TRANSFER AND UTILISATION OF SELECTED AGRICULTURAL PRODUCTION INNOVATIONS IN TANZANIA: A CASE OF KILOSA DISTRICT

BY

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

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ABSTRACT

Farmers can potentially increase their productivity through adoption of agricultural production innovations, practices, and new input packages, if appropriate extension services are put in place. However, many conventional extension approaches in Tanzania have received criticism for being limited to demonstration of technologies, limited use of farmer's knowledge, and using the already packaged information. Thus, this study was conducted to assess the extent of availability, transfer and utilisation of selected cotton and maize agricultural production innovations in Kilosa district, Morogoro region. Specific objectives of the study were to: identify agricultural production innovations available to the extension service; determine the extent to which agricultural production innovations are transferred and utilised; and identify factors contributing to success or failure in transfer and utilisation of agricultural production innovations. Data were collected from 144 respondents including 120 farmers, 4 extension workers and 20 key informants using questionnaires, researcher's diary and checklist. Data were processed and analysed using SPSS computer programme and "content" analysis technique. The findings showed that agricultural production innovations are generally available although in forms that vary in terms of degree to which they can be helpful to the field extension worker and the farmer. The extent of transfer of agricultural production innovations tends to vary from crop to crop, depending on emphasis given by the government in favour of a particular crop. It was concluded that some of the constraints to transfer such innovations are of extension nature while others are clearly beyond the responsibilities of the extension worker. The study recommended that efforts be made to refine agricultural production innovations; provision of necessary incentives

to extension workers (such as transport and regular in-service training); and undertake case studies on interaction between field extension workers and farmers.

DECLARATION

I, LILIAN JESSE MWANGA, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work and that it has neither been submitted nor being concurrently submitted for degree award in any other institution.

15th october 2010

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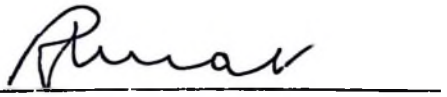
(MARD Candidate)

The above declaration is confirmed



15/10/2010

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(Supervisor)

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

APVCs	Agricultural Production Value Chain
ARD	Agricultural Research and Development
ARI	Agricultural Research Institute
CAN	Calcium Ammonium Nitrate
CIMMYT	Centro Internal de Mejoramento de Maizy Trigo (Central International Maize)
CRC	Cental Research Centre
CSA	Carrot and Stick Approach
DALDO	District Agricultural and Livestock Development Officer
DAS	District Administrative Secretary
DDA	Dual Development Approach
ECGA	Eastern Cotton Growing Area
FA	Frontal Approach
FOs	Farmers' Organisations
FPA	Focal Point Approach
FYM	Farm Yard Manure
GDP	Cross Domestic Product
HYV	High Yield Varieties
IA	Improvement Approach
IK	Indigenous Knowledge
ITK	Indigenous Technical Knowledge
MAC	Ministry of Agriculture and Cooperatives

MAFC	Ministry of Agriculture, Food Security and Cooperatives
MDG	Millennium Development Goal
MFIs	Microfinance Institutions
MOA	Ministry of Agriculture
MSV	Maize Streak Virus
NARSs	National Agricultural Research Systems
NBC	National Bank of Commerce
NGO	Non-Governmental Organisation
NPP	National Pigeon Pea
PFA	Progressive Farmer Approach
RPOs	Rural Producer Organisations
SA	Sulphate of Ammonia
SACCOS	Savings and Credit Cooperative Societies
SMSs	Subject Matter Specialists
SNAL	Sokoine National Agricultural Library
SPSS	Statistical Package for Social Science
ST	Streak Tolerant
SUA	Sokoine University of Agriculture
TA	Transformation Approach
TBC	Tanzania Cotton Board
TDT	Technology Development and Transfer
TMV	Tanzania Maize Variety
TSP	Triple Super Phosphate

ULVA	Ultra Low Volume Applicator
UPE	Universal Primary Education
URT	United Republic of Tanzania
USA	United States of America

CHAPTER ONE

1.0 INTRODUCTION

This is a study of the availability, transfer and utilisation of selected agricultural production innovations. Farmers can potentially increase their productivity through adoption of agricultural innovations, practices, and new input packages, if appropriate extension services are put in place. However, many conventional extension approaches in Tanzania have received criticism for being limited to demonstration of technologies, limited use of farmer's knowledge, and using the already packaged information. Extension workers are perceived as being unable to influence farmer's agricultural practices and thus being ineffective in their job. The purpose of this study was therefore to assess the extent of availability, transfer and utilisation of selected cotton and maize agricultural production innovations in Kilosa district.

1.1 Background Information

Technological change has been the basis for increasing agricultural productivity and promoting agricultural development in many developing countries (Pardey et al., 1997; Polson and Spencer, 1991). The evolution of agricultural research in developing countries has a long and complex history (Morris et al., 2003). The roots were put down in the industrialising countries of Europe, Japan and the USA more than a century ago, and the idea was transplanted in the now-developing world usually as part of colonial administration, initially primarily to foster productivity in the fledgling export crop sector (Chaiken, 1998). Only much later, mostly in the decolonialisation phase of the 1950s and 1960s, did attention of agricultural

researchers become directed to food and subsistence crops. Fears of major hunger problems in Asia especially spurred focused development assistance to institutionalising agricultural research systems in the developing world, manifested in the Green Revolution of India, Mexico, the Philippines, Colombia and many other developing countries, but not all. Successes in this era did, however, spark efforts to replicate such effects in many countries through active support by bilateral donors as well as Multilateral Development Banks (MDBs). There was consequently a rapid expansion of what came to be known as national agricultural research systems (NARSs) (Bennet, 1989). Still, in many countries productivity of research programmes is low and a consensus has now emerged on the need for pluralistic NARSs as a preferred base for agricultural technology generation. Such research systems must be demand-driven with closer linkages to clients, must become more efficient, and must develop sustainable sources of financing (Garforth, 2004).

A feature of successful government agricultural extension organisations in several countries was the free flow of knowledge between researchers in different disciplines, extension agents and farmers (Mattee, 1994; van den Ban, 1999). This made it possible to develop solutions for farmers' problems by integrating knowledge from different sources. Although the extension organisation usually lacked the staff to contact more than half of the farmers on a regular basis, local opinion leaders were often able to influence other farmers by way of example and through discussions with colleagues (Jones, 1981; Karami, 1986). The term "extension education" was first introduced in 1973 by Cambridge University to describe a particular educational innovation of taking the educational advantages of

the universities to ordinary people where they lived and worked. Within a decade the idea had spread to other institutions in Britain and United States. The modern concept of "agricultural extension" originated from the United States when it was formally established through the enactment of the Smith-Lever Act in 1914. This Act provided allocation of land to each State to establish a College of Agriculture (Maunder, 1972; Swanson and Claar, 1984).

Nearly all countries in the world today provide some type of educational service to help rural people improve their agricultural productivity and to raise their levels of living. Extension services in the rest of the more advanced countries also had their beginning in this century and in recent decades had developed into powerful forces for economic and social progress. Most newly developed countries established their systems of extension education after World War II with assistance from the more advanced countries and international agencies (Maunder, 1972). Swanson and Claar (1984) noted that in most developing countries the information on which extension advice is based is not generated within the extension organisation itself but in separate systems (national agricultural research institutes and universities and, increasingly, private research firms). Under separate management structures and incentive structures, research systems give little weight to the extension service's opinions and priorities. Research priorities are, unsurprisingly, not necessarily aligned with those of extension managers or the farmers they come in contact with. Public research and extension organisations often compete for budgets. Researchers typically enjoy a higher status (they are often better educated and have greater

independence), and this produces tension in interactions with extension services that is not conducive to effective extension services (Jones, 1986).

The system of agricultural extension work in Tanzania (Mainland) that has been practiced and developed over the years is basically run by the government. It involves attempts to change or influence local people's farming. From as far back as the colonial period, local people were poor and unsophisticated subsistence farmers, growing crops and raising livestock for their own families' living. Although they were illiterate, they were guided by traditional habits in farming and they were notably independent people, with little or no influence from the global economy (Belshaw, 1979; Keregero, 1981). During colonial time, rural development policy in then Tanganyika focused on export of primary agricultural products namely cotton, sisal and coffee. The policy also sought stability which involved the prevention of famine and unrest, and the maintenance of soil fertility and production levels. Consequently many by-laws concerning soil conservation, stocking rates and planting of famine crops were enacted (Cliffe, 1972). Attempts to resettle people in sparsely populated areas and encourage cash crop production through various settlement schemes were also made.

It is during this period when agricultural extension service originated. It focused largely on small scale farmers. The agricultural extension service utilised agricultural officers and native instructors in the Department of Agriculture whose primary function was enforcement of various agricultural rules and regulations. In order to ensure high return to effort, the "Focal Point Approach (FPA)" which

concentrated efforts in high potential areas in the Northern and Western parts of the country was adopted. Generally, farmers reacted negatively to the force applied by colonial administration (Cliffe, 1972). The result was modification of the FPA, into what was referred to as "Progressive Farmer Approach (PFA)". This approach focused extension resources on "early adopters", usually the rich, more modern farmers with larger than average farms and greater ability to follow extension advice. Kauzeni (1979) noted that the FPA approach contributed towards widening the gap between the haves and the have-nots, a situation which would later not be tolerated in a country that was striving for socialism (*Ujamaa*) and self-reliance.

When Tanganyika gained independence in 1961, it abandoned enforcement of by-laws. People were to be encouraged to move into villages to facilitate self-reliance and development through application of socialist (*Ujamaa*) principles (Nyerere, 1968). As a result of this, some spontaneous settlements were started allover Tanzania. The pre-independence experience with agricultural extension and settlement led in part to the adoption of a "Dual Development Approach (DDA)" in Tanzania, the "Transformation Approach (TA)" and "Improvement Approach (IA)". The TA aimed at modernising agriculture through planned village settlement schemes with expensive capital investment, trained management personnel and modern technology. The IA sought to gradually improve traditional agriculture through extension and credit programmes among small-scale farmers and by encouraging cooperative production in villages was adopted.

According to DeVries (1978), by mid-sixties the failure of the dual approach was apparent. Most settlement schemes were overcapitalised and poorly planned. They led to the creation of spoon-fed, dependent and privileged class of farmers who became source of envy and irritation to the rest of the rural population. The hoped-for demonstration effect also failed to materialise as very few farmers had resources to support the application of what they learned. The improvement approach seems to have been more successful although it also encountered major problems. Since early adopters controlled considerably more resources than average farmers, the latter could not follow this example. The improvement approach contributed to increased rural class differentiation which was a contradiction of the country's policy which espoused socialism and equity. In 1967 Tanzania revisited its development policy, resulting in restatement of development goals and strategies in the Arusha Declaration. As a result of the Arusha Declaration, Tanzania's Five Year Development Plan (1969-1974) adopted the "Frontal Approach (FA)" to socialist (*Ujamaa*) development. According to this approach a whole range of government and political institutions were to be mobilised behind socialist principles (DeVries, 1978). Efforts to educate and politicise the peasants largely gave way to the use of government controlled rewards and pressures, a combination which was also sometimes known as "Carrot and Stick Approach (CSA)" to village development.

Adoption of the Arusha declaration in 1967 set the scene for a more interventionist state committed to stepping up the pace of development in the country. The economic development policies of the socialist regime aimed at modernising the agricultural sector through facilitation of diffusion of new technologies into the

sector. The new technologies included use of hybrid seeds, chemical inputs, and tractors. To facilitate this exercise, agriculture production was organised along socialist principles of collective farming. Therefore, farmers were moved into "socialist villages (*Ujamaa Villages*)" where they could easily be provided with agricultural extension services, farm implements such as tractors, and subsidised inputs on credit basis. In the interventionist regime the aim was to modernise the agricultural sector through facilitation of diffusion of new technologies into the sector by providing free agricultural extension services, subsidised farm implements and subsidised inputs on credit basis (Nyerere, 1967).

Mounting economic difficulties led to a policy shift towards a free market economy in mid 1980s, where all types of public support to the agricultural sector were eliminated resulting into unsatisfactory performance of the agricultural sector and mounting poverty (URT, 2003). According to URT (2004), the current research and extension system in Tanzania is mainly public funded, although decentralising and rightsizing the research establishment have relieved the government's budget strain through complete privatisation of major cash crops. Decentralisation has put extension services under local government authorities to enhance greater client participation in Technology Development and Transfer (TDT) and making these processes participatory as opposed to the previous centralised, top-down set-up. It has, in addition, brought research and extension closer, to better serve the farmers (URT, 2005).

Morogoro region (where data for this study were collected) is one of the 26 administrative regions in Tanzania (Fig. 1). The region has an area of

70 799 km^2. Administratively it is divided into 6 districts of Mvomero, Morogoro Rural, Ulanga, Kilombero, Kilosa, and Morogoro Urban. It comprises 457 villages which are grouped into 140 wards with population of 1 753 362 at growth rate of 2.6 % (URT, 2008). Due to its fertile soils, favourable rainfall and wide range of altitudes, a considerable number of crops are grown in the region. Sisal is the major cash and export crop grown in large scale plantations, while coffee and cotton are grown on a limited scale by smallholder farmers. Major food crops produced are maize, paddy, sorghum, sugarcane (mainly grown on large scale plantations), cassava, oil seeds and pulses. The region is also one of the major suppliers of fruits and vegetables to the Morogoro and Dar-es-Salaam urban centres. However it is not one of the major livestock producing regions in the country. Only limited number of farmers keep cattle, sheep and goats. Kilosa district farmers are among the farmers who grow cotton and maize crops in the region and need utilisation of appropriate agricultural production innovations. The district (Fig. 1) covers about 1 424 500 ha comprising a population of 48 513 people at an annual growth rate of 2.4 % (URT, 2008). The extent of availability, transfer and utilisation of cotton and maize agricultural production innovations and their policy implications remain to be clarified by this study. With this in mind, the problem outline for the study is set in perspective.

