Motorbike -Own cemented and Iron sheet roofed houses with painted walls -Able to send children to higher level schools
	Intermediate (Medium)	- Own less than 10 acres of land -Able to send children to higher level schools -Own bicycle -Own less than six cattle -Own iron roofed houses (uncemented walls and floors)
	Low	-Have thatched roof house -Own 2-3 acres of land -Unable to send children to secondary school
Mangawe	High	-Own more than 100 acres of land and food secure most of the year -Own more than 50 cattle -Own Milling machine or Carpentry workshop machine -Own shop -Own modern house (iron roofed, cemented floors and painted walls)
	Intermediate (Medium)	-Own more than 20 acres of land and food secured -Own more than 10 cattle -Have modern house
	Low	-Own 2 acres of land and food insecure most of the time -Own poorhouse (thatched roof and mud walls) -Cannot send children to secondary school
Ihimbo	High	-Own more than 10 acres of land and food secured -Own more than 10 cattle or pigs -Own modern house (iron sheet roof, block and cemented floors/walls)
	Intermediate (Medium)	-Have modern house (burnt brick walls and cemented) -food secured
	Low	-Own poorhouse (thatched roof, uncemented and mud walls) -Own 2-3 acres and unable to educate children

3.2 Conceptual Framework

Figure1 depicts the conceptual framework of this study. The framework displays a diagrammatical representation of the relationship existing between variables used in this study. The framework holds that maize production has been influenced by the policy and institutional changes following Economic Reform Programs adopted in the country early 1990s. The period of economic reforms was associated with removal of subsidies, collapse of TANSEED and market liberalization (involvement of the private sector). The involvement of private sector as observed by Ponte (2002) resulted into serious market failures particularly in rural areas. High prices of inputs (improved maize seed, fertilizers and herbicides/pesticides), poor distribution of these inputs and low output farm-gate prices are the indicators of market failures. The framework indicates that the mentioned deficiencies are the principle agents of deteriorating maize production in the SHZ. Farmers who for quite a long time, have been relying on informal seed systems through their local (indigenous) knowledge, adopted various copping mechanisms (livelihood strategies) to cope with the changes. These include increased use of landraces (local varieties), increased recycling of both improved and landraces, and increased involvement in off-farm activities. However, because of inadequate use of modern technologies and poor information sharing between farmers and other stakeholders, farmers coping mechanisms cannot on themselves fully recover a farmer from shock without the involvement of the formal sector (FAO, 1999). Using the valuable characteristics of the informal seed systems as building blocks for better, but still dynamic and flexible, seed systems complimented by the improved weaker points of the informal seed system, is likely to offer more sustainable options for farmers (Almekinders and Louwaars, 1999). Thus the role of the institutions such as; Research, Extension, NGOs, Private seed companies, Religious organisations and Marketing boards, is to identify needs on farmers' side and provide services related to meet the needs. These service related

activities include: farmer training to improve local knowledge of seed and crop management, improved information sharing between farmers themselves and between farmers, breeders and seed stockists, and increased farmers' access to high quality seed through on-farm seed production. Improved crop production, which will be manifested through increased food security and household income, will therefore be enhanced through a strong link between formal and informal sectors.

3.3 Research design

The research has taken a positive approach as opposed to normative approach. The positive approach, which starts, from farmers focuses on the question on how farmers arrive at various decisions. The approach entails close observation of farmers' behaviour and attitudes (perceptions) and understands what types of decisions those farmers take and in which situation (Akyoo, 2004; Senkondo, 2000). Similarly the sustainable livelihoods approach puts peoples (in this case farmers) at the center of analysis. A focus group checklist and structured questionnaire were designed to collect information from farmers.

3.4 Data Sources

Both primary and secondary data were used in this study. Primary data were mostly applied as the study is centered on farmers themselves. However, some information to support the study was obtained from various offices such as Department of Agricultural Economics and Agribusiness (DAEA) of SUA, SNAL, TOSCA head office and MAFS

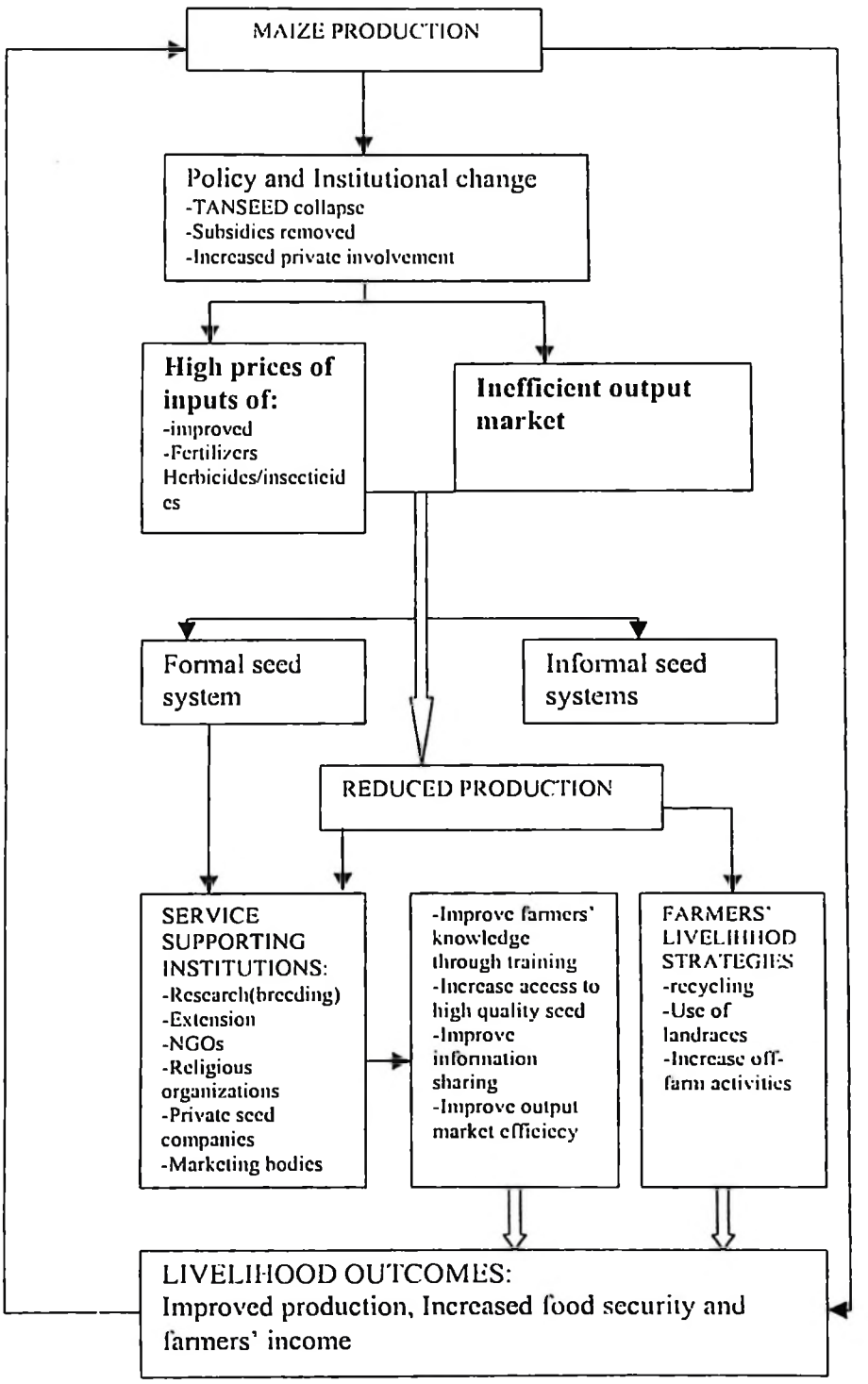


Figure 1: Conceptual Frame work

3.5 Sampling Procedures

3.5.1 The Population

The population for this study consists of maize farmers from four villages - Mponela and Ibembwa (Mbozi district), Mangawe (Iringa district) and Ihimbo (Kilolo district). The villages are among sixteen villages under the SHZ Maize Promotion Project, which is based in Uyole Agricultural Research Institute. The villages were purposely selected based on production domain and farming systems.

3.5.2 The Sample

The sample consisted of a total of 155 farmers sampled from the four villages mentioned. That is 40 farmers from three villages and 35 farmers from one village. Although the unit of analysis was farmers, respondents were also requested to give some household information such as number of dependants and how maize is used in the households. Farmers were purposive selected based on age, gender, education levels, and wealth differences.

3.6 Data collection

Focus group discussions were conducted in each village with the key informants identified by the village leaders. A checklist (Appendix 3) was used to guide discussion with groups. Separate groups of males and females preceded by a short discussion with mixed group were formed for discussion. The reason for separating the groups according to gender was to explore views of both sexes separately because experience shows that, females normally fail to express their views confidently in presence of men. A structured questionnaire (Appendix 4) was used to collect information from 155 farmers. Farmers were visited in their households to enable the researcher have thorough observation of different methods of managing seed and maize grain in general applied by different

farmers. Also some information was obtained informally from farmers who reported by other farmers to be seed experts. Similarly village extension staffs and seed stockists were consulted to clarify some issues related to maize seed.

3.7 Methods for Data Analysis

Both qualitative and quantitative data were analysed by using a Statistical Package for Social Sciences (SPSS) computer program. Descriptive and regression analysis were also employed.

3.7.1 Regression Analysis

The regression analysis was employed to test the hypothesis that farmers' access to improved maize seed is significantly influenced by household characteristics such as: age of the household head, knowledge of improved maize seed, education level of the household head, total land area allocated for maize production, number of dependants in the household, household income level, gender, price of improved seed and distance traveled in acquiring improved seed. The following binary logit model was used in the analysis. The choice of the model was based on the assumption that the random component of the response follows a binomial distribution and the logistic distribution of the error term (Liao, 1994).

$$Y = \frac{e^{(a_0 + a_1 x_1 + a_2 x_2 + \ldots + a_9 x_9 + u_i)}}{1 + e^{(a_0 + a_1 x_1 + a_2 x_2 + \ldots + a_9 x_9 + u_i)}}$$

The model was transformed into:

$$\log\left(\frac{Y}{1-Y}\right) = a_0 + a_1 x_1 + a_2 x_2 + \ldots + a_9 x_9 + u_i$$

Where: Y = Farmers' access to improved seed after economic reforms (1= if farmers' access to improved seed had increased since 1990 and 0 = otherwise)

a_0 = Intercept

a_i's = propensities of independent variables (i = 1, 2, …, 10)

X_1 = age of the household head

X_2 = education level of the household head (0 = if respondent have no formal education and 1 for respondent attended any formal education)

X_3 = knowledge of improved seed (1= if farmer considered knowledge is sufficient and 0 = if knowledge is insufficient)

X_4 = Gender (1 = if male and 0 = if female)

X_5 = Total area of land allocated for maize production

X_6 = Number of dependants

X_7 = Total household income

X_8 = price (1 = if current price of improved seed is considered to be affordable and 0 = if the price not affordable)

X_9 = Distance to the seed shop

U_i = disturbance term

The number of working hypothesis influenced formation of the model. It was hypothesized that farmers' access to high quality seed is significantly influenced by combined number of factors related to farmer's objective. The following independent variables were hypothesized to influence farmer's access to quality maize seed;

(1) Age. Consideration of age as an influential factor in farmer's access to improved maize seed was based on the idea that one is considered economically productive from the age of 15 to 64 years (Mtenga, 1999). Farmers in this category have high mobility, more

access to information, training and technology thus are expected to be more accessible to the high quality seed than farmers of age below or above this category. Observation has also shown that elderly people are conservative thus; tend to prefer landraces to improved varieties as compared to younger people. Assessment of farmers' perception indicated that local varieties/landraces were perceived less risky than modern/improved. This observation clarifies the observation made by Akyoo (2004) that risk averse nature tends to increase with age. Young people tend to take risk more than older people. Thus youths are eager to try out new technology than older people. Therefore youths are expected to have more access to improved seed than older people. However older farmers have experience and would have accumulated capital for some time thus they can afford improved quality seed. Therefore age can have either positive or negative effect.

(2) Education (Dummy): This variable is assigned a value of 1 for respondents attended secondary school and above and 0 for respondent who haven't attended formal education or if only attained primary education. Exposure to education is expected to increase farmer's ability to obtain, understand, analyse and apply the information relevant to improved seed. Education therefore is expected to increase farmer's access to improved seed. Thus education is positive related to farmer's access to improved seed.

(3) Knowledge (Dummy variable): Farmers who had adequate training on improved seed are expected to apply it to their fields. Thus more willing to purchase improved seed is expected from farmers with sufficient c knowledge regarding this seed. This variable is assigned a value of 1 if respondent perceived his/her knowledge to be sufficient and 0 if knowledge is perceived insufficient.

(4) Gender (Dummy variable): Women play a greater role in agricultural activities than men (Nkonoki, 1994; Bwana, 1996; Mtenga, 1999). Due to these factors women are often not available during promotion and training on new technologies. Similarly, men are known to control finance in most households thus have higher purchasing power than women. As such men are expected to have more access to improved seed than women. However this is not the case for female-headed households.

(5) Total area (hectare) land allocated for maize production

Households with sufficient land for maize production are expected to have more access to improved varieties than households with insufficient lands *ceteris paribus*. This assumption arises from the idea that most farmers tend to cultivate both local and improved varieties as a strategy to avoid loss in case one type of variety fail. Therefore total land area as a variable is expected to have positive relationship with access to improved seed.

(6) Number of dependants: Chiduo (2001) observed that the more the number of dependants, the more the money needed for family needs. Thus depending on the level of income, households with large number of dependants will hardly access improved seed. Thus number of dependants is negatively related to farmers' access to improved seed.

(7) Income: High-income households will be able to purchase inputs and are expected to have positive influence on improved seed.

(8) Price. The higher the price the low the quantity demanded and vice versa. Therefore this variable is expected to have positive or negative relationship with farmers' access to improved seed.

(9) Distance to the seed shops: After trade liberalization most private seed companies and seed stockists have been carrying out their operations in towns. This increases cost of traveling to acquire seed. Also sometimes farmers fail to allocate their time for traveling due to farming and household responsibilities they have. It is logically therefore to hypothesize that; farmers who are located far from towns will not have access to this valuable input. Therefore distance is negatively related to access to improved seed.

Table 3: Summary of the variables used in the regression analysis

Variable	Description	expected direction of effects
Age	Years	+/-
Education	Dummy	+
Knowledge	Dummy	+
Gender	Dummy	+
Total land area	Hectare	+
Number of dependants	Number	-
Income	Shillings	+
Distance	km	-
Price	Shillings	+/-

3.7.1.1 Problems and remedies associated with multcollinearity

The common problem associated with regression models is multicollinearity. It is defined as the situation where the explanatory variables are highly Interco related. It is argued that at a very high correlation ($r >= 0.8$) among independent variables it becomes difficult to observe the separate effects of each of the explanatory variables on the explained variables. Multicollinearity leads to imprecision of the parameter estimates (Madalla, 1988). Using correlation matrix to explore if there were strong interrelationships among independent variables tested multicollinearity in this study. Variables that were not backed by economic theory or logical judgment were dropped from the model. Some

errors. Pooling all independent variables instead of running all the parameters together seemed to have reduced multicollinearity since the overall power of the model was significant. Although variables such as number of dependants in the households and income are known to correlate, the effects of the number of dependants to cause multicollinearity was minor since the definition of a dependant stipulate that a dependant contributes nothing in the household.

