A STUDY OF FACTORS AFFECTING THE ADOPTION OF HYBRID MAIZE IN MWANGA DISTRICT

BY

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ABSTRACT

Mwanga district is experiencing continuous food shortages. In spite of the food problems, farmers continue to use traditional ways of food production and have not fully adopted the available modern agricultural technologies and practices.

This study was designed to investigate factors influencing the adoption of hybrid maize in Mwanga district. The specific objectives of the study were: 1) To determine the level of adoption of hybrid maize in Mwanga district 2) To identify and describe factors that affect the adoption of hybrid maize in Mwanga district 3) To determine the relationship between farmers, innovations, institutional and environmental characteristics on one hand and the adoption of hybrid maize 4) To recommend ways which can facilitate farmers to adopt hybrid maize in Mwanga district.

The study was done in two villages involving 90 farmers and one extension worker. Forty five respondents from each village were selected randomly by using a table of random numbers. Data were collected using two types of structured questionnaires: one was for the farmers who grew maize and the other for the extension worker. Field observations

were also used for data collection.

These data were supplemented by documents and records from agricultural offices in Mwanga district and two village extension offices.

Data were analyzed at Sokoine University of Agriculture using the Statistical Package for Social Sciences (SPSS). In the SPSS the sub-programmes "frequencies" and "crosstabs" were used to further analyze the data. Findings show that adoption was found to be significantly associated with gender, farm size, income, cost of inputs and complexity of growing hybrid maize. Moreover, adoption of hybrid maize was affected by other factors like the presence of coffee, inter-cropping system and the de-husking quality of hybrid maize.

Recommendations drawn from this study include:

a) The price of inputs which is expensive need to be addressed. This can be solved by giving farmers subsidies and credits for them to buy farm inputs.

b) Farmers should be encouraged to buy fresh supplies of hybrid maize seed every season.

c) Women should be involved in the decision making process that involve growing of hybrid maize.

d) Farmers should look for alternative arable areas to cultivate such as the lowlands of Mwanga district to offset food shortages.

e) Farmers should be encouraged to use other alternative ways of improving soil fertility such as using composit manure and increase the use of farm yard manure from cattle kraals.

f) To reduce the problem of drought, farmers should be encouraged to adopt modern agricultural practices such as agroforestry and use field water retention techniques.

DECLARATION

I, **CATHERINE PHILLIP MSUYA**, do hereby declare to the Senate of Sokoine University of Agriculture that this thesis is a result of my own original work and that it has never been submitted for a degree award in any other University.

Signature----------

Date----------30/6/1998-----

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DEDICATION

To my beloved mother, Hulda Phillip and my beloved brother Winston Phillip who laid the foundation of my education.

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ABBREVIATIONS

CIMMTY	-	International Maize and Wheat Improvement Centre
GDP	-	Gross Domestic Product
ha	-	hectare
Kg	-	Kilograme
N	-	Number
%	-	Percentage
SAREC	-	Swedish Agency for Research Cooperation
SUA	-	Sokoine University of Agriculture
TARO	-	Tanzania Agricultural Research Oraganisation
URT	-	United Republic of Tanzania

CHAPTER ONE

1.0 INTRODUCTION

The national economies of most Third World countries are dependent on the agricultural sector. However, this sector is often unable to adequately meet the populations' food and foreign exchange requirement. Agriculture in these countries is characterized by being a dual sector. "Firstly, there is a small modern sector using advanced technology and producing for the market. Secondly, there is a large subsistence sector often called 'traditional' using indigenous techniques and producing mostly for home consumption" (Achour, 1990).

In order to improve the traditional sector, agricultural productivity, social and economic conditions, governments and international agencies have tried development strategies based on the adoption of new production techniques. Many agricultural and rural development programs have been implemented in the Third World. Yet, these programs have not alleviated hunger and poverty problems. On the contrary, these programmes have often disrupted the farmers social economic organizations, impoverished small farmers, increased inequality between

large scale and small scale farmers and increased the rate of rejection of the proposed technologies and practices. Several studies show that small scale farmers tend to reject new technologies and practices than adopt them (Rutatora, 1994; Machumu, 1995).

The non-adoption of new ideas by smallholder farmers in developing countries is a concern to international development agencies and governments in the Third World. Several institutions are conducting research on the adoption of new ideas. In their efforts, institutions ask themselves the following questions: Which technologies and practices have the best chances for adoption by the farmers? Which ones will improve the overall social welfare? What kind of information on technologies and practices do farmers need to choose them? What impact does dissemination of technologies and practices have on the labour force?

These questions are especially relevant to Tanzania where agriculture contributes about 46% of the Gross Domestic Product (GDP), over 80% of foreign exchange earnings (United Republic of Tanzania, 1991) and where more than 85% of the population is rural and depends on agriculture for their livelihood (World Bank, 1995).

The country has policies to improve agriculture in order to strengthen the economic base and to improve its food commodities. To achieve this aim, agriculture has to be modernized by changing the existing traditional agricultural practices. For example, since independence in 1961, the country has increased its agricultural technicians, introduced improved seed varieties and increased the use of pesticides (Kemikimba, 1975). Furthermore, a fertilizer factory was built with a view of increasing fertilizer availability but most smallholder farmers have not substantially increased their crop yield per unit area because few use chemical fertilizers in their plots.

Practically, most conditions that make for a good crop can be controlled by the farm operator through adoption of modern scientific methods. For example, a farmer can control the way a seed bed is prepared, planting techniques, the variety of seeds to be planted, determine the type and amount of organic manure, and the appropriate inorganic fertilizers to use. Research on hybrid maize in Tanzania shows that 7.9 ton of grain can be obtained per hectare when 120-160 kg N/ha and 80 kg P/ha are applied (Ministry of Agriculture, 1992). However, the smallholder yield of maize per hectare is less than 2 ton/ha (United Republic of Tanzania, 1991).