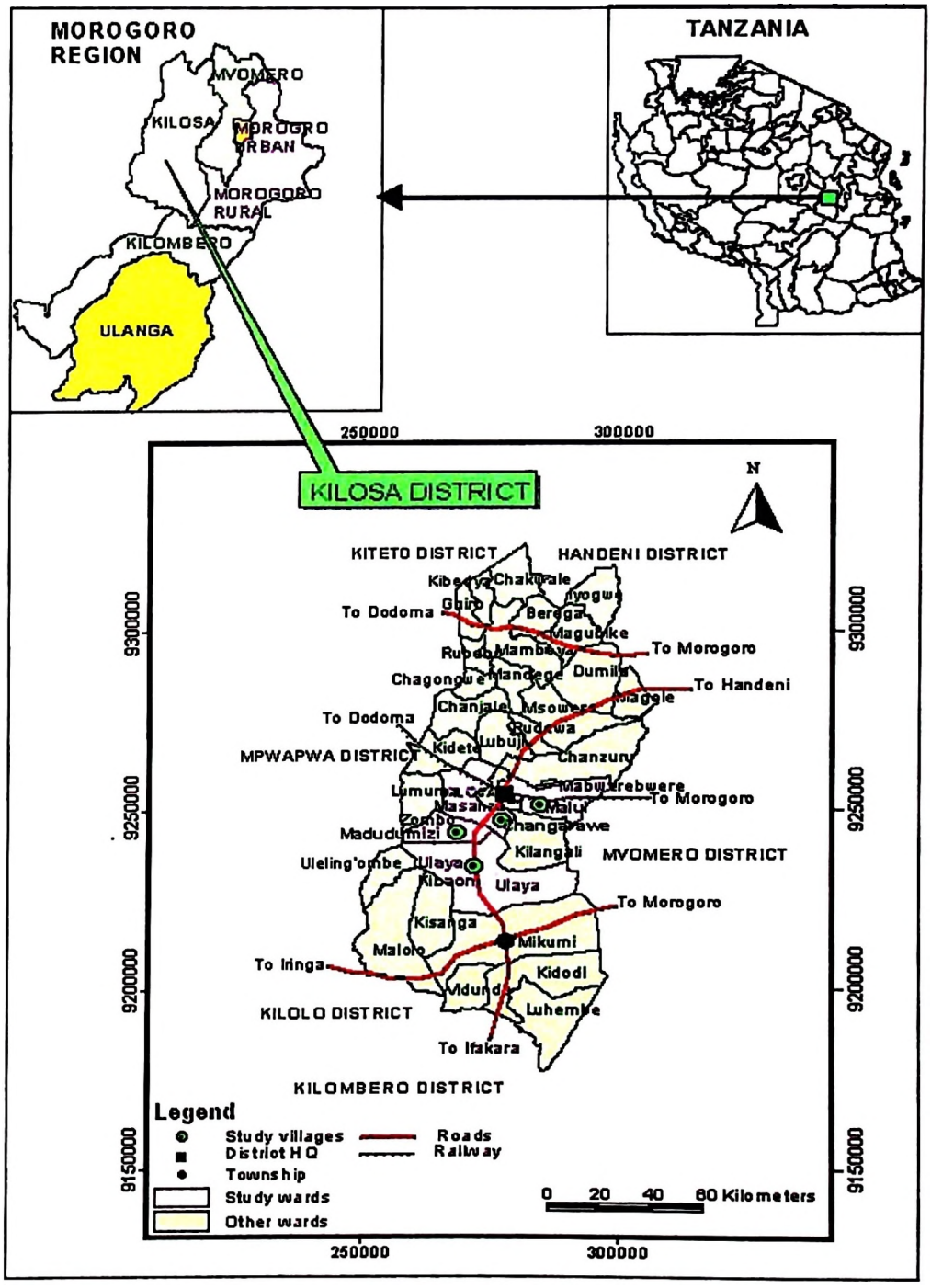

Figure 1: Map of Morogoro region showing Kilosa district and the study villages

1.2 Problem Statement and Justification

The Tanzania Development Vision has set a target of achieving a level of general standards of living typical of medium-income countries by the year 2025 (URT, 2005). Agricultural research has a major role to play in increasing productivity and profitability of the sector through development of scientific knowledge to generate improved technologies for the production systems. Agricultural extension complements this effort by transferring technologies developed by the national agricultural research stations (NARS) to the farmers (Pickering, 1987). Farmers can potentially increase their productivity through adoption of agricultural innovations, practices, and new input packages, if appropriate extension services are put in place (van den Ban, 1998; Manda, 2002).

However, many conventional extension approaches in Tanzania have received criticism for being limited to demonstration of technologies, limited use of farmer's knowledge, and using the already packaged information (Mattee, 1994). This criticism has focused partly on the performance of extension workers in rural areas, who form the backbone and offer a good basis on which to establish a more effective system for dissemination of extension innovations from research institutions. Extension workers are perceived as being unable to influence farmer's agricultural practices and thus being ineffective in their job (Machumu, 1995). This study therefore intended to concentrate on the innovation dimension. It sought to determine the availability of suitable selected agricultural production innovations to the farmer and assess the extent of transfer and utilisation of such innovations in order to ascertain the extent to which they could be integrated within the farming

systems of smallholder farmers and made the engine of economic growth and poverty alleviation in Tanzania.

1.3 Objectives

1.3.1 General objective

To assess the availability, transfer and utilisation of selected cotton and maize agricultural production innovations in Kilosa district.

1.3.2 Specific objectives

1. To identify agricultural production innovations available to the extension service.
2. To determine the extent to which agricultural production innovations are transferred and utilised.
3. To identify factors contributing to success or failure in transfer and utilisation of agricultural production innovations.

1.4 Research Questions

1. What cotton and maize agricultural production innovations are actually available to the extension service in Kilosa district?
2. Do farmers receive any advice on selected agricultural production innovations from field extension agents or other sources? If so in what way(s) does that advice reach them?
3. What is the state of farmers with regard to knowledge, trial and adoption of selected agricultural production innovations?

4. What are the characteristics of innovations and how do these characteristics affect the transfer and adoption or rejection of selected agricultural production innovations?

1.5 Operational Definition of Terms

The terms that will be used frequently in the text are defined here to provide a common basis for conveying meaning. These include: rural/agricultural development: poverty alleviation: agricultural innovations: agricultural extension: extension worker and key variables used in the study.

1.5.1 Rural/agricultural development

Rural development is a process integrated in economic and social objectives. which must seek to transform rural society and provide better and more secure livelihood for rural people. According to Jones (1986). usually this implies the development of agriculture as a means to an end. In this study the terms "rural development" and "agricultural development" will be used interchangeably to mean the perception of rural people of the possible often new ways and means of developing their economies.

1.5.2 Poverty alleviation

Poverty alleviation or poverty reduction is any process which seeks to reduce the level of poverty in a community, or amongst a group of people or countries. Its programmes may be aimed at economic or non-economic poverty through education, economic development, and income redistribution. Its efforts may also be aimed at

removing social and legal barriers to income growth among the poor (Bagachwa, 1994). According to URT (2005), poverty alleviation is a Millennium Development Goal (MDG) aiming at reducing poverty and hunger by 50% by 2015 in Tanzania. It is therefore one of the coping strategies against food insufficiency. In this study "poverty alleviation" means improved livelihoods of farmers resulting from increased income and food security through adoption of cotton and maize production practices.

1.5.3 Agricultural innovations

An innovation has been defined as "the successful exploitation of a new idea". This implies that it is not just the invention of a new idea, but that this idea is actually "brought to market", used, put into practice, exploited in some way, and may be leading to new products, processes, systems, attitudes or services that improve something or add value. There are different kinds of innovations (Rogers, 1983; Lado, 1989). The main ones are: (a) incremental innovation (where something is adapted or modified)-which may mean that an old idea is transferred to a new setting or that existing ideas are embedding in a new setting; (b) radical innovation (which involves completely new ideas). In this study the term "agricultural innovations" means selected cotton and maize agricultural innovations.

1.5.4 Agricultural extension

Extension has been defined as an ongoing process of getting useful information to the people and then assisting those people to acquire the necessary knowledge, skills and attitudes to utilise this knowledge fully (Karami, 1986; Boz, 2002). In this study

the term "agricultural extension" will often be shortened as "extension" for the sake of brevity. Both terms will be used to denote a service or system which assist farm people through educational means, in improving farming methods and techniques, increasing production efficiency and income, bettering their levels of living, and lifting the social and educational standards of rural life.

1.5.5 Extension worker

An individual who is fully employed and engaged in extension work in rural communities (Swanson and Claar, 1984). The term as used here, applies to the staff employed by Kilosa district council responsible for extension work in villages where the study was done.

1.5.6 Key variables used

The definitions of key variables (background, independent and dependent variables) as used in the study are given in Appendix 1. Literature review is presented in the next Chapter.

CHAPTER TWO

2.0 LITERATURE REVIEW

This Chapter reviewed literature from other study findings in order to provide a theoretical framework which guided the development of the conceptual framework on which the data analysis of the present study is based. It focuses on: rural and agricultural development; agricultural innovations; availability of innovations; transfer of innovations; adoption/rejection of innovations; and conceptual framework for analysis of the study data.

2.1 Rural and Agricultural Development

Development and economic growth in the developing countries were, in the past, often regarded as synonymous. However, it is widely accepted that the concept of 'development' is broader than economic growth' (Seers, 1982; Todaro, 1989). The latter basically refers to an increase in output or income, and is usually measured by the Gross Domestic Product (GDP). Development incorporates economic growth, but adds the conditions that the majority of the population benefits from this increase (growth with equity), and that basic needs such as food, shelter and water are met (Todaro, 1989). Thus, development cannot be equated with or measured by mere economic growth, as the benefits of economic growth do not automatically trickle down to all population groups. From an environmental perspective to development, the quality and direction of growth should avoid a general deterioration of the natural resource base. Even if rapid economic growth in developing countries should occur, a change in its direction is significant so as to avoid the accelerated depletion of the natural resources (Arntzen, 1990; Nel et al., 1997).

Rural development is a process integrated in economic and social objectives, which must seek to transform rural society and provide better and more secure livelihood for rural people. Rural development, therefore, is a process of analysis, problem identification and the proposal of relevant solutions. This process is usually encompassed within a programme or project which seeks to tackle the problems identified (Oakley, 1991). Jones (1986) adds that rural development involves the perception of rural people of the possible often new ways and means of developing their economies. He notes that usually this implies the development of agriculture as a means to an end; rural development also embraces the active concern for improvement in welfare and well being of all rural inhabitants. Axinn and Thorat (1972) note that agriculture and rural development, in the broader sense, requires a number of conditions which have been called the mix, following the market tradition. Axinn and Thorat (1972) further add that "the essence of mix is more than the sum". They name the elements of the mix: good farm prices; accessible markets and credit; technology development; processing facilities; and extension services.

The ineffectiveness and slow progress of development strategies in the Third World countries over the last few decades have resulted into a considerable dissatisfaction among development planners. The World Bank in the late 1960's and early 1970's recognised the need for a shift of emphasis and resources towards the rural sector of the developing countries, where about 80% of the population depends directly on agricultural production for its livelihood (World Bank, 1990). The approach concentrated on development as a fundamentally institutional, administrative issue,

implying that development was imposed from above by the experts and often grandiose, but frequently isolated development schemes/projects, rather than from below by consulting and incorporating rural people in the whole process. This approach has been criticised on the grounds that it adopts a centralist view of development process, often only implicit, and that it makes the assumption that local people's activities respond only to externally-induced change.

The view that local knowledge is of little value to development experts, because it is 'primitive', partial or biased is increasingly coming under attack. For example, the relevance and significance of indigenous technical knowledge (ITK) of agriculture has been amply demonstrated by studies in Nigeria (Olukosi, 1976), East Africa (Belshaw, 1979) and Sudan (Lado, 1986). Intercropping for instance, is a trusted and proven agricultural technique that had been actively discouraged by extension workers as inefficient and wasteful. However, a closer examination of the practice reveals that, under certain environmental conditions, it could be the most ecologically and economically efficient method which reduces risk as crop diversification mitigates the failure of one of the crops: it reduces labour demands as weed growth is inhibited, and it helps to conserve soil fertility (Norman, 1974).

In reappraising rural development in Africa in recent years, it seems that the approaches have undergone two fundamental considerations. Firstly, there has been the recognition that a significant proportion of centrally-driven government or agency funded development was inappropriate through its adoption of a 'top-down' approach. Such dictatorial approaches appear to have failed to improve rural

standards of living, and have often alienated the people which they were designed to benefit. In parallel with recent international thinking, the notions of 'bottom-up' people empowerment, and a more democratic approach to development are gaining acceptance amongst governments and Aid Agencies in Africa (Bingen et al., 2003; Mortimore and Triffen, 1995). Secondly, this reassessment of the potential and inherent capacity within communities to help themselves is inextricably linked with a recognition of the suitability and appropriateness of 'indigenous' skills and expertise in development in rural Africa (Nel et al., 1997). In fact, many traditional African food production systems are surprisingly resilient as it is based upon a wide range of indigenous 'coping mechanisms', the essence of which is the detailed appreciation and utilisation of the full spatial and ecological diversity of the resource base to produce varied sources of food at different points in time (Geheb, 1995).

2.2 Agricultural Innovations

An innovation is an idea, practice or object perceived as new by an individual or other unit of adoption. Technology is a design for instrumental action that reduces the uncertainty in the cause effect relationship involved in achieving a desired outcome (Rogers, 1995). The components of technology are: Hardware (physical) and Software (knowledge base). A good innovation should have following five attributes: (i) relative advantage; (ii) compatibility; (iii) complexity; (iv) triability; and (v) observability. Re-invention is the degree to which an innovation is changed or modified by a user in the process of its adoption and implementation. Agricultural development requires and depends on innovation, which can be defined as the successful application of knowledge with social and economic significance.

Innovation as a process and outcome is crucial for development (Roling et al., 1976: Gupter, 2000: Kroma, 2003).

Mortimore and Tiffen (1995) recent research in Kenya confirms the capacity of traditional rural farming strategies to adapt their environment to cope with increasing population. In similar vein Scoones (1995) has confirmed the prevalence of innovation and adaptability among African pastoral groups. New agricultural technologies are considered to have been determinant for some major successes in Sub-Saharan African agriculture. Agricultural research and development (AR&D) therefore features prominently in agricultural development policies. Over the last two decades the context for agricultural development and innovation has changed which also affected AR&D institutions and rural producer organisations (RPOs) (Feder et al., 1985).