CHAPTER FOUR

RESULTS AND DISCUSSION

This chapter presents the results and discussion of the findings from the survey data. The chapter includes the following sub-sections: household socio-economic characteristics, role of maize in the household, factors affecting farmers' access to improved seed, farmers' knowledge, perception and practices on maize, maize crop and seed management practices, input use and sources and implications for breeding.

4.1 Farmers' socio-economic characteristics

The socio-economic characteristics are important attributes of any society as they reflect its behaviour in decision making and its probable expected responses to many stimuli exposed to it (Akyoo, 2004). The socio-economic characteristics of the farmers examined in this study include; age of the farmer, gender of the farmer, main occupation, and education level. The socio-economic characteristics were assessed to understand whether there was any one of these characteristics affecting farmers' access to quality seed.

4.1.1 Age of farmer

In this study the most active age of respondents considered was between 15years to 64years old. Results indicate that 55% of respondents were in the age category of adults that is between 36 to 64years. About 33% of the respondents were in the youth category, that is15-35 years. The category of elders, which is above 64 years, was only 12% of all interviewed farmers. Table 4 presents the age distribution of farmers and their respective villages. The mean age of all interviewed farmers is 43 years. Chi-Square test results indicate no significance difference ($p < 0.5$) in age between Ibembwa, Mangawe, and

Ihimbo villages. Also Chi-Square test results indicated a significance difference ($p<0.1$) in ages between Mponela and other surveyed villages. There was higher representation of adults and elders in Mponela village than other villages. Migration to other places particularly in town to search for jobs was reported in Mponela village as a livelihood strategy of youths. Mponela village is closer to town (about 13km from Vwawa town) than other surveyed villages. However some of them were found during the interview to have returned back due to hardship of life in town.

Table 4; Distribution of respondents by age

Age category	Village									
	Mponela (n = 40)		Ibembwa (n = 40)		Mangawe (n = 40)		Ihimbo (n = 40)		Total (N =155)	
	%	n	%	n	%	n	%	n	%	n
15 35 (Youths)	17	6	40	16	40	16	32	13	33	51
36 60 (Adults)	60	21	57	23	47	19	55	22	55	85
>60 (Elderly)	23	8	2	1	12	5	12	5	12	19

4.1.2 Farmers' Gender

Women play a greater role in agricultural activities than men (Nkonoki, 1994) Experience has shown that in most patriarchal African societies males tend to show-up mostly in events happening outside the households than females. Due to these factors women are often not available during promotion and training on new technologies. There is also a tendency of men to control finance (though not the case for female headed households) in most rural households thus have higher purchasing power than women. As such men are expected to have more access to high quality seed than women. However policies to empower women and ensure equal participation in development activities have been addressed and the relationships between men and women, which existed before, have

started to change. In this study representation of women and men 32% and 68% respectively. Table 5 shows the distribution of respondents by gender.

Table 5: Distribution of respondents by gender

Gender	Village									
	Mponela (n = 35)		Ibembwa (n = 40)		Mangawe (n = 40)		Ihimbo (n = 40)		Total (N = 155)	
	n	%	n	%	n	%	n	%	n	%
Male	22	63	28	70	24	60	31	77	105	68
Female	13	37	12	30	16	40	9	22	50	3

4.1.3 Main occupation

Table 6 shows the distribution of farmers by main occupation. Results indicate that 53% of interviewed farmers are engaged in crop production as the main activity. Crop production supported with livestock keeping is the second main activity of interviewed farmers. About 37% of respondents supported crop farming with livestock. Only 8% and 1% of respondents are engaged in crop farming supported by business and formal employment respectively. Results show that there is variation in farmers' involvement to main activities between villages. In Mponela higher percentage (88%) of respondents engage in crop production as the only source of livelihoods, as compared to Ihimbo village where only 25% of respondents are involved in crop farming as the only means of livelihood.

Table 6: Farmers' main occupation

	Village									
	Mponela (n = 35)		Ibembwa (n = 40)		Mangawe (n = 40)		Ihimbo (n = 40)		Total (N=155)	
Main occupation	n	%	n	%	n	%	n	%	N	%
Crop farming	31	88	22	55	20	50	10	25	85	52
Crop farming + livestock	2	6	8	20	18	45	29	72	57	37
Crop farming + business	2	6	8	20	2	5	1	3	13	8
Formal employment	0	0	2	5	0	0	0	0	2	1

About 6 % of farmers in Mponela village are involved in crop production with livestock and business. In Ihimbo village about 72% of interviewed farmers indicated that crop farming with livestock keeping was their main activities. No much difference existing between Ibembwa and Mangawe villages as far as sources of livelihoods is concerned. The only difference is that about 45% of interviewed farmers in Mangawe village engaged in crop farming with livestock keeping compared to only 20% of respondents in Ibembwa village. However, it was reported by respondents that Mangawe village experienced crop losses during 2002/03 due to drought. Also results shows that higher percentage (20%) of respondents in Ibembwa village participated in business as the main off-farm activity than respondents from other villages. Involvement in off-farm activities has been mentioned as a livelihood strategy to take care of risk in case of crop failure or poor marketing performance of farm produces. For example coffee has been mentioned in Mangawe to be the main source of income followed by maize. But since Tanzania has adopted the economic reforms of 1990s the price of coffee is ever decreasing. Thus farmers have to apply other strategies such as business to cope with the decrease in coffee price.

4.1.4: Education Level

Education especially literacy levels is expected to increase farmer's ability to obtain, understand, analyse and apply the information relevant to quality seed. Education therefore is expected to have positive relationship with farmer's access to good quality seed. The distribution of the education level of the respondents is presented in Table 7. The table shows that 19% of all interviewed farmers have no formal education. However, within villages, Mponela has shown higher percentage (43%) of people with no formal education than Ibembwa (10%), Mangawe (13%) and Ihimbo (12%). Respondents reported that due to low level of income, farmers were not able to send the children to schools. Also other socioeconomic characteristics such as polygamy might be the reason for this problem. Polygamy results into a large number of children for which few smallholder farmers can afford to provide essential needs, like education, to the children. Results also indicate that 72% of all interviewed farmers have completed primary schools.

Table 7: Farmers' education level

	Name of Village									
	Mponela (n = 35)		Ibembwa (n = 40)		Mangawe (n = 40)		Ihimbo (n = 40)		Total (N=155)	
Education level	n	%	n	%	n	%	n	%	N	%
No formal education	15	43	4	10	5	13	5	13	29	19
Adult education	0	0	0	0	0	0	1	2	1	1
Primary education	18	51	30	75	35	87	30	75	113	72
Secondary education	1	3	6	15	0	0	2	5	9	6
College/University	1	3	0	0	0	0	2	5	3	2

Mangawe village shows a higher percent (87%) followed by Ibembwa (75%), Ihimbo (75%) and Mponela (52%). The higher proportions of respondents completed primary schools in Mangawe, Ibembwa and Ihimbo villages is attributed by greater involvement of farmers in off-farm activities to support crop production. Thus farmers are able to send

children to school. In Ibembwa village coffee production might have contributed to the low percent (10%) of people with no formal education as it supplements the income from maize. Results further show that small proportions of respondents have attended higher levels of education like secondary and college/university.

In general the level of education reached by respondents across surveyed villages is sufficient.

4.1.5 Number of dependants

Table 8 shows categories of household dependants. In this study a dependant is any person within a household who depends on others (in the households) for food, money, clothes and shelter. These are children bellow age of going to school (1-5 years), pupils, students, disabled and elders (who could not perform any duty in the household). Majority (47%) of households have between 3 and 5 dependants. The overall average number of dependants is four individuals.

Table 8: Categories of household dependants

Dependants' category	Village									
	Mponela (n = 35)		Ibembwa (n = 40)		Mangawe (n = 40)		Thimbo (n = 40)		Total (N = 155)	
	n	%	n	%	n	%	n	%	N	%
0 - 2	23	66	8	20	15	37	20	50	66	43
3 – 5	12	34	24	60	20	50	16	40	72	46
6 - 8	0	0	7	18	5	12	4	10	16	10
>9	0	0	1	2	1	0	0	0	1	1

Households with 2 or less dependants forms 43% of the sample population (N = 155) while households with between 6 and 8 dependants forms 10% and only 1% of the population are the household with at least 9 dependants. Chiduo (2001) observed that the

more the number of dependants, the more the money needed for family needs. Thus depending on the level of income, households with large number of dependants will hardly access good quality seed.

4.2 Roles of maize and their relationship with peoples' livelihoods

In SHZ and the larger parts of Tanzania, maize is mainly used to meet food and cash needs. Maize is sold to get money to meet other basic needs such as clothes education, health services and shelters (housing). As a strategy to explore market diversification, maize is sold as grain, green or brew (after going some processes). This strategy helps to spread risk better in case one stream of market fail. This implies that diversification of maize marketing enables farmers to enjoy a cross-subsidization between different maize market channels with a profit gained from another maize market channel. Other products from maize crop including maize bran and straws are used to feed livestock.

4.2.1: Maize and household food security

The decision in the households to cultivate maize is perceived to be inevitable. Farmers perceived maize as the only reliable source of food in the households. Thus, household food sufficiency is given first priority in the production of the crop. This perception has greater influence on the decision on what maize variety to cultivate. Local (landraces) varieties are perceived to be less risky in terms of loss associated with drought, pests damage and/or low soil fertility than improved varieties. In this case farmers have to go for local varieties (landraces). This information is an indication that a risk aversion is a typical characteristic of majority farmers. Respondents indicated that in addition to risk of loss landraces were preferred because of qualities such as milling qualities and flavors. Respondents indicated that, depending on the size of household and the amount of produce obtained in the particular season, farmers normally store the stock of maize grain

that is sufficient to cover food needs up to the next harvesting season. An extra amount of two to three bags (200kg to 300kg) of maize is also stored to take care of the unforeseen or speculative events such as ceremonies, and other emergencies. In this extra amount seed is excluded as it is selected before maize is processed for other purposes such as food and marketing. However Ashimogo, (1994) observed that farmers may shift the intended use of maize depending on changes in factors such as price of agricultural and other consumer goods.

Bagachwa *et al.*, (1996) reported that cases of malnutrition and food insecurity in maize producing areas have been existing despite the efforts farmers made to achieve household food security. Bagachwa *et al.*, (1996) further observed that the higher rate of malnutrition in maize surplus producing areas can be related to the lack of crop diversification which increases rural households' income risk and worsen access to food. This observation suggests the importance of improving crop production in these areas by increasing not only access to good quality maize seed but also access to seed of other crops for diversification in improving peoples' livelihoods.

4.2.2 Maize and household income

Income is generally defined as the money that is received as a result of normal business activities of an individual or a firm. Pair-wise ranking (see appendix 5) indicates that maize is a main source of income compared to other crops in three of the four visited villages (Mponela, Ibembwa, Mangawe and Ihimbo). In Mangawe village maize was ranked the second to coffee. Interview indicated that maize contributes to the household income in three ways: first it is sold as grain to traders, second it is brewed to get local beer which is sold to villagers and third maize is sold as green for roasting or boiling. As grain, about 80% to 90% of maize intended for sell, is sold a short period after harvesting

(between June and September). Table 10 indicates that 75% of respondents in study area sold maize grain. The need to get immediate cash causes farmers to sale maize grain at this period. During this period the price of maize is very low due to the high supply. This leads to low returns from maize compared to the income obtained from non-maize activities. Low income renders farmers inaccessible to improved seed and associated inputs. Respondents mentioned that low price of maize during harvesting is the main problem for low income obtained from maize. The price of one bag (100kg) of maize ranged between Tshs 6 000 and 12 000 during or a short period after harvesting (between July and September). Although the price increased up to Tshs 25 000 between December and January, most farmers were out of stock because they sold their maize early after harvesting. Stock of maize stored for speculative purposes can sometimes be sold to get money if surplus maize is out of stock. Table 9 indicates that among maize market diversifications, sale of maize grain contributed higher to the household income than green maize and local brew across the entire four visited village. A mean income of Tshs758 955.00 per year was obtained from maize grain. In 2001/02 farmers in Mponela and Ibembwa villages appreciated a high maize price brought by traders from neighbouring countries after the government has opened border trading of maize. In 2001/02 the government opened the borders by allowing farmers to export maize as a way of improving maize price. Similarly, traders from other countries were allowed to come and buy maize in the country. However, this price was not realized in 2002/03. Farmers insisted that poor rural roads and lack of specific maize market or main collection point in SHZ were the major threats for these traders in buying maize. On the other hand, low maize produce and lack of capital has lead farmers in the study area unable to export maize.

Beer brewing is another important maize marketing option available to farmers. Brewing is mainly done from July to December. Immediately after harvesting period, between June and July, many farmers brew maize beer, but as time goes maize supply decreases thus few farmers brew beer from maize. Many farmers brew beer at harvest because: (a) maize as raw material is higher in supply and cheap (b) there is less farm work thus more time for brewing and socialization. Just like maize grain the price of maize brew is very low during harvesting since the supply of beer is higher than demand. A simple analysis of maize beer brewing shows that one tin (20kg) of maize grain produces four tins (80litres) of maize beer.

Table 9: Mean annual household income by source during 2002/03

	Mean Income (Tshs) per household per year				
	Mponela	Ibembwa	Mangawe	Ihimbo	Total
Sources					
Maize grain	1 20 968.00	208 069.00	225 185.00	204 733.00	758 955.00
Green maize	15 000.00	-	-	206 386.00	221 386.00
Brewing	54 000.00	9 000.00	19 375.00	50 854.00	133 229.00
Non-maize	54 931.00	212 938.00	277 836.00	206 768.00	1 179 586.00

The price of one tin (20litres) of maize beer ranges between Tshs 800 and 1500 during harvest and in off-season the price ranges between Tshs 1500 and 2500. Farmers reported that higher return from maize beer can be realized than maize grain but respondents indicated that the profit is subject to reliability and number of customers. However year 2002/03 contributions from maize beer was the second from maize grain. Women are involved in brewing and selling maize beer. Table 10 shows that about 15% of respondents in the study area brewed maize beer.

Table 10: Proportions of farmers obtained income from maize market sources.

	Village									
	Mponela (n = 35)		Ibembwa (n = 40)		Mangawe (n = 40)		Ihimbo (n = 40)		Total (N = 155)	
Source	n	%	n	%	n	%	n	%	n	%
Maize grain	29	83	30	75	27	67	30	75	116	75
Green maize	2	6	0	0	0	0	18	45	20	13
Maize brewing	2	6	0	0	8	20	13	32	23	15

There are farmers especially women who have specialized in beer brewing and selling as the main off-farm activity. For such farmers brewing is done continuously throughout the year as a source of livelihood. The source of maize for brewing is either from own stock or purchased from other farmers. In most cases maize stored for speculative purposes is used for brewing. Table 9 shows that maize brewing is a second source of income from maize crop. Respondents from four surveyed villages obtained mean income from maize beer of Tshs 133 229.00 per year. In addition, maize beer has been used as an incentive or return for help in special occasions such as *Miguwe*. *Miguwe* is a term used in Mangawe village to mean an occasion in which a household invites other farmers to assist in a specific activity, which need more labour than the household can supply.

Table 11: Mean return per hectare obtained from maize during 2002/03

	Mean return per hectare (Tshs) per household				
Market Source	Mponela (n = 35)	Ibembwa (n = 40)	Mangawe (n = 40)	Ihimbo (n = 40)	Total (N =155)
Maize grain	56 333.00	100 075.00	34 926.00	58 648.00	249 982.00
Brewing	2 675.00	500.00	789.00	11 733.00	15 697.00
Green maize	400.00	000 000.00	00 000.00	38 995.00	39 395.00
Total	59 408.00	100 575.00	35 715.00	109 376.00	305 074.00

This implies that *Migawe* is a means of reducing labour shortage in the households. Farmers acknowledged that there are no special characteristics of maize variety required for maize intended for brewing. This implies that both local and improved maize varieties can be used for brewing.

Green maize is another important source of income from the crop. Results (Table 10) show that about 13% of respondent in study area sold green maize. Apart from income farmers considered sale of green maize as a way of reducing labour costs and other costs associated with post harvest losses. Labour cost is reduced since buyers (traders) harvest the purchased maize. Traders do the harvesting so that they can pick only those cobs that meet the market requirements. The main market requirement for green maize is large sized cobs. Farmers therefore prefer selling green maize because one gets two harvests per plant: first big cobs sold as green maize being the main harvest and the second one comes from the small cobs which, are usually rejected by trader(s) because did not meet the qualities or requirements. Big size cobs, absence of disease or pests damage and the degree of fill (well filled cobs) are the qualities required for sale of green maize. Table 11 shows that a mean income of Tshs 206 386.00 per household per year was accrued from the sale of green maize in Ihimbo village. A mean income of only Tshs15 000 per household per year was obtained in Mponela village from this practice and none from other villages.

The main market for green maize from Iringa is Dar es Salaam city and its peripheries. Mbeya town forms the main market for green maize from Mbozi district. The farm-gate price for green maize ranged between Tshs 25 and 40 per cob during the 2002/03 cropping season. In City/towns traders sell the maize to street venders at a price ranging between Tshs 65 and 90 per cob. Venders sell the maize to the final consumers at a price

of Tshs 100 to 200 per cob. Big cobs are usually preferred because they are usually cut into three to four pieces. One piece of roasted maize is sold at Tshs 50. The second harvest is left to dry and then mixed with maize grain from other maize crop. (This is another aspect where farmers mix the varieties, which suggests more farmers training to improve knowledge of maize and seed management).

Observation indicates that among the four surveyed villages more farmers from Ihimbo village followed by Mponela sold green maize than other villages. About 45% and 6% of respondents in Ihimbo and Mponela village respectively sold green maize. Reliability of transportation from Ihimbo and Mponela villages to the main green maize markets is the main reason for more involvement of these villages in green maize marketing. In Ihimbo village there are swampy/valley bottoms that are used for maize production, especially during off-season, than other villages. Valley bottoms make maize to be cultivated even during off-season thus decreasing the chance of crop loss due to drought. The practice of selling green maize is locally known as "*kugoboa*" or "*gobo*". Within households men, particularly youths are more involved in green maize marketing than women. Experience has shown that women are more concerned with household food security than men thus women tend to cultivate local varieties which are not used for *gobo*. This might be the reason for more involvement of men in green maize business than women.

There are specific maize characteristics that are required for green maize marketing. Taste, flavour and number of cobs per plant are the main characteristics of maize varieties required for *gobo*. Varieties, which have sweet taste, good aroma and two cobs per plant, are commonly preferred for *gobo*. In Ihimbo village hybrid maize particularly H625 is a maize variety which is highly used for gobo. It has sweet taste and yield two cobs per plant. In this aspect farmers perceived improved varieties to be good for business than

local varieties. The source of H625 is seed stockists who purchase it from Kenya. Also H628 was another most important variety planted by farmers in Ihimbo village. The variety was said to have good characteristics such as low amount of bran than flour. This characteristic make H628 preferred also for food as well as for *goho*. The source of this variety is Dabaga Seed Farm. However observation shows that during 2002/03 cropping season H628 was not yet officially released. Table 11 indicates the average return per hectare obtained from maize grain, maize beer and green maize.

Farmers suggested the following solutions for improving maize grain marketing in SHZ: (1) Re-introduce Co-operative societies in the villages, which will be operated by the villagers themselves. The societies are expected to increase farmers' bargaining power for price to sale their maize. However the few maize traders in the villages did not accept this idea. These traders feared that their profit will be interfered as there are will be common price in the market. (2) Establish maize markets (*minada or gulio*) in the village or nearby villages where farmers can send their produce. In this way farmers expect to enjoy the price determined by the market supply and demand forces. This also is expected to withdraw the functions of middlemen who used to buy maize at low price from farmers households and resale them at a price a bit higher to maize traders who come to the village. This implies that through *minada* market transparency will be enhanced. Farmers mentioned Kibaigwa in Dodoma region as an example of maize market they needed in their area. In year 2004 Kibaigwa was declared by the government to be an international maize market, though its operation started locally since the year 2000. (3) The government should provide good environment for traders from outside the country to buy maize from farmers' premises. Maintenance of rural roads was mentioned as crucial in enhancing this suggestion.

4.3 Factors affecting farmers' access to improved maize seed

Regression analysis was used to assess the factors that affect farmers' access to improved maize seed particularly after liberalization of 1990s. Access to improved maize seed was thus a dependent variable, respondents' socioeconomic characteristics including age, education level, knowledge of improved maize seed, gender, total land area allocated for maize production, total household income, price of improved maize seed, and distance traveled to acquire the improved seed were the independent variables. The logit regression model was used as shown in chapter three.

Results of the regression analysis are summarized in table 13. The model predicted correctly at 69.8% and significantly ($P < 0.05$). The variables that were not significant were removed from the prediction model. Pampel (2000) argued that a variable should be entered in the prediction model only if its significance level is less than 0.05 and removed from the model if its level of significance is greater than 0.05.

Table 12: Regression analysis parameters estimates results.

Parameter	Estimated coefficient value	Standard error
Age (X_1)	0.15	0.014
Education (X_2)	0.169	0.451
Knowledge (X_3)	0.853	0.392
Gender (X_4)	0.371*	0.768
Area (X_5)	0.106	0.103
Number of dependants (X_6)	0.032	0.094
Income (X_7)	0.000	0.000
Price (X_8)	0.194	0.445
Distance (X_9)	0.018*	0.016
Intercept	-1.087	0.322

Chi-square = 4.524 significance ($P < 0.05$) Negelkerke R square = 0.0397 * significant at $P < 0.05$

However, the Negelkerke R square shows that the coefficient of determination between access to improved maize seed as a dependent variable and the independent variables is

very low. This suggests that the selected independent variables do not sufficiently explain the probability of accessing the improved maize seed. Results have shown that out of nine variables examined, gender of the farmer and distances traveled to acquire seed were the only socio-economic characteristics, which significantly and positively affected farmers' access to improved maize seed. The positive relationship between gender and the probability of accessing improved maize seed suggests that male have higher access to improved seed than women. This can be explained by the fact that males have higher purchasing power than women do. This might be the reason for greater involvement of men to improved maize varieties than women. Similarly distance traveled to acquire the improved seed significantly ($P < 0.05$) affected farmers' access to improved seed. This suggests the need to improve the infrastructures such as rural roads so that services related to seed distribution reach farmers as closer to their premises as possible. The insignificance of the observed variables suggests that other factor such lack of trust by farmers on improved seed distributed by private seed companies might affected farmers' access to improved seed and not only the examined factors. Some farmers reported that buying fake seed from the shops was common. This may reduce farmers' willingness to purchase the improved seed. After realization of the problem of fake seed lead the government to impose heavy penalties to those who will be found selling fake seed.

4.3.1 Livelihood copping strategies to the declining returns from maize.

4.3.1.1 Diversification

Diversification to non-maize activities such as livestock keeping, increased production of other crops (apart from maize) and off-farm activities was a livelihood strategy to supplement income from maize. As part of livelihood strategies, farmers in the surveyed villages are practicing mixed cropping, and planting crops at different locations and times in a year. Roles are divided according to gender.

4.3.1.2 Livestock keeping

Livestock keeping is an important strategy employed to support crop cultivation in the study area. Livestock also provided manure that is used to replenish the soil fertility and to supplement the use of chemical fertilizers in case it is not accessible by farmers. Males mainly owned livestock such as cattle goats and pigs although women and children provided labour. Women mainly owned small livestock like chickens and guinea pigs. In addition to cropping Table 12 indicates that 19 percent of respondents engaged in livestock keeping as another source of livelihood.

Table 13: **Households engaged in livestock keeping and mixed cropping**

	Mponela (n = 35)		Ibembwa (n = 40)		Mangawe (n = 40)		Ihimbo (n = 40)		Total (N =155)	
	n	%	n	%	n	%	n	%	n	%
Livestock	6	17	4	10	10	25	9	22	29	19
Mixed cropping	11	31	9	22	5	12	10	25	35	22
Both	18	52	27	68	25	63	21	53	91	59

4.3.1.3 Mixed cropping

Mixed cropping was considered the most important livelihood strategy in ensuring income and food security. Cash crops such as coffee (in Ibembwa and Mponela), and crops such as tomatoes, beans, cowpeas, sunflowers and groundnuts are cultivated. According to Lazaro, (2003) the most crop combinations in SHZ include maize/beans: Maize/potato; maize/bambara; maize/banana and coffee/banana. In addition to these combinations other combinations such as maize/sunflowers, maize/cowpeas and maize/groundnuts were observed in the study area. Information regarding these combinations suggests that maize is still dominant in the system regardless of the declined return. Therefore more efforts to promote maize are needed. Coffee/banana is a combination observed in Ibembwa and Mponela village while other combinations were present in all visited villages. Table 12 indicates that about 22% of respondents practiced

mixed cropping and 59% engaged in both livestock keeping and mixed cropping. Mixed cropping is a strategy to manage risks associated with crop failures due to unforeseeable factors.

4.3.1.4 Planting some crops in different fields at different times and locations

Farmers in SHZ plant crop varieties at different times and locations in a year. The main planting season, for instance maize, is between December and January. During off-season (between July and August) maize is planted in swampy (valley bottom) areas called *vinyungu*. These areas are also distinguished by their relatively higher fertility than upland areas. Other crops such as tomatoes and beans are also cultivated in these areas. This strategy is mainly practiced in Ihimbo and Mponela villages than other visited villages because more swampy/valleys areas are present in these villages. In other parts of SHZ irrigation was practiced to supplement crop production during off-season (Mkuchu *et al.*, 2003. Currently there is no irrigation practice in Mponela village but there is an irrigation scheme, which is expected after the on-going dam construction is over. Planting crops at different times and locations is a livelihood strategy employed to manage risks associated with crop failure in case of drought and variability in soil fertility. Mixed cropping and planting crop varieties in different times and locations suggests that, in addition to improving the quality and access to maize seed, increasing access to quality seed of other crops in the study area is important in improving farmers' income and food security.

4. 3.2 Off-farm activities

Off-farm activities were also mentioned during the interview as another important livelihood strategy. Sepälä (1996) observed that diversification to off-farm activities provide an element of flexibility that allows households to distribute risk better. However, Ponte (2002) pointed out that the viability of livelihood strategies does not only depend

on spreading the risk among different activities but also on returns to the capital and labour invested in them. It was observed during the study area that males and females have different strategies as far as off-farm involvement is concerned. Males engaged in: operating shops or kiosks, maize trade (collection and selling), charcoal making and selling, lumbering (Ihimbo village), casual labour, collecting and selling firewood, carpentry and masonry. Others with big capital operate grain-milling machines. Women engaged more in activities such as brewing and selling local brew, casual labour in farms and cooked food vending (*mama-lishe*). Other females engaged in mat weaving.

Table 9 indicates the mean income obtained from maize as well as non-maize sources such as sale of other crops than maize, livestock, and off-farm sources during 2002/03 cropping season. Farmers complained that the amount of income obtained from off-farm activities and other sources after liberalization have not yet been adequate to improve their living standards as expected. According to Ponte (2002) increased commercialization of rural lives as a result of liberalization has resulted to the increased cost of living due to the increased access to incentive goods. This observation implies that rural farmers need cash inflows at several times throughout the year to cope with the increased costs of living. This observation might be the reason for the inadequacy of the income in the study area. The contribution of non-maize activity reveals that sale of coffee (Ibembwa), tomatoes (Ihimbo), and livestock contributes more to the household income than any other non-maize activity. In this study off-farm activities such as shops and milling machines seemed to contribute more than any other source of income but they are possessed by few individuals especially men.

4.4 Assessment of Farmers' knowledge, and perception on maize crop/seed

4.4.1 Farmers' knowledge on seed management

Observation indicates that respondents have an understanding of improved varieties as any ones which: are produced by seed experts, have higher germination percentage, mature early and give higher yield potential than local varieties. This understanding seems to be synonymous with the understanding farmers gave of quality seed, except that in quality seed additional attributes such as diseases and pest resistance were mentioned. Interview also indicated that respondents assessed good quality seed as one which gives high yield per unit area as the main attribute. However, this is not always true since yield potential is a function of variety. A low-yield variety will always give low yield though good in quality it might be. Some respondents perceived the improved varieties and quality seed as hybrids. However according to definitions, quality and improved seed can be any seed from hybrids, OPV or local varieties. Although farmers perceived quality seed as hybrids, they acknowledged their knowledge on hybrid seed to inadequate. Table 14 indicates that 79% of respondents considered their knowledge insufficient for management of improved maize seed. The inadequacy of knowledge is associated with the level of education and agricultural training farmer has acquired.

Low level of technical knowledge on seed management was found among farmers in interviewed villages. Table 14 indicates that 79% of interviewed farmers had insufficient technical knowledge on seed management, particularly management of improved maize seed. They suggested seed experts to provide them with regular training through seminars or workshops (before cropping season starts) on these seed if there is any variety released. Respondents acknowledged that their local knowledge was sufficient for management of landraces. In Ibembwa village ADP-Mbozi through its extension officer created awareness on improvement of farmers' knowledge on seed management, although high

proportion (90%) of farmers in this village acknowledged having insufficient knowledge. Some respondents in Ihimbo village acknowledged to have acquired some knowledge from Sasakawa Global 2000 project.