Liberalisation of the agricultural sector has opened up national and international markets for farmers and other rural entrepreneurs. Policies for agricultural development increasingly put chain development forward as the key to sustainable economic development. Liberalisation also means the withdrawal of the state from providing goods and services and privatisation of rural services. In AR&D systems the private sector focuses on cash crops and addresses farm households that have market links while subsistence crops and more general issues increasingly depend on the public sector (Steenhuijsen et al., 2005). However, few AR&D services are purely public or private and various modalities for public-private cooperation have been developed (Hagman and Chuma, 1999).

Rivera and Alex (2004) note that other reforms in AR&D include: greater autonomy for AR&D organisations, decentralisation of resources and decision-making power to entities, with an agro-ecological or product-specific mandate. Private (for-profit and non-profit) service providers increasingly integrate extension systems that become more pluralistic. These AR&D reforms aim to strengthen farmer participation and enhance user-responsiveness and performance through managing service provision according to private enterprise principles. A variety of funding mechanism has been put in place to give users leverage over service provision. Innovation and AR&D management is nowadays a multi-stakeholder process, where stakeholders' interests, including those of RPOs may diverge.

2.3 Availability of Innovations

2.3.1 Indigenous/traditional innovations

Most recent African indigenous knowledge (IK) literature, especially in agriculture, emphasises that Africans are innovators. This literature is filled with success stories. Excellent examples of local innovations and discoveries include (Chaicken, 1998): crop breeding; grafting against pests; water harvesting; soil management; conservation; and processing. Indigenous agricultural innovations have continued to be important as most of the locally-grown food is for local consumption. The indigenous knowledge in the agricultural sector can be characterised as: (i) rooted in particular places, experiences and unique climatic conditions, (ii) orally transmitted or transmitted through imitation and demonstration, (iii) widely relevant for poor women, (iv) constantly reinforced by experiences and trial and error and adapting,

(v) pragmatic, (vi) shared occasionally, (vii) usually asymmetrically distributed and preserved within a group, (ix) may involve specialists by virtue of experience or authority, and (x) situated within a culture/society including technical information.

At a general level, new approaches may still be needed to address some of Africa's problems. There is some unique knowledge among the local producers that can contribute to help make hunger and malnutrition history, and reduce grass-root poverty, especially among poor women without changing cultural food patterns in Africa. But, too often African indigenous innovators are overlooked in the search process for new solutions (Gupter, 2000).

Two main reasons can be attributed for this: (i) the innovations and discoveries they produce are mostly incremental meaning that they do not carry high income gains: and (ii) culturally, there is little knowledge sharing due to lack of records and the application of innovations in isolation. Indigenous innovators face uncertainty because of a lack of organising frameworks. They lack information as to who needs innovations, how to find the users, when to approach them, why they should be approaching them, and most importantly, whether the receivers will appreciate the effort. The consequence of the lack of an organising framework is that innovators mostly become indifferent to diffusing their knowledge, and not utilising potential scale effects, efficiency and productivity gains from their innovations.

Gupter (2000) further notes that the system can now be said to be caught in an 'indifference-trap' which occurs in a system when innovators no longer share potentially efficiency and productivity-enhancing innovations and discoveries. People thus hold back on productive innovations and discoveries that they would

have otherwise passed to others. However, Gupter argues that, in spite of an indifference trap, African agricultural producers continually need new environmentally-specific innovations and hence, processes and products to deal with changing supply conditions and to use core competencies in a profitable way. To continually increase efficiency and productivity, producers need the support and advice of others. Lack of a cohesive learning and sharing network for innovations detracts from the ability of isolated individuals to take advantage of generally available skills. Therefore, an important obstacle to sharing indigenous knowledge in Africa, particularly in the low-income sector of agriculture, is the absence of a sharing mechanism. Organisational conditions must, therefore, be changed to gradually enable people to share and connect to those who may add to their knowledge.

Allen (2001) noted that in endogenous technological advances, imitations and innovations determine the long-run economic growth-path of a country. Growth of technological knowledge produces useful outputs, and technological advances define the values of resources and the rates of utilisation, hence impacting sustainability in a sector such as African agriculture. To complement the innovative achievements of African local agriculturists, a mechanism is needed to promote, with participatory public support, a sharing and additive system of innovation among the lowest-income producers of Africa. Incubating local agricultural innovations can help to unlock the secrets of the economic and cultural transformation of these societies. The innovations technological and secular approach to innovation systems is based

on putting these innovations into the public domain to achieve a scale effect, and increasing the productivity of the poorest.

2.3.2 Generation of modern/scientific innovations

There are several stages in the generation of innovations (Backer, 1994; Kangashiemi, 2002). The first stage is discovery, characterised by the emergence of a concept or results that establish the innovation. A second essential stage is development, where the discovery moves from the laboratory to the field, and is scaled up, commercialised, and integrated with other elements of the production process. In cases of patentable innovations, between the time of discovery and development there may also be a stage where there is registration for a patent. If the innovation is embodied, once it is developed it has to be produced and, finally, marketed. For embodied innovations, the marketing stage consists of education, demonstration, and sales. Only then does adoption occur.

Some may hold the notion that new discoveries are the result of inspiration occurring randomly without a strong link to physical reality. While that may sometimes be the case, Haug (1999) formalised and empirically verified their theory of induced innovations that closely linked the emergence of innovations with economic conditions. They argued that the search for new innovations is an economic activity that is significantly affected by economic conditions. New innovations are more likely to emerge in response to scarcity and economic opportunities. For example, labour shortages will induce labour-saving technologies. Environmental-friendly techniques are likely to be linked to the imposition of strict environmental regulation.

Drip irrigation and other water-saving technologies are often developed in locations where water constraints are binding, such as Israel and the California desert. Similarly, food shortages or high prices of agricultural commodities will likely lead to the introduction of a new high-yield variety, and perceived changes in consumer preferences may provide the background for new innovations that modify product quality.

The work of Binswanger and McIntire (1987), on the evolution of agricultural systems supports the induced-innovation hypothesis, reveal that early human groups consisting of a relatively small number of members who could roam large areas of land, were hunters and gatherers. An increase in population led to the evolution of agricultural systems. In tropical regions where population density was still relatively small, farmers relied on slash and burn systems. The transition to more intensive farming systems that used crop rotation and fertilisation occurred as population density increased even further. The need to overcome diseases and to improve yields led to the development of innovations in pest control and breeding, and the evolution of the agricultural systems we are familiar with. New innovations currently are linked with discoveries of scientists in universities or research institutions. However, in the past, practitioners were responsible for most breakthroughs. Over the years, the role of research labs in producing new innovations has drastically increased, but field experience is still very important in inspiring innovations.

The modern innovation focus and process differ according to institutional settings and the way rural producer organisations (RPOs) have been established (Bingen et

al., 2003). In commodity sectors (e.g. coffee, cocoa or cotton) and in established outgrowers' schemes (e.g. fruits, flowers), innovation often has a technological focus and tends to be driven by the private sector and specialised agricultural research and development (AR&D) organisations (Kangashiemi, 2002). Parastatals and private sector traditionally invest in capacity building of these RPOs for adequate handling of input supply, processing and marketing of products and relations with RPOs are purely contractual. Less attention goes to facilitating knowledge and information flows and interaction between stakeholders. In developing chains or those that are being upgraded for accessing new markets, innovation is much more institutional and organisational (managerial). More weight is also given to basic conditions such as 'hard' and 'soft' infrastructure. Relations between chain actors often are to be developed and producers' knowledge of market demands and operational knowledge and information flows between chain actors are considered to be essential for overall chain performance. This makes innovation a co-managed process during which modalities for collaboration between chain actors change according to the challenges that are being faced.

According to Friis-Hansen et al. (2004), in the case of general issue-oriented and multi-tiered RPOs and organisations that focus on farmer-led technology development, which emphasises organising grassroots groups and networking between groups and with rural service providers, innovation is often embedded in participatory approaches for resolving problems. Agricultural innovation is driven by farmers' needs and concerns general issues that are common to most farm households. Clearly defined strategies for capacity building and valuing investments

that have been made for innovating are critical for ensuring positive impact on rural livelihoods.

Garforth (2004) notes that innovation and technology dissemination in the agricultural sector used to be organised as a linear and stepwise process: knowledge was acquired and/or generated via research, which was then disseminated by extension services in the form of information adapted to the needs of the end-users and, finally, users were expected to apply this new knowledge. The same pattern is being observed in the organisation of research and extension around agricultural production-value chain (APVCs), along the lines of operations such as production, processing, packaging and storing. Both approaches, whether 'pushed' by the supply of knowledge or 'pulled' by the demand for information, put researchers at the centre of the innovation process and have a top-down focus on innovation and knowledge to be applied at production and farmer levels.

Garforth further observes that the recent reforms undertaken in agricultural research and extension all seek greater stakeholder involvement to strengthen client and user orientation and demand-driven management in order to enhance the impact of the services provided. In some cases, farmers/processors may even supply these services themselves. Besides the formal, national research and extension organisations of the public sector, private enterprises and farmers organisations (FOs) are now often increasingly involved in research and extension (e.g. farmers collaborating in planning and implementation of trials and demonstrations, representing farmers on boards, advisory councils, technical committees, etc.). Changes in stakeholder

involvement in research and extension also illustrate the changing attitudes towards managing knowledge and information for agricultural development.

2.4 Transfer of Innovations

In many government extension organisations the choice of the extension messages is based either on the goals of the government policy or on research findings which are considered to be important for farmers. Although extension is only one of the many factors contributing to greater agricultural efficiency and development, there is no doubt that effective extension workers can and do speed up the development. Kauzeni (1979) noted that agricultural production both per unit of land and per unit of labour in villages in Tanzania was low relative to what could likely be obtained based on modern inputs and husbandry standards. Agricultural production was affected by many factors which were economic, social, political, physical, environmental, administrative and technical in nature. These factors operated in various combinations with varying degrees of effectiveness, depending upon the area under investigation. He recommended that in order to improve effectiveness of agricultural extension approach and extension service as a whole, there was a strong and urgent need to re-examine all aspects of extension service, including: its general role, the linkage with research services and most important extension methods and training programmes. This exercise would aim at making agricultural extension service a tool for village agricultural development.

Keregero (1981), in a study seeking to identify critical requirements for job of extension worker in Tanzania, found out that most of the extension activities in

villages were initiated by extension workers in response to instructions handled down by supervisors. He noted that extension activities most frequently seek educational outcomes and deal more with technological than social matters. The study found contact with clientele to be critical to the job of extension workers and that the primary means of communication by extension workers was face-to-face interaction. The study further revealed that the critical areas of job of extension workers included: (i) diagnosing problems and needs, (ii) interpreting extension and job policy, (iii) recognising unique situations and responding in ways typically beyond the normal repertoire of things covered during training, (iv) developing group and collective activities, (v) conducting international premeditated efforts to facilitate changes, (vi) dealing with identifiable problems and needs of clientele, and (vii) dispensing technological information and advice.

In a study for participation in agricultural extension and village development activities in Mbeya region, Tanzania, Ponjee (1979) found out that the extension system tends to favour certain categories of farmers as well as villagers. Thus, richer, younger and better educated farmers within the surveyed villages had higher levels of extension contact than poorer, older and less educated farmers. More developed villages had higher levels of extension contact than less developed villages. This study showed that group methods were in fact not widely used. Even though extension workers stressed the use of group methods, they in practice winded up with more contact with a particular category of individuals. Even with group approaches like meetings or demonstrations, not everyone would attend. So there

might still be differential extension contact which was not the fault of extension workers.

The agricultural extension system in developing countries has always been challenged with the task of transmitting agricultural innovations from the researcher to the farmers. The major role of extension system is therefore to facilitate such a link. This is viewed as a three-step- process passing scientific information in agriculture from the research scientist to the extension worker then to the participating farmer (Feder et al., 1985). For effective performance of extension worker it is imperative that he be conversant with the communities at both ends. which are the research and farming communities, he himself be a liaison between research and farmer. A successful extension worker therefore needs to acquire the knowledge of better communication methods. A close working relationship with the research system is not sufficient condition for increased agricultural productivity. The farming community must also be included in the technology development and utilisation equation. Farmer education on the use of innovations is an essential ingredient in agricultural development. Farmers cannot successfully adopt a new technology unless they are aware of it and learn how to incorporate it into their farming systems (Swanson and Claar, 1984).

Many extension scientists are now convinced that it is no longer desirable to use a transfer of technology approach in which the extension administrators decide on the targets to be realised by the field-level extension agents. A more participatory approach is instead preferred, in which farmers decide which changes are desirable

and what kinds of support are needed from extension to realise these changes (Roling and de Jong, 1999). How are the possibilities for realising the changes needed related to the ways of financing the extension organisation? A participatory approach requires that the extension organisation becomes a learning organisation with the ability to discover which changes are desirable in each specific situation (Haug, 1999).

2.5 Adoption/Rejection of Innovations

There is often a significant interval between the time an innovation is developed and available in the market, and the time it is widely used by producers. Adoption and diffusion are the processes governing the utilisation of innovations. Studies (Roling et al., 1976; Feder et al., 1985) of adoption behavior emphasise factors that affect if and when a particular individual will begin using an innovation. Measures of adoption may indicate both the timing and extent of new technology utilisation by individuals. Adoption behaviour may be depicted by more than one variable. It may be depicted by a discrete choice, whether or not to utilise an innovation, or by a continuous variable that indicates to what extent a divisible innovation is used. For example, one measure of the adoption of a high-yield seed variety by a farmer is a discrete variable denoting if this variety is being used by a farmer at a certain time; another measure is what percent of the farmer's land is planted with this variety.

Diffusion can be interpreted as aggregate adoption. Diffusion studies depict an innovation that penetrates its potential market. Stoneman and Ireland (1983) note that, as with adoption, there may be several indicators of diffusion of a specific

technology. For example, one measure of diffusion may be the percentage of the farming population that adopts new innovations. Another is the land share in total land on which innovations can be utilised. These two indicators of diffusion may well convey a different picture. In developing countries, 25 % of farmers may own or use a tractor on their land. Yet, on large farms, tractors will be used on about 90 % of the land. While it is helpful to use the term "adoption" in depicting individual behaviour towards a new innovation and "diffusion" in depicting aggregate behaviour, in cases of divisible technology, some economists tend to distinguish between intra-firm and inter-firm diffusion. For example, this distinction is especially useful in multi-plant or multi-field operations. Intra-firm studies may investigate the percentage of a farmer's land where drip irrigation is used, while inter-firm studies of diffusion will look at the percentage of land devoted to cotton that is irrigated with drip systems.