Table 14: Farmers' knowledge on management of improved maize seed

Knowledge	Village									
	Mponela (n = 35)		Ibembwa (n = 40)		Mangawe (n = 40)		Ihimbo (n = 40)		Overall (N = 155)	
	n	%	n	%	n	%	n	%	N	%
Sufficient	11	31	4	10	8	20	9	22	32	21
Not sufficient	24	69	36	90	32	80	31	78	123	79

Respondents in Mangawe village mentioned some few farmers to be seed experts. From some farmers' point of view, ability to use improved seed in all season and high yields from their fields qualified these farmers to be seed experts. However seed experts are more than this. Farmers have more trust on these experts if information regarding new seed passes through them. Other farmers perceived seed experts as any one who is more knowledgeable or well informed about a particular seed variety. For instance elderly people were considered more knowledgeable and hence considered experts for seed management of landraces. This information contradicts the observation made by URT, (2003) that identification of landraces in SHZ is very difficult due unintentional or intentional mixing with other varieties.

4.4.1.1: Sources of information about seed types and management

There are many sources of information about seed management to farmers such as parents, farmer to farmer, farmer groups, extension staffs, and NGOs (Table 15). About 56%of respondents received information about seed types from other farmers.

Table 15: Farmers' main source of information about types of maize seed

	Village									
Source of	Mponela (n = 35)		Ibembwa (n = 40)		Mangawe (n = 40)		Ihimbo (n = 40)		Total (N = 155)	
Information	n	%	n	%	n	%	n	%	N	%
Other farmers	24	68	20	50	25	62	19	47	88	56
Extension	9	26	19	47	15	37	12	30	55	35
Stockists	0	0	1	3	0	0	8	20	9	6
Groups	2	6	0	0	0	0	0	0	2	2
None	0	0	0	0	0	0	1	3	1	1

Very low percent (6%) of respondents received information from seed stockists. This information is an indication that few farmers have contact with seed stockists. This observation clarifies the observation made by Ponte (2002) that seed traders are not willing to serve in the remote area where majority of farmers lives. Poor rural roads is the reason for seed traders not serving the remote areas. Among villages, Ihimbo showed a high proportion (20%) of respondents who received information through seed stockists. Ihimbo village has reliable transport to Iringa town where most seed stockists are located. This is a reason for more access to information. This observation indicates that information sharing between seed stockists and farmers is only accessible to limited farmers who travel frequently to town for other livelihood activities. Farmers' groups were another source of information about different types of seed.

Table 16: Farmers' main source of information on seed management

Source of information	Village								Overall (N = 155)	
	Mponela (n = 35)		Ibembwa (n = 40)		Mangawe (n = 40)		Ihimbo (n = 40)			
	n	%	n	%	n	%	n	%	n	%
Parents	25	71	22	55	17	42	21	52	85	54
Other farmers	4	11	4	10	18	45	7	17	33	21
Extension	4	11	11	27	5	12	11	27	31	20
ADP-Mbozi	0	0	3	7	0	0	0	0	3	2
Sasakawa	0	0	0	0	0	0	1	2	1	1
None	2	6	0	0	0	0	0	0	2	1

However, farmers groups were said to exist in Mponela and Ibembwa village. The groups are associations of ten two twenty members which are not formally registered established to enable farmers assist each other on cash matters and information sharing. In Mangawe and Ihimbo, such groups did not exist. Table 16 shows that about 55% of interviewed farmers mentioned experience inherited from parents to be the main source of information and knowledge about how to manage seed. In Ibembwa village other sources of information include other farmers, and institutions such as ADP-Mbozi through extension services.

4.4.2 Farmers' perception on maize crop/maize seed

In assessing farmers' perception on maize/and or maize seed, Likert-type interview was used. Farmers were expected to indicate negative or positive attitude or opinion against a given statement (See Appendix 4). Farmers were requested to indicate whether they "strongly agree" or "agree" as an indication of positive attitude and "strongly disagree" or "disagree" as an indication of negative opinion. Farmers who had neither positive nor negative opinions were regarded as "undecided". A positive attitude or opinion toward a

negative attitude indicates that the message contained in that particular statement is not acceptable. The aim of this subsection is to explore the deeper understanding or awareness of farmers toward maize crop and maize seed. Table 17 shows the overall responses of farmers' perception toward maize.

4.4.2.1 Perception towards maize crop

Results (Table 16) indicate that 100%of interviewed farmers agreed that maize is an important food crop in the area and about 99% of respondents agreed that maize is an important cash crop in the study area. This observation was also indicated during the focus group discussions where maize was ranked number one by all groups as an important food and cash crop, except in Ibembwa village where maize was ranked number two after coffee as an important cash crop (For pair-wise ranking see Appendix 5.)

Farmers responses also show that 98.7% of interviewed farmers perceived that their standard of living would improve only if efforts to promote maize production in their area are enhanced(Table 17). Farmers have perception that improved production practices will lead to higher yields. Certainly farmers expect increased income through selling maize in large quantities. Therefore increased income will lead to improved well being.

4.4.2.2 Perception towards types of maize seed

About sixty percent of interviewed farmers strongly disagreed on the statement that hybrid seed are not important in their households. This observation indicates that a total of 60% of interviewed farmers have positive opinions toward the importance of hybrid maize seed in their households. Higher yield potential of hybrid maize seed was mentioned as the main reason for the positive response. Farmers acknowledged that

higher income is obtained from these maize varieties as compared to OPV and local varieties. They always say "*yana kipato kikubwa*" meaning hybrids produce higher return. However, most hybrid maize varieties were disregarded in terms of food as they have poor milling qualities. "*Yana pumba nyingi kuliko chakula*", implying that hybrid maize have more bran than flour.

Farmers mentioned that a total of 15 bags per acre (100kg per bag) can be obtained from hybrids if fertilizer is applied but only 1-3 bags per acre (100kg bag) of maize can be achieved if no fertilizer applied. This clarifies the observation made by the Ministry of Agriculture and Co-operatives (1997) that to achieve high production, improved seed has to be combined with fertilizers and other inputs. Although the majority realized the importance of hybrid seed, interview indicated those majorities are not using it. New stock of hybrid seed needs to be purchased every season. Majority (98 %) of respondents strongly agreed that high price of inputs (Fertilizers, Agro-chemicals and the hybrid seed) is the main problem in the use of hybrid seed. Results also indicated that 36% of farmers had negative attitude toward hybrid seed and 4% had no opinions.

Farmers perceived that landraces are better than any other seeds. Preference to local varieties (landraces) is due to accessibility and adaptability to farmers' environment and the sufficient knowledge farmers have on these seeds. Farmers perceived that with local varieties one is "assured" of food though low in yield than improved varieties. It was mentioned that even if farmers wanted improved varieties they would still have a plot for cultivating landraces (local varieties) due to less production risks associated with local varieties compared to improved varieties.

Results indicate that 82% of interviewed farmers had negative response towards a statement that landraces must be abandoned completely if maize production is to be promoted or increased in their area. Results further indicate that 85% of interviewed farmers disagreed on the statement that they will abandon completely the use of landraces if the prices of modern seed and the associated inputs are reduced to the level that farmers can afford. Majority of interviewed farmers had opinion that landraces are good for food, as they always say in Kiswahili "*ni mazuri kwa chakula*". However heaviness characteristics of landraces was mentioned good for business if weighing scale are to be used but since these varieties have good characteristics as food and food security is given first priority, farmers hardly sell these varieties. This observation indicates that landraces are important if food security in the study area is to be achieved. The main source of seed for landraces is farmer-saved, that is seed saved from previous harvests. However, government for a long time have been emphasizing on improved seed.

Farmers indicated characteristics such as flint kernels, tolerance to drought, field pests and diseases and good milling qualities to be possessed by local varieties (landraces). Early maturity was mentioned as another important characteristic of landraces in three villages (Mponela, Ibembwa and Mangawe). However some improved varieties such as H628 were also mentioned to have these characteristics. In Ihimbo the opposite was true where late maturity was an attribute of local varieties as compared to improved varieties. It was reported in Ihimbo village that it takes about five to seven months for landraces to mature while for improved maize varieties it takes only four to five months to mature.

4.4.2.3 Perception on maize varieties by gender

The aim of analysing the perception of farmers with respect to gender arises from the idea that men have higher chance of acquiring new knowledge than women through training.

Literature has shown that men participate more in training seminars or workshops than women (Mtenga, 1999). According to Akyoo (2004), women are dispossessed and denied fair participation in various economic pursuits by the very social fabric in which they live. Due to women's many household responsibilities, they are often not available during promotion and training on new technologies (Mtenga, 1999).

Based on the fact that new technologies have always been directed towards modern or improved varieties, leaving the landraces to rely on farmer's indigenous knowledge (of which females play greater role), it make sense to hypothesize that improved varieties are for men and landraces are for women.

However, results (Table 17) show that 88% of interviewed farmers disagreed on this hypothesis, that modern or improved maize variety are men's crop. Only 4% of farmers agreed on this and 8% had no opinions. Likewise, results indicate that 89% of interviewed farmers disagreed on the statement that landraces are women's crop. But it was agreed by the respondents that men have greater involvement in improved maize varieties than women who to a greater extent are involved with landraces than men.

4.4.2.4 Perception towards improving farmers' access to quality seed

Quality seeds stand a better chance of increasing food crop production. Majority of farmers world-wide use farm-saved seed that have been recycled from 2-6 times and lost their good qualities (Mtenga, 1999). In this study 86.5% of interviewed farmers perceived on-farm seed production as the most important way of increasing access to good quality seed and they need to be involved in the production of seed. Only 3.2% strongly disagreed and 10.3% had no opinion. Nevertheless farmers acknowledged having low degree of technical knowledge on seed production. Mtenga (1999) also observed that

farmers believed more in seeds produced by themselves within their environmental conditions to be better than other seeds distributed to them. In this study farmers perceived also that on-farm seed production would solve the problem of production of inferior type of seeds.

4.4.2.5 Farmers' opinion on improving knowledge

Farmers' training was perceived to be the only way of improving farmers' knowledge. The majority (98.7%) of respondents strongly agreed that training would be a better approach in improving knowledge (Table 17). Only 0.6% disagreed on this statement while 0.6% had either no opinions or disagreed on this approach.

Table 17: Farmers' perception on maize and maize seed

Statement	Agree		Undecided		Disagree	
	Number	%	Number	%	Number	%
Maize is an important food crop	155	100	0.0	0	0	0.0
Maize is an important Cash crop	154	99.4	0	0.0	1	0.6
Hybrid seed are not important in your household	56	36.1	6	3.9	93	60.0
High price of inputs is the main problem that hinders intensive use of modern/ improved varieties	152	98.1	2	1.3	1	0.6
Landraces need to be abandoned completely	22	14.2	6	3.9	127	81.9
In order to increase Maize production in your Village only landraces Need to be promoted	8	5.2	2	1.3	145	93.5
You will abandon landraces if price of fertilizers and modern seed is reduced	17	11.0	6	3.9	132	85.2

Table 17 continues

In your village only modern varieties need to be promoted	12	7.7	3	1.9	140	90.3
Modern varieties are men's crop	6	3.8	13	8.4	136	87.7
Landraces are women's crop	5	3.2	12	7.7	138	89.0
Promoting maize in this village will improve your living standard	153	98.7	0	0.0	2	1.3
On-farm seed production is the most important approach of increasing your access to high quality seed	134	86.5	16	10.3	15	13.5
Training is the most important approach of improving your knowledge on seed management	153	98.7	1	0.6	1	0.6

4.5 Maize crop production and management practices

4.5.1 Land preparation, planting and weeding.

Land preparation is carried out between September and early December. In all visited villages, land preparation, planting and weeding is normally carried out by both men, women and youths in the household, although women are more involved in planting seed, making holes or furrows for planting seed, and in case where heavy practices such as failing/cutting down trees or removing stamps are needed men are mainly involved.

Planting time does not differ across villages. Planting is usually done immediately after the on-set of rainfall from November to mid January. Hand planting is commonly practiced. There was no mechanized planting found in the villages. In case where rainfall delays some farmers have a tendency of dry planting, that is planting is done a short period before on-set of rainfall. This practice has brought some problems because farmers

have to re-plant in instances where rainfall is not sufficient for seed germination or seedling growth. Re-planting renders farmer to either take seed from maize grain or seek from other farmers. Observation indicates that seed taken from maize grain stock or other farmer are usually of mixed varieties or recycled, since farmers tend to mix the maize varieties during shelling after seed selection. Unless order is made during or before seed selection, normally seed taken from maize grain stock or other farmers do not follow the selection criteria as was not intended for sowing. Ox-plough and hand-hoe constitute the main farm implements in the households for land preparation and planting. Results (Table 18) indicate that in overall, 54% and 27% of surveyed households use only ox-plough and hand-hoe respectively for land preparation and planting.

It is observed that there does exist variability with respect to the extent of implement use among villages. Mponela showed the highest proportion (80%) of households using hand-hoe as a main farm implement for land preparation, planting and weeding. Likewise, the highest proportion of households using ox-plough as the main implement for land preparation and planting is observed in Mangawe village (95%) followed by Ibembwa (58%). Very few people in Mangawe (5%) and Ihimbo (2%) used both ox-plough and/or tractor.

Table 18: Main implements for land preparation and planting

	Village									
	Mponela (n = 35)		Ibembwa (n = 40)		Mangawe (n = 40)		Ihimbo (n = 40)		Total (N = 155)	
Implement	n	%	n	%	n	%	n	%	n	%
Hand-hoe	28	80	4	10	1	2	9	23	42	27
Ox-plough	3	9	23	58	38	95	19	48	83	54
Hand-hoe + Ox-plough	4	11	11	27	1	2	11	27	27	17
Ox-plough + Tractor	0	0	2	5	0	0	1	2	3	2

Respondents perceived cultivating using tractor as more expensive than any other methods. It was found during the survey that cultivating by a tractor cost Tshs16 000/-per acre while ox-plough cost half the price of about Tshs 8 000/- per acre. However, labour cost of operating ox-plough (which is in most cases provided by the family/household) was not considered. It was found during the interview that three people are required to operate four oxen. Respondents realized that tractor is more efficient than ox-plough. Few hours is spent when cultivating with tractor than ox-plough. Otherwise if a tractor or hand hoe is used spacing of one foot between planting holes and three feet between planting rows. Farmers plant two to three seeds per hole for both improved and local seed. Where ox-plough is used to make rows for planting seed, spacing is not very much observed. Two to three seed are planted very close to each other within a row. On the other hand, spacing is observed when hand-hoe is used to make holes for planting seed. Two to three seed are planted per hole. Weeding is mainly carried out manually by using hand-hoe. No use of ox-plough or tractor for weeding was observed during the survey, although some farmers in Ibembwa village acknowledged to have previously been using ox-plough for weeding. Inadequate knowledge was mentioned to limit the use of oxen for weeding. Farmers suggested to be provided with training about the use of drought animals.

In general use of poor implements for land preparation limits the total area to be cultivated, which finally limits the amount of yield per hectare. Low yield results to the decreased household income, which in turn limits farmers' capacity to purchase improved seed and the associated inputs.