According to Polson and Spencer (1991), the adoption of a new technology may expand the amount of risk associated with farming. Operators are uncertain about the properties and performance of a technology, and these uncertainties interact with the random factors affecting agriculture. The number of risks associated with new technologies gives rise to several modelling approaches, each emphasising aspects of the problem that are important for different types of innovations. In particular, some models will be appropriate for divisible technologies and others for lumpy ones, and some will explicitly emphasise dynamic aspects while others will be static in nature. Much of the agricultural adoption literature was developed to explain adoption patterns of high-yield seed varieties (HYV), many of which were introduced as part

of the "green revolution." Empirical studies (Gupter. 2000) established that these technologies were not fully adopted by farmers in the sense that farmers allocated only part of their land to HYV while continuing to allocate land to traditional technologies. Gupter (2000) argued that risk considerations were crucial in explaining these diversifications. while having higher expected yield also tended to increase risk.

According to van den Ban (1998). an adoption process is the mental process through which an individual passes from first knowledge of an innovation to a decision to adopt or reject and to later confirmation of this decision. Rogers (1995) has given the following five stages of adoption process:

(i) Awareness: at this stage an individual first hears about the innovation. which means that individual is exposed to an idea but lacking detailed information about it - this is somewhat like seeing something without attaching meaning to it:

(ii) Interest: at this stage an individual is motivated to find out more information about the new idea - an individual wants to know what it is. how it works and what its potential may be:

(iii) Evaluation: at this stage mental trial of new idea takes place - an individual considers the relative advantage of the new idea over other practices/alternatives;

(iv) Trial: at this stage an individual tests the innovation on a small scale for himself - an individual seeks information about technique and method of applying the new idea; and

(v) Adoption: if satisfied with trial an individual will decide to use the innovation on large scale in preference to old methods.

Duration and length of time between any two stages varies with each practice and individual. The rate at which different individuals go through the different stages varies with the personal characteristics of the individual and the nature of the group influences on him. Rogers (1995) observed that the level of adoption of innovations depends on the following factors: (i) source of information, (ii) intrinsic characteristics of the information itself and its appeal to clients (complexity, probability, riskness, and compatibility with other activities), (iii) characteristics of units concerned (resources, size, type of activities, and degree of specialisation), and (iv) preparation of innovation client.

Among the members of a social system some innovations diffuse from first introduction to wide spread use in a few years where as others take more number of years. This is due to characteristics of innovation, that affect the rate at which they diffuse and are adopted. There are five perceived attributes of innovations in universal terms (Rogers, 1995):

(i) Relative Advantage: It is the degree to which an innovation is perceived as being better than the idea it supersedes. It is positively related to its rate of adoption. For example: a weedicide for wheat crop was earlier used as post-emergence weedicide after that pre-emergence weedicide was invented. The use of pre-emergence weedicide was preferred as it did not allow the weeds to grow as compared to the post-emergent weedicide,

which is used after the emergence of weeds which has already incurred some loss to the crop.

(ii) Compatibility: It is the degree to which an innovation is perceived as consistent with the existing values. past experiences. and the need of potential adopter. The compatibility of an innovation as perceived by members of a social system is positively related to its rate of adoption. Beef production lack compatibility with cultural values in India. Eating food with left hand lack compatibility with social norm as left hand is considered to be unclean. Piggery is a profitable enterprise but it is not adopted by Brahmins and Muslims as it is not compatible with their culture.

(iii) Complexity: It is the degree to which an innovation is perceived as relatively difficult to understand and use. The complexity of an innovation as perceived by members of a social system is negatively related to its rate of adoption. For example. change in variety of a particular crop is not that complex as change in total enterprise (e.g. shifting from crop production to poultry production).

(iv) Trialability: It is the degree to which an innovation may be experimented with on a limited basis. For example. new seeds or fertilisers can be tried on a small scale, but new machinery or a thing like cow dung gas plant can not be so tried. The trialability of an innovation as perceived by social system is positively related to its rate of adoption.

(v) Observability: It is the degree to which the results of an innovation are visible to others. The observability of an innovation as perceived by

members of a social system is positively related to its rate of adoption. For example, the results of some practices like application of nitrogenous fertilisers to the plants are easily observed while the results of some innovations like treatments of seeds and soil conservation measures are not easily observed.

Rogers (1995) observed that adopter categories are the classifications of members of a social system on the basis of innovativeness, the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than other members of a system. Rogers (1983) suggested the following standard set of adopter categories that is widely followed today (Fig. 2).

(i) Innovators: Innovators are also known as 'venturesome'. Venturesomeness is the salient value of the innovator. Innovators are very eager to try new idea. They have more cosmopolite social relationship. They have ability to understand and apply complex technical knowledge. They have ability to cope with high degree of uncertainty about an innovation. They are risky, hazardous and daring in nature. They play gate keeping role in the social system. There are 2.5 % innovators in a social system.

(ii) Early Adopters: Early Adopters are also known as 'respectable'. They are localities and have opinion leadership. Members of the social system consider them as "the individual to check with" before using a new idea. Change agents consider them as "local missionary". They hold "central

position" in the communication structure of the system and are respected by peers. There are 13.5 % Early Adopters in a social system.

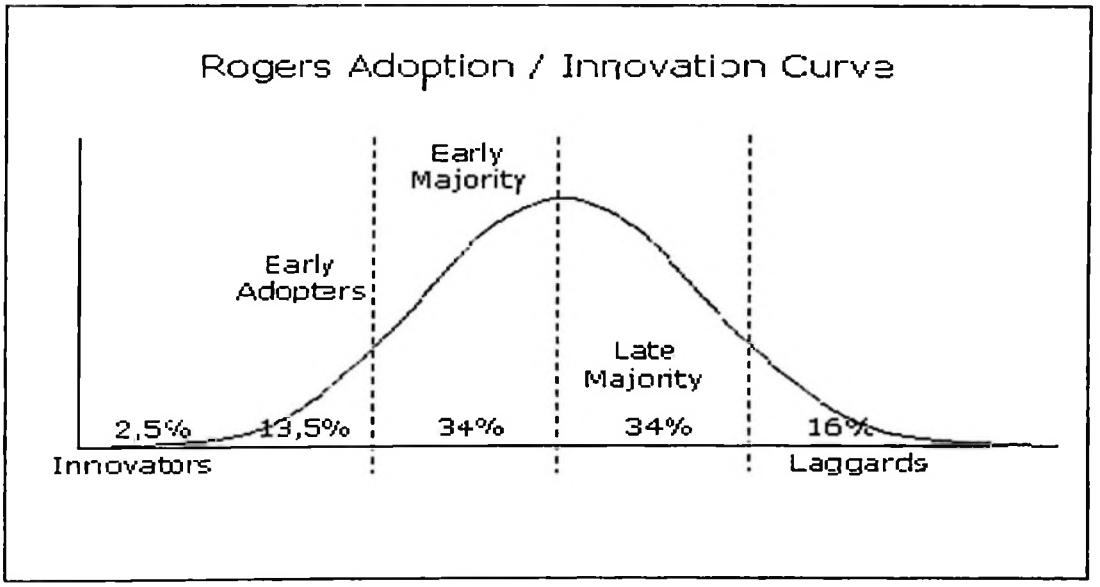

Figure 2: Adoption process model

Source: Rogers (1983)

(iii) Early Majority: Early Majority are also known as 'deliberate'. They adopt new ideas just before the average member of a social system. They seldom hold leadership position. They provide "interconnectedness" in the system's networks. Motto of early majority is- "Be not the first by which the new is tried, nor the last to lay the old aside". There are 34 % Early Majority in a social system.

(iv) Late Majority: Late Majority are also known as 'skeptical'. They adopt new ideas just after the average member of a social system. They adopt an innovation when they feel that it is safe to adopt. There are 34 % Late Majority in a social system.

(v) Laggards: Laggards are also known as 'traditional'. They are the last in a social system to adopt an innovation. They are the most localites and isolates. They possess almost no opinion leadership. The point of reference for the laggards is the past. They interact with people having traditional values. They are suspicious of innovations and change agents. There are 16 % Laggards in a social system.

According to Fliegel (1993), in order to arrive at specific adoption decisions, the farmer requires various forms of information. He must first learn of the information; he must have this additional information to evaluate and apply the new technologies. There is also the need for information about the likely consequences to the farmer and to his social status if he accepts the innovations in farming. Add weather, markets, purchasing inputs and outlook information which further complicate the information problem. The extension service as an agency that communicates innovations must be cautious on the various factors that do affect the way innovations are finally accepted. On the basis of above traits it can be said that technologies which are relatively more advantageous; compatible with social values, past experiences, and the need of potential adopter; simple to understand and use; can be experimented on a small scale; and which results are visible to others are rapidly adopted by the members of a social system. Technologies which are lacking in these traits take more time to be adopted by the members of a social system. Therefore, extension workers need to take precaution and strategies to increase number of farmers who can timely adopt technologies.

2.6 Conceptual Framework for the Analysis of the Study Data

The literature from the present Chapter has been reviewed from a wide perspective of agricultural production innovations. The reflections drawn in this review provides the basis for assessing the availability, transfer and utilisation of cotton and maize agricultural production innovations in Tanzania. In the context of the present study the purpose of which was to assess the availability, transfer and adoption of agricultural production innovations in Kilosa district, the conceptual framework shown in Fig. 3 was developed. This conceptual framework was for analysing a large volume of data and was oriented towards establishing findings which fulfil the objectives of the study. It allows drawing implications on the extent to which agricultural production innovations could be integrated within the farming systems of smallholder farmers and made the engine of economic growth and poverty alleviation in Tanzania. The operational definitions of key variables used are given in Appendix 1. The research methodology is presented in the following Chapter.

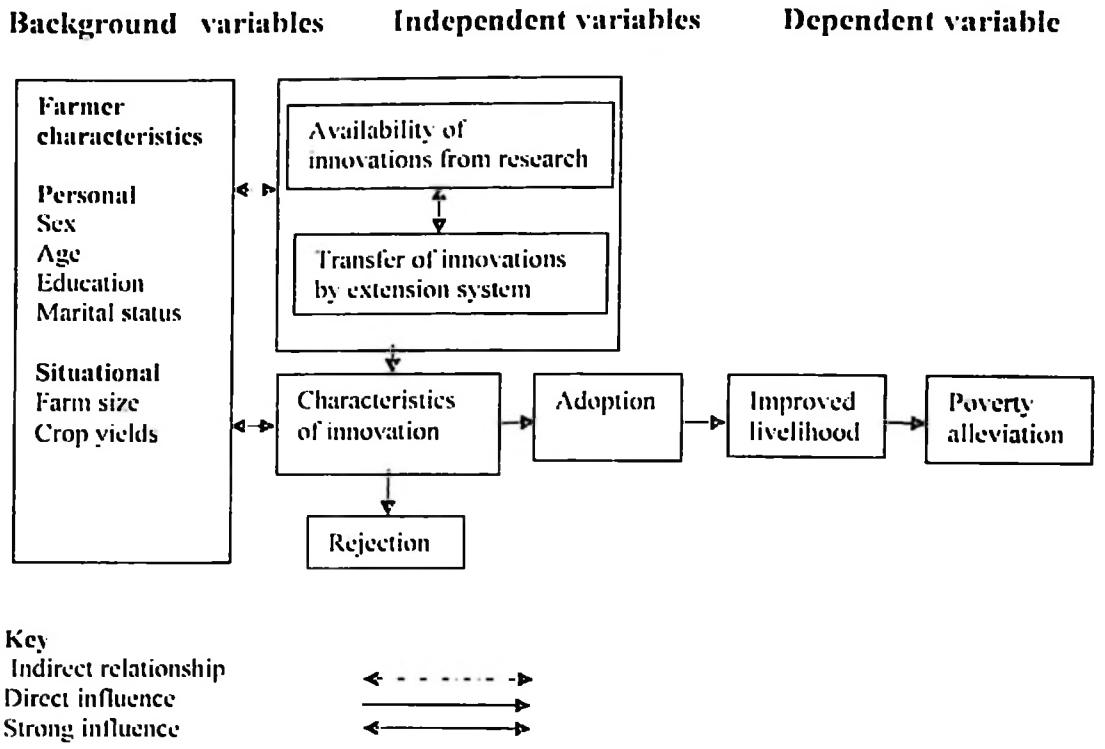

Figure 3: Conceptual framework for analysis of the study data: The availability, transfer and utilisation of agricultural production innovations in Kilosa district

CHAPTER THREE

3.0 METHODOLOGY

This study sought to assess the availability, transfer and utilisation of agricultural production innovations in Kilosa district. This Chapter discusses the methodology adopted under seven parts: (a) study area; (b) study design; (c) sampling procedures; (d) sample size; (e) data collection instruments; (f) data collection procedures; and (g) data processing and analysis.

3.1 The Study Area

The study was conducted in Kilosa district in Morogoro region. The district was purposively selected based on having Ilonga Research Institute involved in cash and food crop research. Agricultural innovations developed on research station are evaluated on-farm in collaboration with extension workers and farmers in order to enhance their transfer and adoption by farmers. The study took place in 4 villages in the district, namely: Malui, Changarawe, Madudumizi and Ulaya Kibaoni, as shown in Fig. 1.

3.2 The Study Design

A case study cross-sectional design in which data were collected in one point at a time was adopted. The method is cheap, quick and effectively utilises limited resources in terms of cash, labour, transport and time. The design is useful for descriptive purposes and the data collected is used to determine the relationship between different variables focused in the field of study (Babbie, 1990; Bailey, 1997).

3.3 Sampling Procedures

Sampling procedures involved multistage sampling technique. It mainly involved purposive selection of study area and respondents based on availability, transfer and utilisation of cotton and maize agricultural production innovations. This technique is convenient for a large sampling unit (Kothari, 2004). The technique was done under two main stages:

Stage 1: First sampling stage involved purposive selection of one export crop (i.e. cotton) and one food crop (i.e. maize) based on availability of their research innovations to the extension service in Kilosa district. In turn, a purposive selection of divisions, wards and villages was done based on access to available cotton and maize agricultural production innovations. There were 9 divisions, 37 wards and 161 villages during the time for data collection for this study in Kilosa district. Each division had more than 2 wards and each ward had more than 3 villages. Thus, two divisions were purposively identified, namely Masanze and Ulaya; and in turn two wards were also purposively selected from each division, namely: Mabwerebwere, Masanze, Zombo and Ulaya. Finally, the same sampling procedure was used to select one village from each selected ward, namely: Malui, Madudumizi, Changarawe and Ulaya Kibaoni.

Stage 2: Second sampling stage involved selection of study respondents. A sample of 120 farmers was selected from the 4 selected villages (30 farmers from each village). Purposive and stratified sampling techniques were used to get the names of male and female farmer respondents from the corrected register of farmers from each

village. The farmers were selected from each village from a list of farmers who in the village extension workers judgment were using cotton and maize agricultural production innovations. Each of the selected villages had one extension worker who was involved in the study. The key informants (that is. essentially knowledgeable individuals who were in position to provide relevant information. ideas and insights on aspects related to the study subject) were selected using snowball technique. After interviewing a respondent. the study author asked him/her to recommend other respondents considered very knowledgeable about the study subject. In this way. 20 key informant respondents were identified and involved in the study.

3.4 Sample Size

A total sample size of 144 respondents comprising of farmers. village extension workers and key informants was selected and involved in the study. A summary of the distribution of all respondents involved in the study is given in Table 1.

Table 1: Distribution of all respondents (N=144) involved in the study

Type of respondent	Number		Total
	Males	Females	
Farmers	81	39	120
Extension workers	4	0	4
Key informants	12	8	20
Total	97	47	144

3.5 Data Collection Instruments

Data collection instruments used for the study were questionnaires, researcher's diary and checklist. as follows.

(a) *Questionnaires*: Two types of questionnaires were used to collect primary data, namely: (i) farmers' questionnaire, and (ii) extension workers' questionnaire

(Appendix 2 and 3). All the questionnaires were completed by means of personal interviews conducted by the author and one research assistant.

(b) *Researcher's diary*: This was used to collect secondary data from relevant documentary sources including Internet websites, Sokoine University National Agricultural Library (SNAL), district and village files, and observation of farmers activities related to agricultural production innovations.

(c) *Checklist*: This type of tool was used to collect primary data from key informants (Appendix 4) to supplement information gathered through researcher's diary and interview schedules.

3.6 Data Collection Procedures

Field work was conducted during the period of October to December, 2009. The permit for data collection was obtained from the District Administrative Secretary (DAS) for Kilosa district after getting an introductory letter from the Director of Research and Post-graduate Studies at Sokoine University of Agriculture (SUA). Much care and foresight were given to legitimising the research in the eyes of the relevant village leaders, farmers as well as government officials in the district. This was first done by reconnaissance survey to allow the researcher orient and familiarise to the study area and then acquire general information on the availability, transfer and utilisation of cotton and maize agricultural production innovations through directed discussions with farmers, village leaders and extension workers. The farmers' questionnaire was translated from English to Kiswahili then pre-tested among few farmers who were not involved as study respondents for reliability and validity, and then corrections and modifications were done accordingly.

Of the 120 interview schedules meant for farmer respondents, all were properly completed constituting a return rate of 100 %. Likewise all the 4 (100 %) interview schedules meant for extension worker respondents were also completed. As far as possible, the interviews were conducted in private farmers' farm environment and each lasted for about 30-40 minutes. When interview was completed in one village, the author moved to the next, usually spending about 4-5 days in each village. In addition, data were collected from 20 key informants through directed discussions. The author also reviewed relevant information from Kilosa district agricultural files related to selected cotton and maize agricultural production innovations. Furthermore, website from internet, Sokoine University of Agriculture National Agricultural library (SNAL), Ilonga Research Institute and Ministry of Agriculture, Food Security and Cooperatives were rich sources of information for the study. Observations made on farmers activities related to utilisation of cotton and maize agricultural production innovations in the sample villages were also recorded.

3.7 Data Processing and Analysis

3.7.1 Data processing

Data from the completed 120 farmers' interview schedules were coded for computer analysis. Each schedule had 226 variables. In addition, data from the bulky extension workers' interview schedule, researcher's diary and checklist were summarised manually to single sheets of paper. In summarising the data great care was taken to ensure that it accurately reflected the original meanings of the statements made.

3.7.2 Data analysis

Data from farmers' interview schedules coded for computer analysis were analysed using programme from the Statistical Package for Social Science (SPSS). The method of analysis involved univariate and bivariate analysis. It used the technique of frequency counts, means and percentages. Furthermore, data processed from extension workers' interview schedule, researcher's diary and checklist were also examined. Qualitative data were analysed using "content analysis" technique which mainly involved transcription of recorded notebooks and then clustering information into sub-themes. Quantitative data were processed and analysed to produce frequencies to facilitate assessment of the availability, transfer and utilisation of agricultural production innovations in the study villages.

3.8 Limitations of the Study

(a) Farmer respondents were involved in on-farm and off-farm activities which mostly took them afar off the living areas. Since the interview was conducted during working hours (day time) when they were at work, the author had to either follow them in their working fields or reschedule the timetable for late hours in the evening at their leisure or resting time after work. This forced the researcher to use extra effort, energy and limited resources to proceed with research schedule.

(b) Poor record keeping by most of the study respondents created difficulties in interpretation of data collected.

(c) Some study respondents' demand for payments delayed data collection process in the study area. The following Chapter presents the study results and discussions.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

This Chapter presents the major findings and discussions arising from the data analysis related to availability, transfer and utilisation of cotton and maize agricultural production innovations in Kilosa district. These were discussed under three main sections. First section dealt with farmer respondents' characteristics. The second section focused on farmer respondents' opinions related to availability, transfer and utilisation of selected cotton and maize agricultural production innovations. The final section looked at extension worker respondents' characteristics and their opinions on availability, transfer and utilisation of selected cotton and maize agricultural production innovations.

4.1 Farmer Respondents' Characteristics

Farmers' characteristics were those personal and situational characteristics in farming which were expected to influence their adoption of cotton and maize agricultural production innovations. These characteristics were examined under two main parts. The first part under personal characteristics involved: sex, age, marital status and level of education. The second part dealt with situational characteristics. Those examined were: land ownership; and levels of average cotton and maize crop yields.

4.1.1 Farmer respondents' personal characteristics

Among the more important personal characteristics dealt with in this part were: sex, age, marital status, and level of education. Examination of farmer respondents' sex

revealed that of the 120 respondents, 81 were males and 39 females (Table 2).

Table 2: Percentage distribution of farmer respondents' (N=120) personal characteristics

Variables	Number	Percentage
Sex		
Male	81	67.5
Female	39	32.5
Age		
25-34	27	22.5
35-44	38	31.7
45-54	30	25.0
55-64	25	20.8
Marital status		
Single	7	5.8
Married	97	80.8
Divorced	6	5.0
Widowed	10	8.3
Level of education		
None	0	0.0
Adult literacy	9	7.5
Primary	111	92.5
Secondary	0	0.0

Further examination of farmer respondents' personal characteristics is organised under the following headings: age; marital status; and level of education.

(a) Age

The age distribution of farmer respondents was between 25 and 64 years. The majority (54.2 %) were below 45 years of age, this is the active and working group as shown in Table 2. However, the findings suggest that, in general, the study respondents were drawn from different age groups of farmers in the villages.

(b) Marital status

It was expected that marital status of farmer respondents would influence adoption

of cotton and maize agricultural production innovations. The farmer respondents' marital status is given in Table 2. Data in Table 2 show that the majority (80.8 %) of the respondents were married. This is more likely to positively affect their participation in cotton and maize agricultural practices where innovation can easily be carried out by a couple, and readily implemented by one in the absence of the other.

(c) Level of education

It was assumed that the extent to which farmers were educated would tend to influence their ability to gain knowledge. This may also affect their participation in the utilisation of cotton and maize agricultural production innovations. The farmer respondents were therefore asked to indicate their level of education, as given in Table 2. The data show that 92.5 % of the farmer respondents had attained level of primary education. This is a reflection of Tanzania's universal primary education policy. Thus implying that farmer's level of education was not an important criterion in adoption/rejection of cotton and maize agricultural production innovations in the study area.

4.1.2 Farmer respondents' situational characteristics

The situational characteristics examined involved factors related to: (a) land ownership; and (b) levels of average cotton and maize crop yields.

(a) Land ownership

It was expected that the total number of acres owned by the farmers would influence

their participation in agricultural development activities. The farmer respondents were therefore asked to indicate the size (acreage) of the private farm that they owned in their villages. The findings revealed that farm size of the respondents ranged from 2 to 8 acres with an average of 3 acres per farmer. The farmer respondents' farm size lies within the Kilosa district farmers' acreage farm size which ranges from 1.5 to 2.5 acres and the average farm size is slightly lower than that of Morogoro region and the country which has been reported (URT, 2005) to be 3.6 acres. This implies that the farm size situation of study respondents was not different from that of smallholder farmers in the country.

(b) Levels of average cotton and maize crop yields

The general crop yield levels of cotton and maize for 2008/2009 from the study villages given by the farmer respondents (on-farm) and researchers (on-station) are indicated in Table 3. A comparison of average crop yields (kg/acre) (for 2008/9 growing season) of cotton and maize crops given in Table 3 indicate that on-station cotton and maize crop yields are generally higher compared to on-farm yields, with a maximum of about 30 % and 50 % of cotton and maize on-farm yields, respectively.

Table 3: Comparison of the 2008/9 average cotton and maize crop yields on-station and on-farm as reported by farmer respondents (N=120)

Type of crop	Average crop yields	
	On-station	On-farm
	kg/acre	kg/acre
Cotton	800 - 1 000	100 - 300
Maize	1 400 - 2 400	500 - 1 200

These findings imply that there is a need for research institutions to further refine agricultural innovations for farmers' more effective utilisation. leading to increased crop yields.

4.2 Farmer respondents' opinions on availability, transfer and utilisation of selected cotton and maize agricultural production innovations

This part will be discussed under the following sections: availability of selected cotton and maize agricultural production innovations to the extension service: nature of farmers' advice and adoption /rejection of innovations: and factors contributing to success or failure of innovations.

4.2.1 Availability of selected cotton and maize agricultural production innovations to the extension service

The study sought to find out whether there are recommended agricultural innovations to extension services for cotton and maize crops in Kilosa district. The findings from district official record files revealed that there are innovations that have existed since colonial times. The major sources of such innovations were the Eastern Research Institute, Ilonga. Table 4 gives indication of existing innovations for cotton and maize production in the district available to the extension service. It was also observed that available cotton innovations had been organised in 10 specific recommendations for the extension worker to transfer and for the farmer to use. The recommendations have been organised in operations as follows:

Table 4: Existing agricultural innovations by type of crop in Kilosa district

Type of innovation/practice	Type of Crop	
	Cotton	Maize
Land preparation	x[a]	x
Selection and use of improved seeds	x	x
Timely planting and proper spacing	x	x
Fertiliser and manure application	x	x
Proper weeding	x	x
Proper thinning	x	x
Spraying for pests and diseases	x	x
Harvesting	x	x
Grading	x	-
Proper storage practices	-[b]	x
Post-harvest practices	x	-

x[a] Available innovations
-[b] Unavailable innovations

1. Early land preparation: This operation ought to take place in month of January. Plough the soil properly 30 cm deep. The use of ridges is recommended for water logged soils.

2. Use of improved seed varieties: The recommendation calls for 5 seeds per hole. One tin of seeds is enough for one hectare. The use of seeds from the Tanzania Cotton Board (TCB) or primary cooperative society guarantees quality control.

3. Timely planting and proper spacing: Early planting is considered as starting in the beginning of February to the end of March. It is recommended that cotton be planted in pure stands and in proper spacing according to the following specifications:

   (a) 90 cm ridge: Plant 1 row on the ridge and leave 30 cm from hole to hole with 1 plant per hole. If spacing of 60 cm from hole to hole is used, leave 2 plants per hole.

(b) On flat cultivation: Plant in rows, keeping 90 cm from row to row and 45 cm from hole to hole. Advantages of line planting include: easy crop weeding, spraying of chemicals and harvesting.

4. Fertiliser and manure application: Due to high soil fertility in the Eastern Zone, use of fertilisers in cotton fields is not common. However, soil looses its fertility and ability of high and good quality crop yield. It is therefore recommended to apply 3t/acre of FYM or 1tin of FYM spread every three walking steps before planting.

5. Proper weeding: Early weeding not more than one month after seed germination before excessive weed competition is recommended. Weeding properly 2 to 3 times assures effective weed control.

6. Proper thinning: Reduce seedlings 3 weeks after planting to 1 seedling per hole if 30 cm spacing was used from hole to hole or 2 seedlings per hole if 60 cm spacing was used from hole to hole during planting.

7. Spraying for pests and diseases: If cotton has germinated and is properly cared for, spraying is very important. Spraying for cotton ought to start 9-10 weeks after planting. It should be continued after every 2 weeks for 6 times. Insecticides used include Thiodan and Ripcord.

8. Harvesting: It is recommended to harvest cotton when the pods have matured and opened completely. If you harvest late, the white colour of cotton could be spoiled by rain, dust or other debris that lowers its grade and reduce income.

9. Grading: Cotton should be graded properly before selling. Grade A is cotton which is well matured and white. This grade sells high. Grade B is cotton which is dirty and not well matured and sells low.

10. Post-harvest practices: This recommendation calls for uprooting and burning of all cotton stalks before 15th November every season. This helps to control Spiny and Red Bollworms.

The findings further revealed that agricultural innovations that are actually available to the extension service on maize farming were reported in a complex manner and did not appear to be readily usable. The recommendations were as follows:

1. Land preparation: It is ideal to plough the soil 15-30 cm deep before beginning of first rains. Make a fairly smooth and weed free seedbed. Preparation procedures are governed by local conditions. Ridges, for example, are used in water logged areas.

2. Use of improved seed varieties: Maize has many high yielding varieties and hybrids. The recommended varieties in the Eastern Zone on attitude is as follows:

Attitude	Type of seed variety		
	Long (120 days)	Medium (110 days)	Short (90 days)
Low (0-900m)	- Staha - Tuxpeno - CHI - Lishe-1	- TMV-1 - Situka M-1	- Kito--ST - Katumani-ST
Medium(900-1500m)	- Kilima - Staha	- TMV-1	- Kito-ST - Katumani-ST

3. Time of planting and spacing: It is recommended to plant early in the season with first onset of rains in order to take advantage of nitrogen flush. Plant

(c) Farm Yard Manure: 10 – 15 t/ha of FYM before planting repeated after every 4 years. However, 3 tons of FYM applied together with the above recommended fertiliser application give a good response.