4.5.1.2 Harvesting

Harvesting of maize intended for dry grain is done from late June to July depending on the onset of rainfall, which determines the date of planting. There is no rainfall during harvesting maize, thus there is no rotting of maize is experienced. Men and women are

responsible for harvesting maize intended for dry grain. Hand harvesting is a common practice. Dryness of the outer husk is the indication that the grain is dry and ready for harvest. Harvesting methods include; removing the cobs with sheaths from the stalks or removing the cobs without husks and transport home. No influence on seed selection was observed as far as method of maize harvesting is concerned. For farms located very far from home (as observed in Mangawe village), drying and shelling is done in the field in order to facilitate transportation. Farmers have to spend day and nights in fields taking care of maize until the harvesting and processing of maize is complete. For nearby or homestead fields drying and shelling is done at home. Shelling is done by beating with sticks after drying for two months. Special cages made up of wood poles and bars are used for drying maize before shelling. In cases where household members cannot provide sufficient labour for harvesting practice, members from other households are invited to provide assistance. Assisting members are given local brew and sometimes food as return for the assistance. This practice of alleviating household labour shortage is locally known as "*Migawe*" as observed in Mangawe village.

4.5.1.3 Transportation

Men are mainly involved in the transportation of maize from fields, except for nearby/homestead fields where all household members are involved. The commonly methods used for maize transportation include; oxen or donkey drawn carts, bicycle, hiring tractors and head carrying. Table 19 indicates that head carrying is the most common method of maize transportation followed by ox-cart. Results indicate that a total of 46 and 21 per cent of interviewed farmers practiced head-carrying and ox-cart respectively as methods for transporting maize from field to home. Combination of two to three methods of maize transportation is common in a single household.

Table 19: Means of maize transportation

Transportation	Village									
	Mponela (n = 35)		Ibembwa (n = 40)		Mangawe (n = 40)		Ihimbo (n = 40)		Total (N = 155	
Method	n	%	n	%	n	%	n	%	N	%
Head-carrying	19	54	13	33	11	28	28	70	71	46
Ox-cart	2	6	10	25	12	30	9	23	33	21
Bicycle	11	31	8	20	1	2	2	5	22	14
Tractor	3	9	9	22	16	40	1	2	29	19

However, the popularity of a particular method of transporting maize varied among the four villages. Head carrying was a most common method in maize transportation as higher proportion of interviewed farmers in Ihimbo (70%), Mponela (54%) and Ibembwa (33%) applied it. In Mangawe, tractor (40%) was mostly applied method of maize transportation, followed by ox-cart (30%). If seed selection is done in the field, seed is packed in a marked bag and transported together with maize intended for food or marketing. Farmers mark the bag containing seed to avoid mixing with maize intended for other purposes.

4.5.1.4 Maize grain storage

Maize can be stored as grain after shelling or without shelling. Women and men are involved in grain storage. If maize is transported un-husked, husking is normally done before storage. Observation indicated that no maize intended for food or marketing is stored unhusked. However farmers acknowledged that storage of unhusked maize have been done by their elders in many years ago. Bags, traditional structures called *vihenge*, and above-fire (smoky) place are the common methods used to store maize grain. Results (Table20) indicate that polypropylene bags are the most applied methods in maize storage as higher proportions (63%) of overall farmers interviewed applied it. Farmers mentioned

theft) and allow for easier handling (e.g. pesticides application) and it keeps correct record of the balance than cribs (*Vihenge*).

Table 20: Means of maize grain storage

Storage	Village									
	Mponela (n = 35)		Ibembwa (n = 40)		Mangawe (n = 40)		Ihimbo (n = 40)		Total (N = 155)	
method	n	%	n	%	n	%	n	%	n	%
Vihenge	2	6	3	7	23	9	20	50	34	22
Bags	29	83	37	93	24	60	8	20	98	63
Above fire	1	3	0	0	0	0	0	0	1	1
Vihenge+bags	3	8	0	0	7	17	12	30	22	14

According to farmers, costs incurred in purchasing bags, susceptibility to fire if a house catches fire and pests attack (e.g. rats and termites) if not treated well are the major threats in using bags as a storage method.

Among villages, about (20%) of respondents in Ihimbo village used bags as a maize grain storage method. Ibembwa village showed a higher percentage (93%) of farmers using bags as storage method, followed by Mponela (83%) and Mangawe (60%). Being located near the border higher rate of grain theft was reported in Mponela and Ibembwa villages. Maize is stolen and sold in a nearby country. Interview indicates that *vihenge* (Plural) is the most preferred method of storing maize grain than bags. The following are the major reasons for using *vihenge* as storage method: minimum cost is incurred since once constructed they can stay for many years (more than ten), provide more ventilation for stored maize than bags, can be constructed outside the house thus provide space in the house and they are traditional. Most farmers in all visited villages mentioned that pests such as rodents or rats and termites less attacked maize stored in cribs (*vihenge*), than in

bags. With respect to weevils attack both *vihenge* and bags were reported susceptible. Major threat in using *vihenge* as a storage method is theft since they are commonly constructed outside the house. Few farmers construct the *vihenge* inside the house. In this study more than 50% of farmers in Ihimbo village used *vihenge* for maize grain storage and more than 9% of respondents in Mangawe village applied it. It is observed that incidences of grain theft in these villages are minimum compared to Mponela and Ibembwa. Results indicated that about 2% of respondents in Mponela applied above fire (smoky) area as a method of storing grain. Storage without application of pesticides is the main reason for using smoky (above fire) as a method for storing grain.

4.5.2 Seed management practices

The aim of this sub-section is to determine the actual seed management practices in the study area with a view to developing training and/or extension advices for strengthening farmer management practices and capacities. The practices examined include: seed selection, seed processing, and seed storage.

4.5.2.1 Seed selection

Seed selection is an important aspect of seed management. It was observed in this study that most farmers in the study area select maize seed after harvest or prior to storage. Further selection takes place before sowing. Field seed selection is not a common practice. Men and women participate in seed selection, although women are more involved. The manner in which maize grain is stored possibly resulted into variability in seed selection practices among villages. In Ihimbo village, farmers do not separate seed from maize intended for food. The cobs are packed in *Kihenge* in a special sequence where big cobs form the bottom layers with the tip of each cob facing downwards. This implies that maize cobs are arranged in *Kihenge* (singular) according to size. The sizes

increase from top to the bottom. Farmers start to consume maize from the top layers to the bottom layers. The reason for this arrangement is to enables farmers to have big cobs during seed selection, which is done at a later time prior to planting. In Mponela, Ibembwa and Mangawe villages most farmers select seed immediately after harvesting. Farmers mentioned characteristics such as size of the cob, size of the seed, absence of diseases or insect damage and degree of maturity to be the basis for seed selection. In addition the cob selected should not show any symptoms of rotting.

4.5.2.2 Seed processing

Cobs selected for seed are always shelled at homestead prior to the treatment with industrial pesticides such as Actellic super dust or botanicals. Shelling takes place after drying for two to three months. Most farmers considered the middle portion of the cob as suitable for seed. Grains from the top or bottom of the cob are normally used for food or selling. Hand shelling is commonly practiced. Hand shelling is considered the best means of processing seed, as it does not lead to seed damage, hence maintaining the quality of processed seed.

4.5.2.3 Seed storage

Storage structures and practices should protect the seed against the damage of rats and other pests. Storage structures for food grains are often designed for the same purpose of protecting stored crops produce (Almekinders and Louwaars, 1999). In this study, farmers practiced a wide range of seed storage methods. The methods varied in popularity according to their effectiveness in storing seed. The same methods applied for both local (landraces) and improved maize seed. A particular method was considered effective if it allows for minimum damage pests damage (insects, rats or rodents) and proper germination. For the shelled grains; tins, pots, gunny bags or polypropylene bags were

commonly applied. *Vihenge* were applied mostly for unshelled cobs. However, it is not advisable to store maize without shelling if pesticides are to be applied. The efficiency of pesticide applied to unshelled maize is reduced because of double action encountered. This implies that the applied pesticide have to act on maize grain as well as on the maize cob.

For pesticides to be effective, it is advised to shell maize and clean it to remove chaffs before application of pesticides. However, polypropylene bags were the most popular method of seed storage. Bags allow for easy management practices such as frequent turning of grains and pesticides or botanical application. Some farmers in Mponela and Mangawe villages mentioned pots as another seed storage method. Contrary to food, maize seed storage was regarded in all villages as women's task. Grain and seed dressing is regarded as men's task. To control storage pests stored seed are frequently dressed with Actellic super dust or botanicals such as *Mwasamla or Mvanga* (in Mangawe village), *limung'anung'a*, and *Utupa* (Mponela and Ibembwa villages) and *Mdupala* and *Ngategau* (Ihimbo village). In addition, leaves of a peaches tree and pyrethrum are used across all villages except Mangawe. However, respondents mentioned that botanicals are not as effective as industrial pesticides. Few farmers hang maize cobs above fire or on the tree. The later methods are cheaper than storage in bags as they allow for storage of seed without chemical or botanical treatment. Farmers in Mponela and Ihimbo village mentioned that seed stored on the trees or above fireplace had poor germination and rats easily damaged them. Therefore, these methods are frequently less applied. The storage constraints mentioned were; expired pesticides, rats, termites and grain borers such as *Streptophanus tranctus*.

4.6 Input use and sources

4.6.1 Maize varieties and seed sources

Landraces, OPV and hybrids are the main types of maize seed cultivated in the study area. A farmer either can cultivate landraces only, improved varieties only, a combination of landraces and improved (though in separate plots) or mixed varieties. OPV and hybrids are known as certified or improved maize seed. These seed can be saved from previous season (recycled), locally traded or purchased from seed stockists. Hybrids show decreased yields in the following cropping season if recycled. In this aspect seed stockists become the main source of hybrids and OPVs. In Mponela and Mangawe villages UH615 is a hybrid maize variety appreciated by farmers for its high yield potential than other hybrids they used to cultivate. UH615 is a newly released maize variety from ARI-Uyole. Table 21 shows proportions of respondents planted seed of different types and sources during 2002/03 cropping season and their sources. Observation indicates that few farmers bought new seed of hybrids or OPV. Respondents mentioned that high price of improved seed as well as associated inputs such as fertilizers, and long distance traveled to acquire the seed limit farmers to purchase certified (OPVs and hybrids) maize seed regularly. To solve this problem farmers recycle the improved seed or acquire from other farmers.(Table 21).

Exchange of new improved maize seed with maize grain is a common means of payment if a farmer acquired a new improved maize seed from other farmer. A Farmer who needed seed offers two tins (40kg) of maize grain and acquires one tin (20kg) of maize seed. Purchasing at low price from other farmers was another means of acquiring new type of maize seed.

Table 21: Proportions of farmers planted different types of seed during 2002/03

Type of seed	Mponela (n = 35)		Ibembwa (n = 40)		Mangawe (n = 40)		Ihimbo (n = 40)		Total (N = 155)	
	no	%	no	%	no	%	no	%	no	%
Farmer-saved										
Landraces	22	53	21	49	18	31	28	62	89	48
OPV	2	5	0	0	5	9	0	0	7	4
Recycled hybrid	4	10	2	5	13	22	1	2	20	11
Mixture	10	25	1	2	3	5	0	0	14	7
Locally traded										
Landraces	0	0	0	0	4	7	1	2	5	3
OPV	0	0	0	0	2	3	0	0	2	1
Recycled hybrid	2	5	2	5	11	19	0	0	15	8
Mixture	0	0	1	2	1	2	0	0	2	1
Stockists										
OPV	1	2	0	0	0	0	0	0	2	1
Hybrid	0	0	16	37	1	2	15	33	32	17

no = number of observations

Table 21 shows that local/landrace varieties continue to be highly cultivated compared to improved varieties. The reasons for continued growing of local varieties included earliness and adaptability to the local environment. In addition, flint kernel and good taste characteristics of local varieties make it mostly be preferred as food. This observation indicates that although liberalisation has increased the supply of different maize varieties, yet it has not been able to supply the variety, which meets farmers' needs. However, farmers acknowledged that local varieties have low yield potential. Results have shown that the proportion of farmers cultivating landraces differs between villages. Table 21 indicates that Mponela and Ihimbo villages show a higher proportion (53% and 62% respectively) of households cultivating local varieties. The commonly local varieties used are; *Ibandawe* in Mponela and Ibembwa villages, *Kibunzimwali* and *Kimkoka* in Mangawe and Ihimbo villages respectively. Also observation indicates that farmers mix varieties (improved and landraces) deliberately or accidentally. Deliberate mixing of varieties occurred when farmer want to incorporate some characteristics of local varieties

to improved ones or when re-planting is needed especially if seed saved in previous season was not sufficient for replanting. These are the farmers' strategies for ensuring household seed security to cope with high input prices following the government removal of subsidies.

Table 21 indicates that Mangawe and Ihimbo villages show higher proportions (37% and 33% respectively) of respondents who purchased new seed of hybrid maize. According to wealth ranking determined, it seems respondents from Ibembwa village are wealthier than respondents from other villages due to coffee production. Thus, most farmers in this village can afford to buy inputs required for the production of improved maize. Similarly, in Ihimbo village cultivation of tomatoes increases farmers' income hence their purchasing power increased. In addition, sale of green maize, which is most common in Ihimbo village, requires purchasing of new seed every season in order to fetch higher prices. In addition, farmers who sale green maize tends to sale all big size cobs during harvest, which could be better for seed selection. This renders farmers to buy new seed every planting season. Generally, results indicate that seed saved (recycled) from farmer's previous harvest was the commonest source of seed for both landraces and improved varieties. Different types of landraces and improved varieties are cultivated in the study area (Table 22).

If farmers were to be provided with new variety they suggested the following characteristics; it should: bear two ears, be tolerant to diseases, and be resistant to field and storage pests have a hard kernel and mature early (3 months). Additional characteristics such as white grains and medium height stems were also mentioned in Ibembwa village.

Table 22: Types of maize varieties planted in SHZ

Variety type	Village			
	Mponela	Ibembwa	Mangawe	Ihimbo
Local/landraces				
Njelenje	√	√	x	x
Ibandawe	√√	√√	x	x
Inchancha	√	√	x	x
Usaza	√	√	x	x
Kibunzimwali	x	x	√√	x
Kimkoka	x	x	x	√√
Improved				
H614	√√	√√	x	√√
H632	√√	x	x	
H628	x	x	x	√
H625	x	x	x	√√
H6302	x	x	x	√
UH615	√√	√√	x	x
C4141	√√	√√	x	√√
C4142	x	x	√√	√√
Pioneer	x	x	√√	x
UCA	x	x	x	√
Katumani	√	x	x	x
Ukiliguru	x	√√	x	x
Kilima	x	√√	√√	√√
Kito	x	x	√√	x
TMV1	x	x	√	√√
TMV2	x	x	x	√√

Key: √ less preferred
√√ Highly preferred
x Not planted

4.6.2 Fertilizers, Pesticides and herbicides application and sources

Industrial fertilizers as well as farmyard manures are used to improve soil fertility. Farmers mentioned that improved maize varieties require intensive use of industrial fertilizers. The then Ministry of Agriculture and Co-operatives (1997) emphasized that to achieve the goal of increased agricultural production and productivity, the use of improved seed has to be combined with the use of fertilizers, pesticides and other inputs.

The common industrial fertilizers used are DAP, TSP, CAN, SA and Urea. Using pesticides controls storage and field pests. Actellic super dust and Actellic EC are the common industrial pesticides applied. Although, respondents complained that Actellic super dust and Actellic EC are not effective in controlling weevils observation indicated that some respondents could not follow properly instructions on how to apply pesticides. For example different application ratios (in terms of amount of pesticide, amount of water and the amount of grains to be mixed) were mentioned by different respondents. It is recommended to apply 100g of Actellic super dust to 90kg of maize grain but farmers tend to apply the same dose to more than 90kg of maize grain. This is done in order to reduce costs of purchasing the pesticides. Failure to follow the instructions on how to apply pesticides reduces the effectiveness of the pesticides dosage. Some farmers used botanicals to supplement the use of industrial pesticides. Herbicides to control weed were rarely used.

However it was observed that due to high prices and the limited knowledge of industrial fertilizers pesticides and herbicides, the extent of use of them varied among farmers and villages. In Mangawe village none of the respondent used any chemical fertilizer or herbicides as they mentioned that chemical fertilizers burn the maize during crop development. Some respondents used farmyard manure to supplement industrial fertilizers while others didn't use any fertilizer. They acknowledged that using manure leads to higher yield than cultivating without it. Using Actellic EC or Actellic super dust mostly controlled storage pests. A botanical called *Mwasamla* or *Mvanga* was used to control both field and storage pests. The barks of these trees were dried and pounded to obtain a powder that was then applied to maize funnel in the field or mixed with maize grain during storage. Some farmers in the village have specialized in the production of this botanical and sell it at affordable price to other farmers. The use of botanicals was

considered as a livelihood strategy to reduce cost of purchasing industrial pesticides. in case farmers have insufficient income to purchase them.

In Ihimbo both chemical fertilizers and farmyard manure are used to improve soil fertility. It was mentioned by farmers in the later village that a whitish soil obtained from termite mounds (*vichugau*) is used to supplement manures. Actellic super dust as well as botanicals such as *Mdupala* and *Ngategau* is used to control storage pests such as weevils. These botanicals are also used to control field pests such as stem borers. Leaves of *Mdupala* are pounded, soaked in water for few minutes and then sieved to obtain the liquid, which is then applied in fields. Roots of *ngategau* are collected, sliced into small pieces, sun-dried and then pounded to obtain powder, which is then added to the maize funnel. In addition, peaches leaves and pyrethrum are used across all villages except Mangawe. Leaves of peaches were used to control field pests such as stalk-borers and other storage pests. The leaves are soaked in the water for one day or more, pounded and sprinkled over the maize crops or stored maize grain. The efficiency of botanicals is similar for both landraces and improved maize varieties. Botanicals are used to control pests in case industrial pesticides are not accessible. During the study there was no indication of herbicides use in the study area.

In Ibembwa and Mponela Industrial fertilizers are also used. Storage pests are mostly controlled by applying synthetic pesticides such as Actellic super dust or Actellic EC. Botanicals such as pyrethrum and leaves of neem were also used to control pests in case farmer cannot afford to buy the pesticides. The common source of industrial fertilizers, herbicides and pesticides are the private shops. The government announced to subsidize fertilizers during the 2002/03 cropping season but majority of the respondents did not access the subsidized fertilizer. Farmers mentioned that the price of fertilizers in private

shops doubled as compared to the price of the previous season, thus increasing the cost of production. Due to this, majority of farmers failed to use fertilizers on time as they were waiting for government's subsidization. This might have greater influence on maize yield and choice of varieties for the next cropping season.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The following general conclusions are made with regards to the findings from the study objectives:

(a) As far as objective number one is concerned maize plays an important role in meeting peoples' foods and cash needs in the study area. Food security is given first priority in the production of the crop. Apart from food security, maize is sold as grain, green and brewing (local beer) to get money for other basic needs such as clothes, shelter, health services and education. Local beer from maize grain is used for both economic and social reasons. Economically beer brewing is a means for reducing household labour shortage through exchange and is a source of income and employment for farmers who specialized in brewing as their main off-farm activity. Beer brewing and consumption is also a way of socialization. Both local and improved varieties are good for brewing. A mean return of about Tshs 249 982.00 and Tshs 15697.00 per hectare per household was obtained from maize grain and maize beer respectively. The income obtained from maize is not sufficient to meet all basic needs of farmers. Therefore, farmers engage into other activities such as increased crop diversification, livestock keeping and off-farm activities such as business to raise household income.

(b) With regard to objective number two it is concluded that since liberalization has taken place farmers access to improved varieties has been significantly ($P< 0.05$) influenced by gender and distance traveled to acquire these seed. This suggests that male have higher access to improved seed than females. The influence of distance to farmers in acquiring seed is due to the fact that many seed distributors tend to save areas where transport is

reliable. Also as far as this objective is concerned, mixed cropping, planting crops at different location and time and more involvement to off-farm activities such as business were the copping strategies to the declined return from maize. However despite these copping strategies involved maize is still leading in the contribution to peoples' livelihoods.

(c) Determination of farmers' management practices and farmers' perception on maize crop or maize seed was objective number three. As far as the objective is concerned it is concluded that farmers employed different types of maize seed management practices Seed management practices are important consideration in any effort to ensure quality of seed. In this study seed selection, processing and storage were the seed management practices examined. It is concluded that farmers use characteristics such as size of the cob/grains (big cobs/grains) and absence of pest damage, disease symptoms and rotting as criteria for seed selection. The manner in which maize grain is stored result in variability in seed selection practices among farmers. Similarly farmers employ different methods of seed storage. The methods include: polypropylene bags, traditional structures called *vihenge*, pots, above fire and hanging maize cobs on trees. A particular method was considered most effective if it allows for easy management practices such as pests application, minimum pests damage (rats/rodents or insects) and proper germination. Polypropylene bags and *vihenge* were mostly used methods of seed storage. Grain borers are the major constraints in maize seed storage. The pests were controlled by using Actellic super dust or Actellic EC. Botanicals such as *limung'anung'a. mwasamla/mvanga*, and leaves of *neem*, and peaches were used to control pests in case synthetic pesticides are not accessible. Both local and improved maize varieties were preferred for the production of the crop.

Assessment of farmers' knowledge, perception, and practices on maize crop or maize seed leads to the following conclusions According to respondents, knowledge of hybrid maize and pesticides application is insufficient and can be improved through frequent training. Farmers tend to rely on instructions given by the pesticides stockists for pesticides application and not the instruction provided by the manufacturer. This might lead to wrong application of the herbicides if the stockist is not well informed about the chemical. Local knowledge has been used to manage both local varieties and improved varieties.

Farmers perceived quality maize seed as hybrids or any other maize seed produced by researchers in research centers but not local varieties (landraces). This perception is wrong since quality seed can be local varieties (landraces), OPVs or hybrids. Farmers assessed quality seed in terms of yield potentials only without considering other attributes of the seed. Farmers perceived farmer-saved seed (mainly local maize varieties/landraces) as the currently most reliable source of maize seed in the study area. Similarly, farmers acknowledged that on-farm seed production could be another most reliable source of seed if properly managed by farmers under close supervision by qualified seed experts from research centers. Local maize varieties were perceived good for food while improved maize varieties were perceived good for maize grain marketing.

(d) As for breeding implications, farmers need different types of maize seed for different purposes such as food, marketing, adaptability to the environment and high yield potentials.

5.1.1 Government response to declining use of improved varieties

To promote the use of improved maize varieties, the government has decided to subsidize chemical fertilizers starting from year 2002/03 cropping season. In this season (2002/03) observation indicated that majority of farmers could not access the fertilizers. Thus majority did not use fertilizers in their farms as they were waiting for this subsidization. This indicates that the distribution system failed to ensure that all farmers access the subsidized fertilizers. Unreliability of fertilizers availability has greater impact on farmers' choice of variety to cultivate. However some farmers have negative attitude towards the industrial fertilizers, for example in Mangawe village some farmers reported that industrial fertilizers burns the maize during development.

5.1.2 Implications for breeding

Results have shown that seed of both local maize varieties (landraces) and improved maize varieties are important inputs for the production of maize. However local varieties or landraces, which are mostly farmer-saved seed, continue to be highly cultivated regardless of the economic reforms adopted in the country. Local varieties have been perceived to be good for food as they meet milling and other food qualities. A minimum amount of maize produce sufficient to meet household food needs can be obtained even if local varieties are cultivated without the use of chemical fertilizers and pesticides. This implies that landraces are more adapted to the local environment. In this aspect local maize varieties were considered less risky in the production of maize. This observation suggests that liberalization has not yet increased the supply of maize varieties that sufficiently meet farmers' needs. Similarly improved varieties are perceived to be good for marketing as they yield higher than local varieties. But contrary to local varieties, yield loss is higher in improved varieties if chemical fertilizers and pesticides are not used.

Regardless the good return realized from improved varieties, high prices of the seed and the associated inputs (fertilizers and pesticides) makes them less applied or recycled for more than four times. This implies that the expectations concerning the outcome of the private seed companies involvement in distribution of agricultural inputs in rural areas has not yet been met. It was expected that more involvement of private companies in seed marketing would lower the price of maize seed in rural areas as a result of increasing competition among them and therefore increased use of improved seed. Poor roads and poor storage facilities limit the distribution of improved varieties rendering them inaccessible to farmers. Although the government subsidized the chemical fertilizers as a means of promoting the use of improved maize varieties in the year 2002/03 cropping season observation has shown that majority of farmers could not access it. This observation suggests that local varieties (farmer saved seed) continue to be the most reliable source of seed in the SHZ regardless these efforts made by the government to promote the use of improved varieties. Therefore basing on this observation it is important that there is a need for a breeding program that will address the following issues related to farmers' needs.

Farmers need a combination of different types of maize seed varieties for different purposes such as food and markets. Resistance to weevils during storage and milling qualities such as more flour than bran are the specific characteristics required for maize intended for food. Farmers appreciate landraces to meet at least some of these characteristics as compared to improved varieties. For green maize marketing, farmers need maize seed types, which yield two cobs per plant, produce well-filled cobs, and have good taste, aroma and flavour. In addition to meeting food qualities, farmers need landraces for adaptability to the environment. For this characteristic landraces are said to have stable yield compared to improved varieties (especially hybrids) in cases where

fertilizers is inaccessible. For maize grain intended for sale farmers appreciate the high yield potential of hybrids or improved varieties compared to local varieties (landraces). However hybrids have been reported to be lighter in weight than landraces.

Although the National Maize Breeding Program is addressing most of these issues related to farmers needs, its contribution towards improving peoples' well-being has been very little. Lack of funds and poor working facilities limits the national breeding program to perform its duties pertaining to the addressed issues, thus failing to meet the needs of farmers as required.

5.2 Recommendations

5.2.1 General recommendations

(a) It has been observed in the study that peoples' livelihoods in the study area depend much on maize. Thus the production of maize is inevitable. Therefore the current efforts to promote maize production must continue even after the current project promoting maize in the SHZ phases out. Promotion must target both local and improved maize varieties. The efforts made by the government to subsidize chemical fertilizer as away of promoting the use of improved varieties needs to continue. However, there must be a clear distribution system of the subsidized fertilizers so that it reaches all farmers at the right time. Alternatively, introduction of crop insurance schemes in the study area will be a better option to reduce the uncertainty of losses due to unforeseeable events such as drought.

(b) There is a need to improve not only farmers' access to quality maize seed but also to maize marketing with the aim of identifying more possible market opportunities available to farmers so that farmers are advised to carry out maize production on commercial basis.

Production of maize on commercial basis will enable farmers to purchase new seed and associated inputs every cropping season.

At present there is a need to introduce input loan schemes in the study area. The loans will enable farmers to access the improved seed, fertilizers and the pesticides. the government seed policy of 1994 stipulates that the government will encourage in line with current policy of free market economy the provision of necessary credit arrangements by various institutions deserving farmers and organization. This policy to be puts clearly so that all farmers benefit from it.

(c) More Training should be provided to farmers as a way of improving knowledge on maize seed and management particularly on the use of pesticides and improved seed. Farmers should be trained on proper seed selection techniques such as field seed selection. Similarly farmers need to be supplied with modern simple and cheap seed storage technologies in order to avoid the storage losses.

5.2.2 Specific recommendation for maize breeding

The study has identified that farmers need different types of maize seed for different purposes. To meet these specific needs of farmers there's need to increase budget from the government to the national maize breeding program in order to carry out its operation effectively.

Breeding maize specifically for commercial purposes and introduce in the study area is important for increasing farmers' income. Breeding for green maize marketing must consider the important attributes such as two cobs per plant, well filled grains and big size cobs.

Since there is no specific maize characteristics required for brewing, there is a need to breed a variety that will be used for beer only. The variety should not necessarily bear the characteristics for food and marketing. This will reduce the chance of brewing maize intended for food or marketing hence increasing household food security and income. Increased income will enable farmers to purchase inputs such as improved seed, pesticides and fertilizers required for maize production.

5.2.3 Suggestion for improving maize production and other crops in the study area

Strengthening of organic farming (OF) techniques in villages where this has started as an alternative type of farming to reduce the use chemical fertilizers and pesticides, which not only increase the cost of production but also play role in environmental pollution is important. More research on botanicals is needed for intensive use if OF is introduced. However strengthening organic farming technologies requires an implementation of a plan that describes the practices used in producing crops and livestock products. However, OF requires well trained farmers as it requires a detailed recording system that trucks all products from the field to the point of sale. OF should not only be used for the production of maize but also for the production of other crops. Increased income from other crops can be used to purchase inputs required for maize production. OF will be a better option for involving the formal sector on improving quality and access to seed of other crops in the study area.

REFERENCES

Akyoo. A.M. (2004). Agricultural Production, Natural Hazards and Risks: An Analysis of Copping Mechanisms and the Potential of Crop Insurance. Unpublished Dissertation submitted for Award of MSc Degree at Sokoine University of Agriculture, Morogoro, Tanzania. 132pp.

Almekinders, C.J.M. and Louwaars, N.P. (1999). Farmers' Seed Production: New Approaches and Practices. Intermediate Technology Publications, Southampton Row, London UK. 291pp.

Anandajayasekeram, P., Kaliba, A., Martella, D., Moshi, A., Mwangi, W. and Shao F. (1999). Economic Impact of Maize Research in Tanzania: *A paper prepared for presentation at the EACART/ASARECA/CTA workshop on Impact Assessment of Agricultural Research in Easter and Central Africa*, Entebe, Uganda, 16-19 November1999. pp.2-5.

Ashimogo, G. (1994). Peasant Grain Storage and Marketing in Tanzania. A case study in Sumbawanga District. Unpublished Thesis submitted for Award of PhD at Humboldt University. Berlin, Germany. pp. 22.

Ashley, C. and Carney, D. (1999). Sustainable Livelihoods: Lessons from Early Experience. Department for international Development, London, UK. pp. 45-47.