5. Weeding: Weeds complete with plants for available moisture and nutrients, especially when they are in the farm 45 days after germination. The frequency of weeding depends largely upon nature of infestation but it is recommended to weed 2 times (i.e. 2 weeks and 4 weeks after germination) in order to keep the field in weed free condition.

6. Thinning: Thinning to one plant per hole proceeds immediately after weeding. The objective is to effect the correct plant population per hectare. Thinning is usually done 2 weeks after planting.

7. Control of pest and diseases: The control of diseases and pests covers the following:

(i) The most important maize diseases in Eastern Zone are lowland rust (*Puccinia polysora*), blight (D. maydis), maize streak virus (MSV) and stem rot. The best control of these diseases is varieties that are resistant or tolerant to them. Early planting may reduce the incidence of MSV.

(ii) The most important field pests of maize are stalk borers and armyworms. The most common borers are the spotted stalk borer (*Chilo partellus*) and pink stalk borer (*Sesamia calamistis*). These are controlled by applying a pinch of dust or granules of an insecticide such as Endosulphan 4 % dust, at 5 kg/ha; Cymbush dust 1 %, at 2.5 kg/ha; or Sumicombi 1.8 %, at 5 kg/ha. Once the damage is assessed

to be economic, insecticides should be applied to all plants in the field. Armyworms (*Spodoptera excempta*) occur in major outbreaks. These pests are controlled at the national level through aerial spraying of insecticide. Hand sprayers and ultra low volume applicators (ULVA) may also be used for local control. Chemicals such as Malathion 50 EC at 1.25 L/ha. and Cypermethrin 25 EC at 0.5 L/ha may be used.

8. Harvesting: Time of harvesting depends on type of maize variety. Most of the current recommended varieties such as staha are ready in four (4) months after planting. However, it is recommended to harvest the maize when it has reached physiological maturity and the "black layer" has been formed. Harvested maize should be dried on the cob and shelled and winnowed before it is stored. Cleaning may be done manually or by hand-held maize shellers.

9. Storage: The grain to be stored must be below 15 % moisture content and should be treated with chemicals before being placed in bags or other containers. Common storage pests in Eastern Zone are the larger grain borer (*Prostephanus truncatus*), the maize weevil (*Sitophilus zeamais*) and the angomumois moth (*Sitotroga cerealella*). Chemicals available for controlling these pests include Primiphos methyl (Actellic 25 EC or 50 EC), Permethrin (50 EC) and Actellic Super (Primiphos methyl 1.6 % and Permethrin 0.3 %). Rodents can cause considerable damage to maize crop in the field and storage. A combination of rodent control methods (cats, rodenticides and ratguards) may be used.

These findings may be evidence that district agricultural offices have access to information about improved and recommended agricultural production innovations based on research from our research stations. However, the study does not provide clues about effective linkages between research and extension service with regard to cotton and maize growing. Evidence suggests that available cotton recommended practices for cotton growing appear to be more simplified and therefore easily usable by the extension service. The recommended practices for maize growing are, however, complex and not so easily understood by the farmers, let alone the extension workers. It would appear that the elaborateness of recommended practices for cotton reflects the fact that cotton has very much been researched upon. On the other hand, the lack of refinement on the part of recommended innovations on maize growing may be a reflection of the extent of research that has been done on the crop, particularly in relation to farmer-oriented husbandry practices.

4.2.2 Farmers perceptions on extension methods used to disseminate recommended cotton and maize agricultural production innovations

Based on the list of cotton and maize agricultural production innovations identified in Table 4, the study sought to determine the way farmers are advised by field extension agents, the extent of advice and the degree farmers adopt the recommended practices for cotton and maize farming. The two selected agricultural crops are fairly predominant in the study area and are well served by extension service. The following aspects are addressed under this part: (a) extension methods used; (b) extent of emphasis given to cotton and maize farming; (c) extent of use of

recommended and traditional cotton and maize agricultural production practices; and (d) farmers' degree of innovativeness.

(a) Extension methods used

An attempt was made to identify extension methods frequently used by field extension workers in advising farmers with regard to recommended practices for selected cotton and maize production. Three categories of methods (individual, group and mass) were used to solicit farmers' responses. Their views expressed in percentages of respondents are given in Table 5.

Table 5: Percentage distribution of farmer respondents' (N=120) perceptions on extension methods frequently used in relation to recommended agricultural practices

Selected recommended agricultural practices	Extension Methods Used		
	Individual	Group	Mass
	Percent	Percent	Percent
Land preparation	38.8	40.8	20.8
Selection and use of improved seed varieties	38.8	41.7	20.0
Proper spacing	39.2	41.7	19.2
Proper thinning	39.2	41.7	19.2
Proper weeding	39.2	41.7	20.0
Use of chemical fertiliser	33.3	40.0	26.7
Use of organic manure	34.2	38.3	27.5
Use of insecticides	37.5	42.5	20.0
Average	37.5	41.6	21.7

The findings in Table 5 show that, on average, 41.6 % of the farmer respondents identified group method as a more frequently used extension method. Individual method was identified by 37.5 % of the respondents while mass method was identified by only 21.7 %. Generally, the findings revealed that group extension method was more frequently used followed by individual and mass methods as the

least frequently used. These findings might be a reflection of Tanzania policy which provides priority in terms of government support, including extension services to farmers groups rather than individuals. This in turn requires group organisation and group decision-making which can result only from meetings and other group activities.

Furthermore, the most frequently used types of group method were identified to be village meetings and group discussions organised on farms for demonstration purposes. It was also revealed with regard to individual methods, home visits offers opportunity for dialogue between farmers and field extension workers on proper spacing, thinning and weeding. These practices involve field demonstrations and therefore may easily be advocated by field extension workers. Finally, mass method seems to be important in relation to the use of organic manure (27.5 %) as compared to other selected recommended practices. This could be due to the efforts currently made to create public awareness on the use of organic manure as important source of plant nutrients.

(b) Extent of emphasis given to cotton and maize farming

The study sought to test the generally held view that extension workers tend to put emphasis, in terms of time spent, on advising farmers on cash crop production rather than food crop production. In Kilosa district as is elsewhere in Tanzania, cotton is considered as a cash crop while maize is considered as a food crop. In order to test this, farmer respondents were asked to indicate whether field extension workers spent more time in advising farmers on cotton or maize production in relation to

selected agricultural practices. The findings are summarised in percentages of respondents, as given in Table 6.

The findings in Table 6 show that, on average, greater emphasis by way of advice given to farmers by field extension workers was put on maize production than cotton production. Specifically, the majority (50 % and above) of the farmer respondents indicated that field extension agents spend most of their time in advising farmers on maize growing in all selected recommended practices except in the use of insecticides where 40 % were on the opinion that more time was spent on maize growing. This may be a reflection on the emphasis that has recently been put on food crop production by field extension workers in the study area.

Table 6: Percentage distribution of farmer respondents' (N=120) perceptions on extent of emphasis given to cotton and maize crop production practices by extension workers

Selected recommended agricultural practices	Type of crop	
	Cotton	Maize
	Percent	Percent
Land preparation	39	62
Selection and use of improved seed varieties	43	57
Proper spacing	48	52
Proper thinning	50	50
Proper weeding	49	51
Use of chemical fertilisers	37	63
Use of organic manures	33	67
Use of insecticides	60	40
Average	45	55

However, this observation is rather surprising in light of the fact that recommendations for cotton growing have been advocated for years in Kilosa district. One possibility is that recommended practices have, over the years, been

reduced to mere slogans due to shortages or lack of inputs and supplies associated with some of the recommendations. Consequently, farmers have in some cases, had to rely on traditional ways or mere past experience in cotton growing.

(c) Extent of use of recommended and traditional cotton and maize agricultural production practices

The study also sought to determine the extent of use of recommended and traditional cotton and maize agricultural production practices by farmers. Data on this aspect constituted the perceptions of farmer respondents about the use of recommended cotton and maize agricultural production practices by farmers. Their views expressed in percentages of respondents are given in Table 7.

Table 7: Percentage distribution of farmer respondents' (N=120) opinions on the extent to which they use recommended and traditional cotton and maize agricultural production practices

Agricultural practice	Type of crop			
	Cotton		Maize	
	Recommended	Traditional	Recommended	Traditional
	Percent	Percent	Percent	Percent
Land preparation	60.8	39.2	59.2	40.8
Selection and use of improved seed varieties	86.7	13.3	70.0	30.0
Proper spacing	85.6	14.4	82.5	17.5
Proper thinning	90.0	10.0	88.3	11.7
Proper weeding	90.0	10.0	88.3	11.7
Use of chemical fertilisers	26.7	73.3	21.7	78.3
Use of organic manure	25.8	74.2	20.8	79.2
Use of insecticides	93.3	6.7	48.3	51.7
Average	69.9	30.1	59.9	40.1

The findings from Table 7 reveal that the farmer respondents felt that cotton and maize practices were generally in use at different levels with more farmers relying on recommended practices. This observation is not surprising in light of the fact that

recommendations for cotton and maize growing have been advocated for years in the study area. However, these findings may imply that more work need to be done by the field extension workers in order to gain confidence of the farmers with regard to use of recommended practices in growing cotton and maize. With regard to the use of organic manure, the farmer respondents largely (74.2 %) felt that traditional practices were being used in cotton production. This is not surprising since due to high soil fertility in the Eastern Zone, use of fertilisers in cotton fields is not common and farmers traditionally plough vegetation under the soil as a way of enriching the soil with nutrients. The use of FYM does not arise because greater amounts of input would be required. This is both cumbersome to transport and also in short supply in view of the large acreages involved in cotton production. The findings in Table 7 also show that there was a high rate of use of recommended practices for cotton production with regard to selection and use of inputs, such as: improved seed varieties (86.7 %); and use of insecticides (93.3 %). This may imply that such inputs are available and most farmers are able to obtain them.

On the other hand, the high rate of use of traditional practices for maize growing with regard to use of chemical fertiliser (78.3 %) and use of organic manure (79.2 %) may imply that farmers are still conservative in the use of such practices. It could also be an indication that the extension service has not made major breakthroughs. As noted by Gupter (2000), the farmers are not necessarily more conservative but they are certainly more cautious. They know what they will get if they follow traditional practices. The moment they change to new practice, they are moving from a state of security to a state of insecurity.

(d) Farmers' degree of innovativeness

It was felt that a measure of farmers' degree of innovativeness would provide some indications of the extent to which the farmers utilised recommended agricultural practices for increased crop yields in the study villages. Three elements of the adoption process, namely: knowledge, trial and adoption were chosen in this case. By use of questions, in relation to the 8 selected cotton and maize agricultural production practices posed to farmers, it was possible to determine their degree of innovativeness in terms of extent they had performed in respect to the three elements. The findings are summarised in Fig. 4.

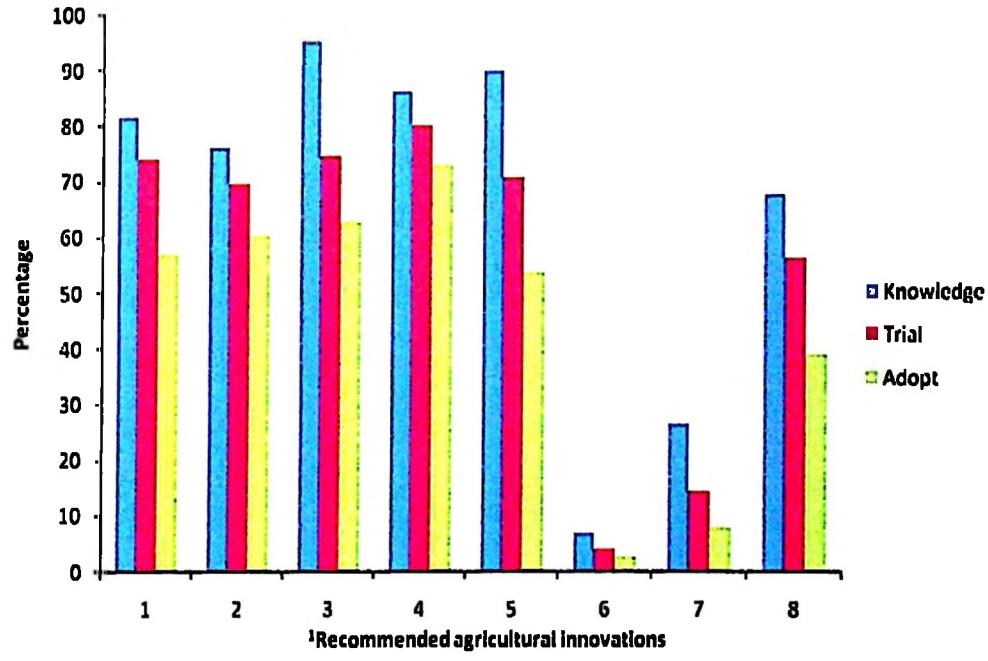

Figure 4: Farmers' degree of innovativeness

[1]Recommended agricultural innovations/practices

1. Land preparation
2. Selection and use of improved seeds
3. Proper spacing
4. Proper thinning
5. Proper weeding
6. Use of chemical fertilisers
7. Use of organic manure
8. Use of insecticides.

According to Fig. 4, a number of observations can be made. Firstly, the level of knowledge acquired by farmers was generally higher than the extent to which trial and adoption were reached. This observation is in line with the principles of adoption process which portray human beings as progressing from an initial stage of awareness through interest, evaluation and trial before adopting an innovation (Rogers, 1995). In this case therefore one is likely to expect progressively more farmers in the "knowledge" category than in the "trial" and "adoption" categories. Secondly, it appears that more farmers had scored higher in terms of knowledge with regard to proper spacing and trial and adoption with regard to proper weeding than any other practice for cotton and maize production. It can be inferred here that with regard to these practices, extension field workers have done a relatively good job in raising the consciousness of farmers as well as demonstrating its operations and merits to the extent of convincing them to start spacing and thinning properly.

Thirdly, farmers lagged behind when it came to knowledge, trial and acceptance of the use of chemical fertilisers compared to other practices. This might be a reflection of available high soil fertility in the Eastern Zone, thus the use of fertilisers in cotton and maize fields is not common. These findings indicate that the data bear a relationship with what is already known about the adoption process. The implication that may be drawn from these findings is that the successful motivation of farmers is a culmination of series of distinct phases. These involve awareness of a new opportunity, generation of interest in it, consideration of its suitability, its trial examination and finally its adoption in agricultural production practices. Each group of farmers and each phase of adoption tends to require a particular behaviour and

rejection can occur at any time. Good field extension workers will therefore adjust their approach to farmers in light of this sequence. That is, field extension workers always need to first learn what stage of adoption process farmers are in. Based on this, they can then operate in accordance with the stage reached. In this way the field extension workers may communicate to farmers at different levels.

4.2.3 Reasons for farmers' rejection of recommended cotton and maize agricultural production practices

It was felt that an understanding of farmers' reasons for rejecting recommended agricultural innovations would provide some clues on the extent of acceptance or rejection of recommended agricultural innovations. Five intrinsic characteristics of innovations and appeal of innovations to farmers were used. Farmers' responses to structured questions involving these characteristics were analysed. The findings are summarised in percentages of respondents for each of the recommended practices for cotton and maize growing, as shown in Table 8. The findings in Table 8 show that, on average, there are slight variations in the proportion of farmers rejecting recommended practices for cotton, when compared to those of maize growing, with regard to each of the intrinsic characteristics of innovations. These findings appear to be contrary to those given in Table 6, where it was shown that field extension workers tended to put more emphasis on advising farmers on maize production than cotton production. This may be an indication that such efforts have not made any significant impact on farmers' acceptance or rejection of recommended practices.

The findings in Table 8 further reveal that the farmers felt that the previously used practice for cotton and maize growing were better than recommendations regarding: Land preparation: selection and use of improved seed varieties; proper spacing; proper thinning; and proper weeding. This means that these recommended practices are not perceived to have obvious advantages over the old and therefore have less relevance to needs of farmers in their prevailing situation.

Table 8: Percentage distribution of farmer respondents' (N=120) reasons for rejecting recommended cotton and maize agricultural production practices

Selected recommended agricultural practices	Practices previously used are better		Inconsistence with past experience		Difficulty in Technology		Not easily triable		Not easily observable	
	C[1]	M[2]	C	M	C	M	C	M	C	M
	%	%	%	%	%	%	%	%	%	%
Land preparation	88	87	79	81	28	28	9	11	3	3
Selection and use of improved seed varieties	94	93	84	86	8	10	4	5	4	4
Proper spacing	92	90	82	82	12	12	5	6	3	3
Proper thinning	93	92	85	84	12	13	5	6	2	2
Proper weeding	93	93	79	80	10	9	6	7	3	3
Use of chemical fertilisers	58	57	53	54	31	31	22	24	8	7
Use of organic manure	54	56	52	52	43	43	26	27	8	8
Use of insecticides	54	56	52	52	43	43	26	27	8	8
Average	83	81	74	74	20	20	11	12	4	4

[1]Cotton
[2]Maize

Specifically, 94 % and 93 % of the farmer respondents rejected selection and use of improved seed varieties for cotton and maize growing, respectively. In case of cotton, this may be due to the fact that farmers are required to collect recommended cotton seeds in each planting season from the nearby primary cooperative societies, and therefore they may tend to ignore further advice on the practice. On the other hand, despite the widespread of farmers dissatisfaction with recommended hybrid

maize varieties, little progress has been made towards developing suitable replacements, as observed by the researcher in the surveyed area. This might have been the reason why most farmers were still using their traditional maize varieties. Furthermore, data in Table 8 indicate that 92 % of farmer respondents rejected use of proper spacing for cotton growing when compared to 90 % of the farmers who rejected the same practice on maize growing.

Considering that the use of proper spacing for cotton and maize growing has been tried at different levels for more than five decades now, these findings may mean that farmers might have tried the use of proper spacing and remained unconvinced. This could particularly be due to high demand for farmers' labour involved in use of the practice. In addition, 93 % of the farmer respondents reject the use of proper weeding for both cotton and maize growing. This may also be due to problems of labour constraints as well as "blanket recommendations" advocated by field extension workers. The findings also revealed, in almost equal proportions, that farmers' failure to use chemical fertilisers for cotton and maize is due to such a recommendation being inconsistent with past experience. In particular, 53 % and 54 % of the farmer respondents felt that the practice, when applied on cotton and maize growing, respectively, was inconsistent with past experience. This might be the reason for most farmers not having bothered to learn how to incorporate the use of chemical fertilisers into their farming system. These findings may generally imply that various characteristics of innovations such as: relative advantage; compatibility; triability; and observability appear in this study to contribute to different rates of acceptance or rejection of agricultural production innovations.

4.3 Extension Worker Respondents' Characteristics and Their Opinions on Availability, Transfer and Utilisation of Cotton and Maize Agricultural Production Innovations

Features related to village extension worker respondents and their job performance was examined in order to ascertain the impact of their extension strategy in farmers' utilisation of cotton and maize agricultural production practices. These features are now presented under: extension worker personal characteristics; extension methods used to disseminate selected cotton and maize agricultural production innovations; importance and use of information sources; and factors contributing to success or failure of transfer and adoption of available selected cotton and maize agricultural production innovations.

4.3.1 Extension workers' personal characteristics

Personal characteristics were expected to influence village extension workers' performance in extension activities at village level. Among the more important personal characteristics dealt with in this part are gender, age, marital status, level of education and personal experience of working in villages. All the four village extension worker respondents were male. Their age distribution was between 46 and 59 years. Their field experience ranged from 18 to 33 years and all of them were married. It was also noted that all the four extension worker respondents belonged to the Ministry of Agriculture, Food Security and Cooperatives. All the respondents had attained a secondary education and diploma in agriculture and all had attended in-service training at least once in the last 8 years. However, regular in-service

training is more highly needed for all of the extension workers to orient them on crop production practices, build more of their capacity and increase their competency in this discipline. In view of the fact that crop production innovations have been changing with changing technology, there is a need for every extension worker to undergo continuous process of renewal, by attending on regular basis, refresher courses and other professional programmes.

4.3.2 Extension methods used to disseminate cotton and maize agricultural production innovations

An attempt was made to identify the extent to which the selected extension methods were used by the village extension worker respondents with regard to the dissemination of the specific selected recommended agricultural production practices for crops grown in the study villages. These practices were: (i) land preparation; (ii) selection and use of improved seed varieties; (iii) proper spacing; (iv) proper thinning; (v) proper weeding; (vi) use of chemical fertilisers; (vii) use of organic manure; and (viii) use of insecticides. Two categories of methods (individual and group) were examined. Individual methods were further considered under farm/home visits and office visits; while group methods included farm demonstrations and group meetings. The percentages of village extension worker respondents who indicated that they used particular extension methods for each recommended agricultural production practice are given in Table 9.

The data in Table 9 indicate that, overall, the most frequently used individual method was farm/home visits and none of the respondents frequently used office visits.

On the other hand, the most commonly used types of group methods were found to be group meetings and on-farm demonstrations. Generally, the findings reveal that the individual method was most frequently used. Specifically, it appears that the individual method was used by 3 out 4 of the respondents in relation to land preparation, proper spacing, proper thinning, and use of insecticides.

Table 9: Percentage distribution of village extension worker respondents (N=4) extent of using particular extension methods for communicating recommended cotton and maize agricultural innovations to farmers

Recommended cotton and maize agricultural practices	Type of extension method			
	Individual			Group
	Farm/home visit	Office visit	Demons-tration	Group meeting
Land preparation	XXX[a]			X
Selection and use of improved seed varieties	XX			XX
Proper spacing	XXX			X
Proper thinning	XXX			X
Proper weeding	XX			XX
Use of chemical fertilisers		X	XXX	
Use of organic manure			XXX	X
Use of insecticides	XXX	X	X	

X[a] Frequency of extension worker respondents' responses

In addition, the findings indicate that a high percentage of extension worker respondents made frequent use of group meetings in promoting practices such as selection and use of improved seed varieties and use of proper weeding. Overall, the data in Table 9 show that in general village extension workers used a combination of extension methods in promoting particular cotton and maize agricultural production practices. The focus on extension intervention was on farmer groups and individual farmer. This suggests that they supplemented group extension methods with

individual extension methods which enabled them to respond to individual farmers concerns and problems.

4.3.3 Importance and use of information sources

It was felt that understanding the village extension workers' efforts in contacting farmers and other individuals or groups for information, within and outside the villages in which they worked, would provide some indication of how they updated their knowledge related to the job of extension worker. The village extension worker respondents were, therefore, requested to give their opinions on the types of selected personal information sources they considered important for their work. They were also asked to rank these information sources according to their level of importance. The extent of use of these information sources was measured by the level of village extension workers contact with different groups/persons that were in position to provide information related to extension. The findings on the level of importance of the information sources are shown in Table 10.

Table 10: Percentage distribution of village extension worker respondents' (N=4) ratings of the importance of particular types of information sources

Type of information source	Extension worker respondents rating	
	Important	No opinion
Farmers	XXXX[a]	
SUA staff	XXX	X
Fellow extension workers	XXX	X
DALDOs SMS	XXX	X
Other village professionals[1]	XXX	X
Research staff	XXX	X

[a] Frequency of extension worker respondents' responses

[1] Extension workers from other sectors

The data in Table 10 show all extension worker respondents perceived farmers who are rich in indigenous knowledge, as being important information sources. In addition, all the other information sources were also perceived by 3 out 4 of the respondents as being important. This is as expected, for example, research as generated from the Ministry's (MAFSC) research institutions and the Sokoine University of Agriculture is supportive to the work of extension workers, since it seeks solutions to the problems of inputs and techniques that farmers are actually facing. Extension becomes the all important bridge between producers and adaptive research. Two things follow: First, without an efficient extension service, research loses momentum and its sense of purpose, with a strong probability of being irrelevant to production needs. Secondly, an active extension service will continuously remind researchers that their clients are farming communities. This suggests that the village extension workers under the local government authorities should pay particular attention to upward communication of farmers' problems in their research system, a key function now advocated by the World Bank's own experts (Rivera and Alex. 2004).

Furthermore, the village extension worker respondents' importance ratings of their fellow extension workers, other professionals (extension workers from other sectors) in the villages and subject matter specialists (SMSs) from District Agricultural and Livestock Development Officer's (DALDO's) office imply that they were willing to co-operate with other fellow workers since discussions over mutual problems can be very useful. The above findings, therefore, suggest that particular attention should be given by the local government to ensure that the village extension workers are ready

to co-operate and exchange information with farmers, their colleagues, and research personnel from different institutions and workers from other relevant agencies in the villages. This exchange of information and assistance can be useful for improving the effectiveness of extension, thus leading to greater extension efficiency. The above reflections from the data given in Table 10 suggest that, because extension is essentially an activity involving the exchange of information, it follows that the effectiveness of extension services must depend highly on the quality, reliability and efficiency of information sources from which the village extension workers themselves draw.

4.3.4 Factors contributing to success or failure of transfer and adoption of available selected cotton and maize agricultural production innovations

4.3.4.1 Problems that constrain the transfer of selected cotton and maize agricultural production innovations

An analysis of the problems that constrain field extension workers in transferring cotton and maize agricultural production innovations was carried out. The findings are given in Table 11. Data in Table 11 revealed that the major constraint for field extension workers for transferring cotton and maize production innovations was poor transport facilities. This was revealed by all the extension worker respondents. Involvement in many other activities in addition to extension role and lack of incentives to provide good service were both rated by 3 out of 4 of the respondents each.

Table 11: Percentage distribution of extension worker respondents' (N=4) perceptions on constraints to transfer of selected cotton and maize production innovations

Type of constraint	Extension worker respondents rating	
	Important	No opinion
Poor transport facilities	XXXX[a]	
Involvement in many other activities	XXX	X
Lack of incentives	XXX	X

X[a] Frequency of extension worker respondents' responses

In Kilosa district, as is the case in Tanzania as a whole, transport facilities are persistent constraint in the extension system. Considering the large areas covered by extension workers (normally 4 to 6 villages) it is high time for district councils to take action in provision of appropriate transport facilities to extension staff in order to increase effectiveness of extension service. Involvement in many other duties additional to normal extension activities of field extension workers appears to affect the quality of work of field extension workers. Contrary to the job description of field extension workers that appear on paper, for too little time is actually spent on advising farmers on agricultural production practices. With many additional tasks there may be dilution of efforts, poor competence and unwarranted interruptions. Field extension workers are likely not to have incentives to provide good service if they lack transport, suitable accommodation, proper working tools, supportive technical services and training facilities. Also lack of necessary extension inputs such as credit and marketing facilities may make extension programme unsuccessful. In this case farmers inevitably blame field extension workers for not being able to make available to them such inputs. This situation could reduce the effectiveness of field extension workers.

4.3.4.2 Problems that constrain farmers' adoption of selected cotton and maize agricultural production innovations

An analysis of the perceptions of field extension workers on the problems that constrain farmers in adopting recommended cotton and maize production innovations put forward to them was carried out. The findings are indicated in Table 12. Data in Table 12 show that low level of farmer training was identified by all extension worker respondents as a major constraint for farmers' adoption of selected cotton and maize production innovations. However, there were signs that the Universal Primary Education (UPE) launched more than five decades ago in Tanzania has influenced educational levels of farmers. Thus, in future the extent of illiteracy will be greatly reduced considering that the number of youth recently benefiting from secondary education will be farming in the country side.

Table 12: Percentage distribution of extension worker respondents' (N=4) perceptions on constraints to farmers adoption of selected cotton and maize agricultural production innovations

Type of information source	Extension worker respondents rating	
	Important	No opinion
Low level of farmer training	XXXX[a]	
Lack of recommended innovations	XXX	X
Lack of agricultural credit	XXXX	

X[a] Frequency of extension worker respondents' responses

Lack of agricultural credit was also identified by all extension worker respondents as being important constraint. Considering that new agricultural technology usually demands the use of inputs which must be purchased, these findings indicate a notable recognition that farmers have no funds to pay for these inputs. It appears that the Microfinance Institutions (MFIs) such and National Bank of Commerce (NBC) and

the Savings and Credit Societies (SACCOS) which are expected to provide loans to farmers – especially small scale operators, have not been effective enough in providing necessary credit to farmers. In some cases these institutions have been blamed for their lengthy bureaucratic commercial procedures which work in disfavour of smallholder farmers.