Aziz, A.A., Mallya, J.I., and Muliokola, S.W. (1994). *Traditional Seed Storage Facilities in Tanzania and Their Effects on Seed quality*. In 2nd SADC seminar on seed research and certification. Maseru, Lesotho. 17-20 May 1994. pp. 4-5.

Bagachwa, M.S.D., Mbelle, A.V.Y., and van Arkadie, B. (Eds) (1996). Market Reforms and Parastatal Restructuring in Tanzania. Dar-es-Salaam University Press. 328pp

Barbara, W.F. (1996). The Lore and History of Maize. Available at www. Mythinglinks.org/ip~maize.htm. Visited on 19-07-2003

Basra, A. S. (1994). Seed Quality: Basic Mechanisms and Agricultural Implications. Food Product Press. An Imprint of the Haworth Press, Inc. NY; London; Norwood, Australia. 389pp.

Bisanda, S. and Mwangi, W. (1996). Adoption of Recommended Maize Technologies in Mbeya Region of the soutern Highlands of Tanzania. Addis Ababa. 41pp.

Bwana, E. N. (1996). An Assessment of the Adoption of Improved Food Grain Storage Structures in Mara Region. Unpublished Dissertation for Award of MSc Degree at Sokoine University of Agriculture, Morogoro, Tanzania. 118pp.

Chambers, R. and Conway R. (1992). *Sustainable Rural Livelihoods. Practical concepts for the 21st Century*. IDS discussion Paper No. 296. Brighton: Institute of Development Studies, University of Sussex. pp. 5-11.

Chiduo, C. M. P., (2001). Microenterprise Finance in Tanzania: Case Study and Policy Design Analyses. Unpublished Dissertation submitted for Award of MSc Degree at Sokoine University of Agriculture, Morogoro, Tanzania. pp. 68-9.

Cromwell, E. (1990). Diffussion Mechanisms in Small farm communities: Lessons from Asia, Africa and Latin America. New York Paper 21 ODI, London. pp. 1-7

Cromwell, E. (1996). Governments, Farmers and Seeds in a Changing Africa. CAB International; In association with the ODI, London. 174pp.

de Boef, W., Amnor, K. and Wellard, K. (1993). Cultivating Knowledge for Genetic Diversity, Farmer Experimentation and Crop Research. IT publications, London. 105pp.

Due, J. M. (1988). Tanzania Cultivars Release, Seed Multiplication, and Distribution Systems. Technical Report No. 7. Department of Rural economy. SUA, Morogoro, Tanzania. pp. 46.

FAO, (1994). FAO *Seed review 1989-90.* Food and Agriculture of the United Nations, Rome, Italy. 228pp.

FAO, (1999). Restoring Farmers' Seed Systems in Disaster Situations. *Proceeding of the International Workshops on Developing Institutional Agreements and Capacity to Assist Farmers in Disaster Situations to Restore Agricultural Systems and Seed Security Activities.* Rome, Italy. 225pp.

Farrington, J. and Bebbington, A. (1993). *Relactant Partners? Non-Government Organisations, the State and Sustainable Agricultural Development*. Routledge, London. 222pp.

Fistritzer, W. P. and Kelly, A. F. (1978). Improved Seed Production: A manual on the formulation, implementation and evaluation of seed program and projects. FAO, Rome. pp. 14.

Fowler, J. F. (1996) Improving Survey Questions. Design and Evaluation. Applied Social Research Methods Series Volume 38. Sage Publications. International Education and Professional Publisher. Thousand Oaks, London New Delhi. 48pp.

Hella, J.P; Lamboll R. and Temu, A.E. (2003). An Impact of Economics Reform on Quality Seed Utilization in Tanzania. Evidence from Southern Highlands Regions. Unpublished paper presented to the Seed Stakeholders' meeting 30-31 July2003, Iringa, Tanzania. pp. 1-27.

Hornby, A.S. (1992). Oxford Advanced Leaner's Dictionary of Current English. Oxford University press. 1989pp.

Kane, T., Jamela., S., Kabarhuza, H. Musengimana, S., J. Mulyungi., Sawado A., Chitiga-Machungauta R.M. and Okelo, J.A. (1990). Voices from Africa: NGOs and Grass-root Development. United Nations Non-Governmental Liaison Service, Geneva, Switzerland. 114pp.

Lazaro, E. A. (2003) *Background Information to the Study of Local knowledge in relation to Management of Agro-biodiversity and Food Security in Southern Highlands and Central Zones-Tanzania.* Consultancy Report Submitted for Project GCP/RAF/NOR gender, Bio-diversity and Local Knowledge Systems to Strengthen Agricultural and Rural Development. FAO LinKS Tanzania. pp. 1-58.

Liao, T.F. (1994). Interpreting probability models; Logit, Probit and other generalized linear models. *Quantitative application in the social sciences*, series 101. A Sage University paper. Sage publication. Thousand oaks, California. 87pp.

Longley, C. and Richard P. (1998). Farmers Seed Systems and Disasters. *International Workshops on Developing Institutional Agreements and Capacity to Assist Farmers in Disaster Situations to Restore Agricultural Systems and Seed Security Activities.* Rome, Italy. pp. 2-9.

Meredia, M. and Howard, J. (1998). Facilitating seed sector Transformation in Africa. Key findings from the Literature. USAID. Michigan State University. pp. 1-6.

Ministry of Agriculture and Co-peratives (1997). A Draft Report on the National Seed Industry Development Programme. Ministry of Agriculture and Co-peratives. Planning and Marketing Department. Dar-es-Salaam. pp. 52.

Msambichaka, L.A and Naho, A. (1995). *Agricultural Sector Performance under SAP in Tanzania: Promising or Frustrating Situation?* In Beyond Structural

Adjustment Programmes in Tanzania, (Edited by Mjema *et al.*). Dar es Salaam Economic Bureau.

Msambichaka, L.A., Moshi, H.B. and Mtatifikolo, F.P. (ed.) (1994). Development Challenges and Strategies for Tanzania. An agenda for 21st century. Dar es Salaam University Press, Tanzania. 319pp.

Mtenga, K.J. (1999). Smallholder Seed Production in Tanzania: Potentials and Limitations. Unpublished Dissertation Submited for Award of MSc Degree at Sokoine University of Agriculture, Morogoro, Tanzania. pp. 13-36.

Mtenga, K.J., Magayane, F.T., Miles, C.A., and Mattee A.Z. (1999). Existing Mechnism for Smalholders Seed Production and Dissemination in Tanzania. Bean/cowpea Collaborative Research Support Program. *East African Proceedings*: Bean Seed Workshop January 12-14. Sokoine University of Agriculture, Morogoro, Tanzania,Washington State University, Vancouver, WA, USA.pp. 1-6.

Mukuchu, M., Mongi-Henday, R., Elanga, A., Kisandu D., Natai, S. and Maimu, J. (2003). *A Study of local knowledge in relation to management of agro-biodiversity for food security*: Case studies on local seed management practices in Southern Highlands of Tanzania. pp. 105.

Mumby, G. (1994). Seed Marketing. Food and Agriculture Organisation of the United Nations, Rome, Italy. 132pp.

Musa, T. (1998). Farmer Seed Systems. *International Workshop on Developing Institutional Agreements and Capacity to Assist Farmers in Disaster Situations to Restore Agricultural Systems and Seed Security Activities:* In Plant Production and Protection Paper FAO, 1999. Rome, Italy. pp. 111-122.

Mussei, A.N., Mbwile, R.P., Kamasho, J.K., Mayona, C.M., Ley, G.J. and Mghogho, R.M. (1999). Agro-ecological Zones and Farming Systems of the Southern Highlands of Tanzania. 55pp.

Mussei, A.N., Nsemwa, L.T.H., Lyimo, N.G., Kabungo, C. and Mkoma, M. (2003). The Impact of Market Liberalisation on Improved Maize Seed Marketing in Ruvuma Region. MAFS/ARI-Uyole, Mbeya, Tanzania. 35 pp.

Mwanga, J., Letayo, E. Nonga, D., Senyagwa, A., Lugeye, E., Mangapi, S., Mnyone, S., and Laura, S. (2003). A study of local knowledge in relation to management of agro-biodiversity and food security in semi-arid central Tanzania. Intermediate report. FAO links project. pp. 33.

Mwangi, W. Mussei, A. and Verkkuijl, H. (1999). Adoption of Improved wheat Technologies by Small Scale Farmers in Mbeya District of Southern Highlands Dar es Salaam University Press, Tanzania. 89pp.

Nkonoki, S.R (1994). Gender, Technology and Agricultural Development. In *Proceeding of the Women Research and Documentation Project*, University of Dar-es-Salaam. Tanzania. pp. 240-260.

Pammpel, F.C. (2000). Logistic regression. A Primer. Sage University Papers series on Quantitative applications in the social sciences. Thousand Oaks, CA: Sage. pp. 7-32.

Ponte, S (2002). Farmers and Markets in Tanzania: How Policy Reforms Affect Rural Livelihoods in Africa. Mkuki na Nyota, Dar-es-Salaam, Tanzania. 204pp.

Regassa, E; Mwangi, W., Verkuijl, H., Hassena, M. and Alemayehu, Z. (1998). *Farmers Seed Sources and Seed Management in Chilalo Awraja, Ethiopia. IAR-Ethiopia.* CIMMYT. pp. 1-36

Senkondo, E.M.M. (2000) Risk Attitude and Risk Perception in Agro-forestry Decisions. The Case of Babati, Tanzania. Unpublished thesis submitted for award of PhD Dgree at Wageningen University, The Netherlands. 208pp.

Sepälä, P. (1996). 'The Politics of Economic Diversification: Reconceptualizing the Rural Informal Sector in South-East Tanzania', *Development and Change* 27: 556-79 Dar es Salaam, Tanzania. 328pp

Sumberg, J.E. (1991). NGOs and Agriculture at the Margin: Research, Participation and Sustainability in West Africa. *Agricultural Administration (Research and extension) Network paper No. 27.* ODI, London. pp. 37.

Temu, E.M. Deutsh, A. Croon, J. (1984). *Maize Production in Tanzania's Southern Highlands. Current Status and Recommendations for the Future.* International Maize and Wheat Improvement Centre. Working paper for . DF, Mexico. pp 2-89.

Tripp, R., (1995). Seed Regulatory Framework and Resource-poor Farmers. A literature Review. *Agricultural Administration (research and Extension) Network Paper No. 51*. ODI, London, UK. pp. 5-7.

Tripp, R., (2001). Seed Provision and Agricultural Development: The Institutional for Rural Change. Overseas Development Institute, London; In association with Currey J., Oxford and Heinemann, Portsmouth (N.H.). 167pp.

United Republic of Tanzania (2001). Rapid Appraisal Survey 1999/2000: Survey result Statistics Unit, Ministry of Agriculture and Food Security, Dar es Salaam. Tanzania. pp. 27.

United Republic of Tanzania (2002). Seed Technology Training Manual (Technical handbook No. 8). pp. 4.

United Republic of Tanzania/Crop Protection Programme/INADES formation (2003). *Situation Analysis of Maize growers in the Southern Highlands of Tanzania with particular Emphasis on Access to and Management of Maize Seed. Working paper*. Crop Protection Research Programme, DFID and the Division of the Research and Development, Ministry of Agriculture and Food Security (MAFS), Tanzania. pp. 3-7.

United Republic of Tanzania/European Economic Commission (1987). Regional Development Plan, Iringa. Dar-es-Salaam, Tanzania. pp. 57.

Wiggins, S. and Cromwell, E. (1993). Non-Governmental Organisations and seed provision. New York. pp. 3-6.

Wright, M., Donaldson, T., Cromwell, E. and New, J. (1994). The Retention and Care of Seed by Small-scale Farmers. NRI, UK. 163pp.

APPENDICES

Appendix 1: Draft terms of reference

Farmers' access to and management of maize seed in the Southern Highlands of Tanzania: Implication for breeding and seed development

Background

Maize is the most important food crop in Tanzania. it is a staple food which account for 60% of dietary calories as well as up to 50% of utilizable protein for the majority of Tanzanian rural population. It is the most widely cultivated crop in the country, covering about 45% of the under annual crop cultivation in Tanzania. When it comes to national food security, maize is recognized as the most important crop in alleviating hunger nation-wide. Although maize is such a widely cultivated crop, the Southern Highlands (SH) of Tanzania (comprising Iringa, Ruvuma Mbeya and Rukwa regions) provide the most favourable climatic condition for the production of maize. Currently the SH account for almost 50% of the national maize production. In addition, up to 90% of the annual purchase of maize for the national strategic grain reserve is normally done in the SHZ.

Although maize plays an essential role in the livelihoods of people in the SH (as well as consumers outside the zone), significant changes in context have been taking place with major implications for peoples' livelihoods. The relationship between peoples' assets, strategies and outcomes has been influenced by shocks (e.g. Gray Leaf Spots, *El Nino*) and trends (e.g. increasing population density, declining soil fertility, persistent crop pests (e.g. stem borers), storage pests, diseases (e.g. Maize Streak Virus); policies (e.g. Structural Adjustment Programmes (SAPs)) and Institutions (public sector research and private companies).

The relationship assets, strategies and outcomes is to some extent cyclical and an analysis can start at any point. For example SAPs are generally associated with a removal of subsidies and an increase in input prices (e.g. seed and fertilizers), retrenchment in the public sector and an expanded role for the private sector. Seed one of the key inputs/assets, particularly important to crop production as it determines the genetic resistance of the crop to pests and diseases. The pre- and post harvest protection of seed also determines the genetic resistance of the crop to pests and diseases. The pre and post harvest protection of seeds also determines: (a) whether it carries inocula of various pests and diseases and (b) seedling vigour essential for good establishment in the face of weeds and other adverse biotic and abiotic factors. However with respect to seed of improved maize varieties there has been a significant increase in price and a subsequent decline in return to the crop. How have farmers adapted their livelihood strategies in response? e.g. growing a larger area of maize to compensate for a decline in fertilizer use, switching to other crops, reducing the amount of improved variety seed purchased and making greater use of re-cycled seed. This situation is also associated with a lack of trust from seed companies and many other institutions dealing with seed distribution. The outcomes has varied, but for many still dependent on maize, the returns from the crop/profitability has declined with implications for peoples capital asset base (e.g. less money to purchase inputs, possibly unable to support children going to school).

What should be the way forward to improve access to maize seed in the SH? The above analysis suggests entry point may include:

(1) High price of seed – through improving farmers' ability to manage seed both pre and post harvest.
(2) Increase in the use of farmer-saved/ re-cycled seed – through improving farmers' ability to mage seed both pre and post harvest.
(3) Loss of confidence or trust – trust building activities between farmers and service providers and where appropriate among service providers.

The Southern Highlands Maize seed Project puts people at the center of the analysis and identifies sustainable access to and management of quality maize seed as a major issue which needs to be addressed to improve the impact of breeding initiatives, particularly on poorer people. A key element in this initiative is the need to understand better the current livelihoods context of people in the project area, how and why people are managing their maize particularly maize seed and implications for access to maize seed and breeding.