Lack of cotton and maize recommended innovations was identified as being important constraint for adoption of cotton and maize production innovations by 3 out of 4 of the field extension worker respondents. In many cases in Tanzania, despite the farmers willing to adopt new technology, adoption has been impaired by sheer unavailability of certain essential inputs on the market. For example, the researcher noted that insecticides which are not available to farmers had been recommended for use on maize production in all the villages surveyed. Thus, while it is not the direct role of field extension workers to make inputs available to farmers, their work is greatly affected by unavailability of such inputs.

4.4 Summary of the Discussion

The overall objective of this study was to assess the availability, transfer and utilisation of selected agricultural production innovations in Kilosa district. The findings show that district agricultural offices have access to information about improved and recommended agricultural innovations based on research from our research stations. Available recommended practices for cotton growing appear to be more simplified and therefore easily usable by the extension service. The recommended practices for maize growing are, however, complex and not so easily understood by the farmers, let alone the extension workers. It would appear that the

elaborateness of recommended practices for cotton reflects the fact that cotton has very much been researched upon compared to maize.

On the other hand, the lack of refinement on the part of recommended innovations on maize growing may be a reflection of the extent of research that has been done on the crop, particularly in relation to farmer-oriented husbandry practices. The extent of transfer and utilisation of cotton and maize agricultural production innovations was found to vary from crop to crop. Some of the constraints to the transfer of such innovations are of extension nature while others are clearly beyond the responsibilities of extension service, such as: price system (free market); political influence; transport factors; alternative crops; labour supply and type of soils. The following Chapter gives conclusions and recommendations based on the major findings of the study.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

1. The extension service appears to have an inventory of extension innovations to disseminate for cotton and maize farming. Cotton innovations are more simplified while those of maize are complex for extension workers to transfer and farmers to use. In general, it would seem that for all other crops, innovations are available although in forms that vary in terms of degree to which they can be helpful to the field extension worker and the farmer. It would therefore seem that such innovations need to be further refined.
2. The transfer of agricultural innovations from district agricultural offices to farmers generally take the form of advice. Field extension workers tend to advise farmers mainly through group and individual extension methods. The field extension workers appear to be more knowledgeable about cotton farming than maize farming. However, they tend to give more emphasis on advising farmers about maize production than cotton production. Thus, in general, the extent of transfer of agricultural innovations tends to vary from crop to crop, depending on emphasis given by the government in favour of a particular crop. Some of the constraints to the transfer of such innovations are of extension nature while others are clearly beyond the responsibilities of extension service.
3. The study has shown that farmers prefer to utilise innovations which are perceived to be better than those which were previously used, consistent with the past experience, simple to apply, triable and observable. Successful

continued utilisation of agricultural innovations appears to be constrained by low level of farmers training, lack of agricultural credit and lack of recommended innovations.

5.2 Recommendations

1. Since, generally, innovations for all other crops are available but in forms that are not easily understandable and complex to the farmers use, much effort should be made to refine agricultural innovations into simplified packages of practices that can easily be understood and disseminated to farmers. This calls for closer links among research, training and extension organisations for such further refinement.
2. In view of the fact that agricultural innovations have been changing with the changing technology, there is a need for every extension worker to undergo a continuous process of renewal, by attending on regular basis, refresher courses and other similar professional programmes. Such programmes would: continually update their technical knowledge, expose them to extension methods and techniques, increase their morale and group spirit, and generally provide professional re-orientation to their work. In addition, the district councils should take action in provision of transport facilities to extension staff in order to increase effectiveness of extension service.
3. Considering that the number of youth currently benefiting from secondary education in Tanzania will be future farmers in the country side, there is a need for the government to improve secondary education quality, access and equity.

5.3 Suggestions for Further Research

This study has not exhausted all aspects concerning availability, transfer and utilisation of agricultural innovations. It is clear that a lot more needs to be done. Two suggestions are therefore made concerning specific areas that should further be studied.

1. To undertake case studies on the process of acquisition of information by extension workers from the district agricultural offices. The major purpose of this study would be to find out if the extension workers are offered opportunity to retrieve information on agricultural innovations from research stations and to process it adequately for use by farmers.
2. To undertake case studies on interaction between field extension workers and farmers. The major purpose of this study would be to elicit more reliable clues about communication behaviours of field extension workers and farmers during the process of innovations transfer. The Participant-As-Observer technique could be useful in seeking data for such a study.

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APPENDICES

Appendix1: Definition of the key variables used

Variables	Operational Definition
Age	Number of years lived since birth by an individual
Sex	Biological differences between male and female
Education Level	Number of years spent in formal schooling
Marital status	The state whereby an individual is either married. single, divorced. separated or widowed
Farm size	Area of land that a farmer own and is being used for agricultural activities
Crop yield	Cotton and maize average crop yields
Innovations	A new idea of farming that is introduced to farmers with an intention of increasing agricultural productivity -used interchangeably with the term "practice" and "technology"
Utilisation of innovations	Used interchangeably with the term adoption of innovation
Availability of innovations	The situation whereby new ideas of farming are present within the reach of the smallholder farmers
Transfer of innovations	An act of passing on new method of farming by the agricultural extension agents to farmers
Extension workers	Any individual or group of individuals who in one way or another transfer new methods of farming to farmers for increased agricultural production. Used interchangeably with the terms "extension agent"
Characteristics of innovation	Features that new method of farming has
Adoption of innovations	Acceptance and utilisation of the new method of farming by farmers
Rejection of innovations	Denial to utilize new method of farming by farmers
Livelihoods	Means to gain adequate stocks and flow of food and cash to meet basic needs together with reserves and assets to offset risks, ease shocks and meet contingencies
Poverty alleviation	Any process or an attempt which seeks to increase levels of income of the low-income segment of a community through agricultural related activities

Appendix 2: Farmers' questionnaire

Confidential
Questionnaire: Personal Interviews
Respondents: Farmers
Study Topic: The transfer and utilisation of agricultural production innovations in Tanzania: A case study of selected villages in Kilosa district
District: _____ Division_____ Ward _____ Village _____ Respondent's Number _____ Date_____

A: Farmers' Characteristics

Personal characteristics

1. Age_____ (years)
2. Sex_____ [1] Male, [2] Female { }
3. Marital status_____ [1] Single [2] Married, [3] Widowed. [4] Divorced { }
4. What is your final level of education?
   [1] None
   [2] Adult literacy
   [3] Standard IV { }
   [4] Standard VII/VIII
   [5] Post primary
   [6] Others (specify).....

Situational Characteristics

5. Do you have a private farm for crop production? [1] Yes [2] No
6. If YES in 5 above, what is the area of your farm_____ (acres?)
7. Do you grow the following crops?
   [1] Maize Yes/No
   [2] Cotton Yes/No
8. In relation to the following table record acres, average yield and purpose of maize and cotton growing in 2008/2009 and if it was for food, cash or both

Type of crop	2008/2009 season		
	Area (acres)	Average yield	Major purpose
Cotton			
Maize			

B: Availability of agricultural innovations

9. I would like to have your views on the recommended agricultural practices involving cotton and maize production.

Type of practice	Types of crop			
	Cotton		Maize	
	Aware	Ever used	Aware	Ever used
Land preparation				
Selection and use of improved seed varieties				
Proper spacing				
Proper thinning				
Proper weeding				
Use of chemical fertilisers				
Use of organic manure				
Use of insecticides				

10. What do the following practices imply as currently used in cotton and maize farming?

Type of practice	Implication	
	Cotton	Maize
Land preparation		
Selection and use of improved seed varieties		
Proper spacing		
Proper thinning		
Proper weeding		
Use of chemical fertilisers		
Use of organic manure		
Use of insecticides		

3. List problems that make it difficult for farmers to adopt recommended agricultural innovations put forward to them

i. .....
ii. .....
iii. .....
iv. .....
v. .....

4. What recommendations can you give for successful transfer and utilisation of agricultural innovations?

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

C: Transfer of Agricultural Innovations

11. Have you ever received advice from extension or any other source on the following agricultural practices involving cotton and maize production practices?

Type of practice	Maize			Cotton		
	Yes		No	Yes		No
	Extension worker	Others (specify)		Extension worker	Others (specify)	
Land preparation						
Selection and use of improved seed varieties						
Proper spacing						
Proper thinning						
Proper weeding						
Use of chemical fertilisers						
Use of organic manure						
Use of insecticides						

12. If yes in Qn. 11 above, through which extension methods were you advised in agricultural practices.

Type of Practices	Extension Methods		
	Individual	Group	Mass
Land preparation			
Selection and use of improved seed varieties			
Proper spacing			
Proper thinning			
Proper weeding			
Use of chemical fertilisers			
Use of organic manure			
Use of insecticides			

13. Put tick [√] against one crop in which extension worker put more emphasis in terms of time spent in advising farmers in relation to selected cotton and maize agricultural production practices.

Type of practice	Types of crop	
	Cotton	Maize
Land preparation		
Selection and use of improved seed varieties		
Proper spacing		
Proper thinning		
Proper weeding		
Use of chemical fertilisers		
Use of organic manure		
Use of insecticides		

D: Adoption/ Rejection of Agricultural Innovations

14. What is your opinion on the use of traditional and recommended practices with regard to cotton and maize farming practices?

Type of practice	Traditional				Recommended			
	Mostly used		Not mostly used		Mostly used		Not mostly used	
	Cotton	Maize	Cotton	Maize	Cotton	Maize	Cotton	Maize
Land preparation								
Selection and use of improved seed varieties								
Proper spacing								
Proper thinning								
Proper weeding								
Use of chemical fertilisers								
Use of organic manure								
Use of insecticides								

15. Indicate whether you still apply the following recommended agricultural practices for cotton and maize production?

Type of practice	Types of crop			
	Cotton		Maize	
	Yes	No	Yes	No
Land preparation				
Selection and use of improved seed varieties				
Proper spacing				
Proper thinning				
Proper weeding				
Use of chemical fertilisers				
Use of organic manure				
Use of insecticides				

16. Which of the following statements accurately describe the major reason for your continued rejection or failure to use the following improved practices for cotton and maize farming?

Type of Practice	Practices used are better		Inconsistence with past experience		Difficult in technology		Not easily triable		Not easily observable	
	Cotton	Maize	Cotton	Maize	Cotton	Maize	Cotton	Maize	Cotton	Maize
Land preparation										
Selection and use of improved seed varieties										
Proper spacing										
Proper thinning										
Proper weeding										
Use of chemical fertilisers										
Use of organic manure										
Use of insecticides										

Appendix 3: Extension workers' questionnaire

Confidential
Questionnaire: Personal Interviews
Respondents: Extension workers
Study Topic: The transfer and utilisation of agricultural production innovations in Tanzania: A case study of selected villages in Kilosa district
District: _____ Division_____ Ward _____ Village_____
Respondent's Number _____ Date_____

A: Personal characteristics

1. Age_____ (years)
2. Sex_____ [1] Male, [2] Female { }
3. Marital status_____ [1] Single [2] Married. [3] Widowed. [4] Divorced { }
4. What is your highest level of education?
   [1] Standard VII/VIII
   [2] Form IV { }
   [3] Form VI
   [4] Others (specify).....
5. Professional training? Complete as follows:

Level of training	Final qualification	Specialisation	Graduation year
Certificate			
Diploma			
Degree			
Other (specify)			

6. In-service training? Complete as follows:

Organised by	None	1-2	3-5	> 5	Last time attended (Month & Year)
DALDO					
Others (specify).....					

7. Length of tenure in extension service _____ (yrs)
8. Length of service in the present village _____ (yrs)
9. How many village do you serve.....villages
10. Indicate major field activities in which you have been engaged?
    [1] .....
    [2] .....
    [3] .....
    [4] .....

B: Availability of Innovations

11. Are there recommended cotton and maize innovations for extension service from research stations. YES/NO.? If Yes. what are the specific recommendations by type of crop?

Type of practice	Specific Recommendation	
	Cotton	Maize
Land preparation		
Selection and use of improved seed varieties		
Proper spacing		
Proper thinning		
Proper weeding		
Use of chemical fertilisers		
Use of organic manure		
Use of insecticides		

C: Transfer of Innovations

12. Below is a list of selected agricultural practices for cotton and maize production. Put tick (√) against an extension method you're frequently using in advising farmers for each practice.

Type of Practice	Extension Method				
	Individual		Group		Demonstrations
	Farm visit	Office visit	Field tour	Meetings	
Land preparation					
Selection and use of improved seed varieties					
Proper spacing					
Proper thinning					
Proper weeding					
Use of chemical fertilisers					
Use of organic manure					
Use of insecticides					

13. Put tick (√) against one crop on which you put more emphasis in terms of time spent in advising farmers in relation to selected agricultural practices.

Type of practice	Types of crop	
	Cotton	Maize
Land preparation		
Selection and use of improved seed varieties		
Proper spacing		
Proper thinning		
Proper weeding		
Use of chemical fertilisers		
Use of organic manure		
Use of insecticides		

14. Below is a list of statements on constraints to extension workers' transfer of agricultural innovations. On your opinion rank constrains as being very important, important, not important, no opinion based on your transfer of cotton and maize production innovations.

Type of constraint	Opinion			
	Very Important	Important	Not Important	No Opinion
Lack of incentives				
Poor transport facilities				
Involvement in many other duties				
Others (specify)				

D: Adoptions/Rejection of Innovations

15. What are your opinions on the use of traditional and recommended practices with regard to cotton and maize farming?

Type of practice	Opinion							
	Traditional				Recommended			
	Mostly used		Not mostly used		Mostly used		Not mostly used	
	Cotton	Maize	Cotton	Maize	Cotton	Maize	Cotton	Maize
Land preparation								
Selection and use of improved seed varieties								
Proper spacing								
Proper thinning								
Proper weeding								
Use of chemical fertilisers								
Use of organic manure								
Use of insecticides								

16. Below is a list of constraints for farmers' adoption of agricultural innovations, on your opinion, rank the constraints has being very important, important, and not important or no opinion based on adoption of agricultural innovations.

Type of constraint	Opinion			
	Very Important	Important	Not Important	No Opinion
Low level of farmers training				
Lack of agricultural inputs				
Lack of credit				
Others (specify)				