Terms of reference
1) outline-using a Sustainable Livelihoods Framework- the relationship between maize and peoples' livelihoods in the study area. This should take into account variability between people and factors influencing livelihood strategies and outcomes.
2) Explore peoples' knowledge, perceptions and practices with respect to maize management in general and use this information to:
3) Examine in details peoples' seed management strategies and their influence on maize genotypes.
4) Assess the implications of the above for maize breeding in the Southern Highlands.

Appendix 2: List of private seed companies

S/N	Name of seed company	Adrress
1	Maungu Seed Company (T) Ltd	P.o. Box 9753 Dsm
2	Zanobia Seeds Ltd	P.o. Box 114 Arusha
3	Mosanto (Cargill) (T) Ltd	P.o. Box 1280 Arusha
4	Incomet Ltd	P.o. Box 243 Mafinga, Iringa
5	Krishna Seed Co. Ltd	P.o. Box 7304 Arusha
6	East African Seed (T) Ltd	P.o. Box 14455 Arusha
7	Kibo Seed Company (T) Ltd	P.o. Box 25 Arusha
8	ELCT Diocese of Meru	P.o. Box 98 Arusha
9	Sluis Brothers E.A. Ltd	P.o. Box 350 Arusha
10	Suba Agro Trading and Eng. Co. Ltd (SUBA Agrotech)	P.o. Box 14702 Arusha
11	Alpha Seed Company Ltd	P.o. Box 1743 Moshi
12	PANNAR Seed Ltd. (Representative for Starks Ayres Ltd)	P.o. Box 2390 Arusha
13	Rotian Seed Co. Ltd	P.o. Box 11584 Arusha
14	Multiflower Ltd	P.o. Box 14387 Arusha
15	Pop vriend (T) Ltd	P.o. Box 35 Arusha
16	Pioneer Ltd	C/o Bytrade Tanzania P.o. Box 3491 Dsm
17	TANSEED International Limited	P.o. Box 140 Njombe
18	Fica Seed (2002) Ltd	P.o. Box 11748 Arusha
19	Fill Ltd (Seed producers/Exporters/Marketing	P.o. Box 56Arusha
20	Liborius Gehrken Africa Ltd	P.o. Box 2418 Arusha
21	Mringa Estae	P.o. Box 34 Arusha
22	Tanzania Seed Trader Association TASTA	P.o. Box 15216 Arusha

Source: MAFS, 2003

Appendix 3: Checklist for focus group discussion

1. Importance of maize in the area

- List the crops that are cultivated in your area
- Rank the crops according to importance starting with 1 as the most important
- Indicate the purpose of each crop (see table 1)

2. Maize varieties

Mention the maize cultivars and their varieties that are currently grown in your area
What are the common characteristics used to differentiate varieties?
Give the reason why the varieties are preferred
What are the planting and harvesting times for these varieties?
Is there need for research of new varieties in your area? (Yes/No)
If yes, what are the characteristics would you prefer these varieties to have?

3. Maize Seed

a. Accessibility

- What are the sources of your seeds?
- Why do you prefer these seeds?
- When (season) do you get the seeds?
- How do you get it?
- Who, in the family, have access to these seeds?
- What are the constraints encountered in acquiring seeds?
- What are the possible solutions?

b. Management

i. Selection

- Do you sort/ select seed before sowing storing for later use?
- When do you select your seed? (probe)
    - *Immediately after harvesting (how?)*
    - *Sometimes later after harvesting. (how?)*
    - *While in the field (how?)*
- What are the criteria used in seed selection?
- Are there seed producers in the village?
- What are the differences between farmers' produced seed and improved seeds?

ii. Storage

- Do you store seeds before planting?
- How do you store your seeds?
- Are there any constraints in storing seeds?
- If yes, what are the constraints?

iii. Distribution

- Is there any seed distribution mechanism/ channel used to ensure seed availability in farmers' area? (Yes/ No)
- If yes, what is the mechanism for seed distribution?
- Who is responsible for seed distribution?
- What are the constraints in seed distribution?
- What are the possible solutions?

Amount harvested (Kg).....

- How do you use maize in your area?
  - *Food*
  - *Sale*
  - *Local brew*
  - *Livestock*
- If maize is used for income, at what form?
  - *Green maize for roasting/boiling?*
  - *Sale dry grains?*
  - *Beer*

5. Farmers' Knowledge

- What is the source of knowledge on maize seed management/production in your area?

i.
ii
iii

- If training is one of the sources, who conducted the training? (*Extension agents, NGOs eg Churches, Private traders)*
- Is the knowledge sufficient to enable you manage or produce seeds?
- If no, what can be done to improve your knowledge on maize seed management?
- What are the issues would you like to be trained more for improvement of seed management? Give reason for your choice.
- Do you have access to extension services?
- What are your suggestions for improving extension services?
- Which organization/institution do you prefer to provide that service? (*Government, Private, NGOs*). Give reason for your choice (*more trust, cheap, etc)*

6. Maize marketing

- What are the maize marketing possibilities in your area? (*mention them*)
- Does the price for maize differ with different maize varieties?
- What do you think about the existing marketing system?
- From your opinions what must be done to strengthen the marketing system in Tanzania?

7. Land issues

Issues to be discussed:

- Area cultivated per household
- Land conflicts (if any), how are the conflicts solved?
- Land accessibility and ownership by gender

B. Village government group

The village leaders will be required to give information on the following:

- Details on population growth trends
- Total area used for agriculture
- Land conflicts (if any)
- Government involvement in solving these conflicts (if any)
- Incidence and severity of natural calamities such as drought, excessive rainfall, pests and diseases
- How the government assists villagers if the above calamities occur

- Government involvement in seed provision (if any)
- Regulations imposed on private seed traders (*licensing, etc*)
- How does the village react to those selling fake seeds/ seeds that do not meet the standard?

8. Maize production practices

How is maize grown in your area? (Explain the whole process) eg:

a. Land preparation

- Who is responsible for site selection? (husband, wife or children, others)
- Who is responsible for land preparation?
- What are the implements for land preparation in your area? (hand hoe, tractors, oxen plough etc)

b. Harvesting

- How do you harvest maize?
- At what stage do you harvest maize?
- Who normally own the produce after harvesting?

c. Storage

- Do you store maize before use/sale?
- How do you store maize?
- List the different storage methods used in storing maize
- Rank the method according to importance. Give reason for ranking (see table 2 below
- What are the constraints encountered in storing maize?
- How do you solve the mentioned constraints?

Appendix 4: Questionnaire for farmers interview

1. Background information

Name of interviewer_____

Name of respondent_____

Date of interview_____

Questionnaire No._____

Name of village_____ District_____ Region_____

2. Table 1. Household characteristics

Age of respondent	Gender	Marital status	Education level	Main occupation	Household head	Household size	Number of dependants

Code: Gender; 1 = male 2 = female **Marital status;** 1 = married 2 = single 3 = divorced 4 = widowed

Education level; 1 = no formal education 2 = adult education 3 = primary 4 = secondary 5 = college/university

Main occupation; 1 = cop farming 2= livestock keeping 3 = fishing 4 = business 5 = formal employment 6 = crop farming and livestock

Household head; 1 = male 2 = female

3. How many plots of land do you own? _____

4. Please give the names of plots, crops you cultivated in each plot during 2002/2003, area (in acres) and owner of each plot

Plot name	Crop cultivated in 2002/2003	Area (acres)	Ownership: 1= husband 2 = wife 3 = both
1			
2			

5. Which varieties of maize did you cultivate during 2002/03?

6. Which category of varieties do you prefer most?

(1) Improved (modern) varieties (2) Landraces (local varieties)

7. Which year did you first acquire the varieties you mentioned in question (4) above?

Variety	Year

8. How did you first acquire the seed?

(1) Bought (2)Barter (3)Free (4)Others (Specify)

9. Who in the household first acquired the seed varieties you mentioned?

Seed variety	Acquisition: 1= Husband 2 = Wife 3 = son 4 = Daughter

10. What was the source of each variety mentioned in question 4?

Variety	Source

11. Did you cultivate the same variety during 2003/2004?

Variety	Same variety? 1 = Yes 2 = No

12. If no what new varieties did you cultivate?

(1) (2) (3) (4)

13. What varieties did you stop cultivating?

(1) (2) (3) (4)

14. Why did you stop cultivating the varieties mentioned?

15. Who plants maize seed in your household?

(1) Husband (2) Wife (3) Children (4) Both

16. What implements did you use for land preparation?

(1) Hand-hoe (2) Ox-plough (3) Matchet (4) Tractor

(2) Others (Specify)

17. Is seed of modern cultivars planted differently from landraces?

(1) YES (2)NO

18. If YES Why?

.....

19. Is purchased seed planted differently from recycled one?

(1)YES (2) NO

20. If YES Why?

.....

21. Do you store maize before use as food?

(1) YES (2) NO

22. If yes, do you treat maize stored as food?

(1) YES (2)NO

23. If YES how do you treat maize stored as food?

.....

24. Is purchased seed stored differently from recycled ones?

(1) Yes (2) No

25. If yes Why?

.....

26. If no Why?

.....

27. How do you transport maize from the farm to your household?

(1) Use hired car (2) Use ox-cart (*Mkokoteni*) (3) Carry by head

28. Who is responsible for the transport of maize produce from the farm to home?

1) Husband (2) Wife (3) Children

(4) Both (5) Others (mention

29. Do you normally store maize grain separately from maize seed?

(1) Yes (2) No

30. If yes mention the methods you use in storing maize grain and give reason each method used

Method	**Reason**
(1)Vihenge (cribs)	
(2) Bags	
(3)Above fire place	
(4) Others (specify)	

31. What criteria do you consider in seed selection?

.....

32. How did you select maize seed for the 2002/2003 planting season(s)

.....

33. Have you ever selected seed in the field?

(1) YES (2)NO

34. If YES why?

.....

35. If no why?

.....

36. Who is responsible for seed selection in your household?

(1) Husband (2) Wife (3) Children (4) Both

(5) Others (mention

37. Do you store your maize seed before planting?

(1) YES (Fill in answers for question 35 and 36 in table 10)

(2) NO

38. If NO why not?

.....

39. If Yes what method(s) did you use to store maize seed in the 2002/03 seasons?

Give reasons for each storage method used

Method	**Reasons**
Vihenge (cribs)	
Bags	
Above fire place	
Others (specify)	

40. Do you normally store the improved maize seed varieties separately from local seed varieties?

(1) Yes (2) No

41. If Yes why?

.....

42. If shortage of seed occurs in your household, how do you respond (Copping strategies) to the problem?

43. What are the criteria used to ensure quality of seed exchanged

.....

.....

44. What have been your sources of information about different types of maize seed?

.....

45. What have been your sources of information about how to manage maize seed?

.....

46. What is good quality maize seed?

.....

48. Who outside your community has more knowledge about maize seed?

.....

49. Is your knowledge on high quality maize seed sufficient to enable you carry out seed management practices?

(1) Yes (2) No

50. If No, what can be done to improve your knowledge on maize seed management/production? (What are the opportunities?)

.....

51. Where did you sale maize last season?

(1) Outside the village (2) To traders within the village

(3) Transported to local market in the village

52. Are there specific maize variety characteristics for the market?

(1) Yes (2) No

53. If yes, what are the characteristics for maize varieties marketing?

.....

.....

54. Indicate how maize was utilized as both source of income and food (table 11)

Maize variety type	Amount planted	Amount harvested	Amount sold						Food	Others
			Green	Income (Tshs)	Grain	Income (Tshs)	Brew	Income (Tshs)		

55. Apart from maize mention other sources of income (including non-farm sources) in your household

Other source of income	Total income (Tshs)per year

56. From your opinion what must be done to improve maize marketing opportunities in your village? Mention and rank the opportunities in order of importance.

.....

.....

57. How much seed did you need for planting in all your maize plots during 2003/04?

_____kg

58. Did you get all the amount of seed you needed?

(1)Yes

(2) No

59. If no what are problems encountered in acquiring maize seed (particularly improved seed)

(1)

(2)

(3)

(4)

60. If distance is among the problems, indicate the distance traveled in acquiring high quality seed _____km

61. How do you perceive this distance in relation to acquisition of high quality seed?

(1) Very far (2) Reasonable

62. **Assessing farmers perception**

The aim of this part is to capture farmers' views on maize and maize seed. Indicate whether you strongly agree, agree, disagree, strongly, disagree or undecided with each of the following statements:

Statement	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Maize is not the most important food crop in your family					
Maize is not the most important cash crop in your family					
Maize production in this village has declined because people don't need it any more.					
Promoting maize production in this village will not improve your welfare					
Hybrid seeds are not important in your area					
Local varieties must be abandoned forever					
Improved cultivars are men's crops					
Local cultivars are women's crops					
High price is the only problem that hinders the intensive use of					

improved varieties					
If the prices of improved varieties are reduced, I will abandon completely my local varieties and use improved ones					
In order to promote maize in this village only local varieties must be promoted					
In order to promote maize in the southern highlands only improved varieties must be promoted					
On-Farm seed production is the only way of improving farmers access to high quality seeds					
Farmers' training is the most appropriate way of improving farmers knowledge on Maize seed					

Appendix 5: Pair-wise ranking of crops grown Ibembwa and Mponela villages

Crop	Village ranks by gender			
	Ibembwa		Mponela	
	Males	Females	Males	Females
Food crops				
Maize	1	1	1	1
Beans	2	2	2	2
Groundnuts	4	3	3	4
Soybeans	6	6	-	-
Sunflower	5	5	-	-
Finger millets	3	4	4	3
Sweet potatoes	7	-	5	5
Irish potatoes	6	-	-	5
Banana	8	7	-	-
Cassava	-	-	-	6
Cowpeas	-	-	-	7
Cash crops				
Coffee	1	1	2	2
G/nuts	4	4	4	5
F/millets	5	5	5	4
Maize	2	2	1	1
Beans	3	3	3	3
I/potatoes	6	6	-	-

(-) A crop was not mentioned in the particular village/group.
1, 2, 3… indicate the decrease in importance of the crop in the area.

Appendix 6: Pair-wise ranking of crops grown in Ihimbo and Mangawe villages

Crop	Village ranks by gender			
	Ihimbo		Mangawe	
	Males	Females	Males	Females
Food crops				
Maize	1	1	1	1
Beans	2	2	2	2
Groundnuts	8	7	4	4
Sunflower	6	6	3	-
Wheat	7	5	-	-
Irish potatoes	3	3	-	-
Cowpeas	4	4	5	5
Peas	5	-	7	6
Finger millets	-	-	6	7
Cash crops				
Tomatoes	1	1	-	-
Cowpeas	4	4	3	2
Sunflowers	5	5	2	4
Maize	2	2	1	1
Beans	3	3	3	3
I/potatoes	6	6	-	-
Finger millets	-	-	5	5
Groundnuts	-	-	4	4

(-) A crop was not mentioned in the particular village/group.
1, 2, 3... indicate the decrease in importance of the crop in the area.