The importance of improved agricultural technology in relation to agricultural development have been realized in Tanzania (Mvena and Mattee, 1987). It is believed that technological changes allow farmers to compare and assess input/output relationships. This is crucial to a country like Tanzania and especially in Mwanga district where food is increasingly becoming scarce while population is increasing. This is caused by the low yields farmers obtain per annum that do not last until the next harvesting season. Less than 5% of the farmers in Mwanga district use fertilizers in their farms in growing maize (Maghimbi, 1995). People have cultivated this land for a long time without adding fertilizers resulting in decreased yields yearly. This situation forces farmers to buy food from other areas. For example, about 70% of the people in Mwanga district buy maize from Tanga and Moshi districts yearly (Maghimbi, 1995).

1.1 STAGES OF ADOPTION OF INNOVATION

The immediate and uniform adoption of innovations in agriculture is quite rare. In most cases, adoption behaviour differs across socio-economic groups and overtime. Some innovations have been well received while others have been adopted by only a very small group of farmers (Feder et al., 1985).

However, cumulative proportion of adoption follows an S-shaped curve in most cases in which there is a slow initial growth in the use of the technology, followed by a more rapid increase and then a slowing down as the cumulative proportion of adoption approaches its maximum (CIMMYT, 1993). Lionberger and Gwin (1991) asserted that the curve has three parts, meaning that the adoption starts slowly by a majority of people who wish to see the innovation tried locally by someone else first. This is followed by an increased adoption rate as a result of interpersonal communications and finally the adoption rate declines at the third part. Sometimes a significant proportion of farmers may have experience with the technology but few of them use it. CIMMYT (1993) says that in such a situation, it is worth trying to get information on why farmers stop using the technology.

1.2 ADOPTERS CATEGORIES

Not all individuals in a social system adopt an innovation at the same time. Rather, they adopt it in a time sequence. It is much easier and more meaningful to describe individuals in terms of adopter categories. Adopter categories are classification of members of a social system on the basis of innovativeness.

According to Rogers (1983), there are five adopter categories. These are innovators, early adopters, early majority, late majority and laggards. Each of these categories is discussed below.

1.2.1 Innovators

Innovators are venturesome individuals in a social system, who are very eager to try new ideas, have substantial financial resources, and the ability to understand and apply complex technical knowledge. They are also able to cope with a high degree of uncertainity, and play an important role in launching a new idea in a social system by importing it. They are the gate keepers with regard to flow of new ideas in a social system, and cosmopolitan in terms of social relations.

1.2.2 Early adopters

Early adopters are a more integrated part of the local social system than innovators. Whereas innovators are cosmopolites, early adopters are localites. This adopter category has the greatest degree of opinion leadership in most social systems more than any other. Potential adopters look to early adopters for advice and information about the innovation.

The early adopter is considered by many people as "the individual to check with" before using a new idea. This adopter category is generally sought by change agents to be a local missionary for speeding the diffusion process. Early adopters serve as a role model for other members of a social system because they are not too far ahead of the average individual in innovativeness. This adopter category is respected by its peers, and is the embodiment of successful and discrete use of new ideas. They also know that to continue to earn the esteem of colleagues and to maintain a central position in the communication structure of the system, it is necessary to make judicious innovation decisions. The role of the early adopter is to decrease uncertainty about a new idea by adopting it, and then convey a subjective evaluation of the innovation to near-peers by means of interpersonal networks (Rogers, 1983).

1.2.3 Early majority

The early majority adopt new ideas just before the average member of a social system. The early majority interact frequently with their peers, but seldom hold leadership positions. The early majority's unique position between the very early and the relatively late to adopt, makes them an important link in the diffusion process.

They provide interconnectedness in the system's networks. The early majority may deliberate for some time before completely adopting a new idea. Their innovation- decision period is relatively longer than that of the innovator and the early adopter (van den Ban and Hawkins, 1996).

1.2.4 Late majority

Late majority are people in a social system, who adopt innovations relatively late. They do so only after the innovations have been adopted by majority of people in the society. Rogers (1983) contends that late majority are skeptical, their adoption is in response to economic necessity and peer pressure.

1.2.5 Laggards

Laggards are the last people in a social system to adopt innovations. They possess almost no opinion leadership. They are the most localite in their outlook of all adopter categories; many are near isolates in social networks. Decisions are often made in terms of what has been done in previous generations and these individuals interact primarily with others who also have relatively traditional values.

When laggards finally adopt an innovation, it may already have been superseded by another more recent idea that is already being used by the innovators. Laggards tend to be suspicious of innovations and change agents (van den Ban and Hawkins, 1996).

1.3 PLACE OF MAIZE IN THE ECONOMY OF TANZANIA

Maize is the most important cereal food crop in Tanzania. The crop is grown in almost every region in mainland Tanzania in 13 agro-ecological zones (Haule, 1988; Mbwaga, 1988). Major maize producing regions include Iringa, Mbeya, Rukwa, and Ruvuma in the Southern highlands and Arusha and Kilimanjaro in the Northern highlands. Other regions include Kigoma, Morogoro, Mwanza, Tabora and Tanga.

Maize is produced in Tanzania by smallholder farmers whose farms average between 0.4 and 3 ha, and contribute about 80% of the total estimated national production. The other group is composed of public and private farmers with farm sizes of over 100 ha. contributing 5% of the total national production (Semguruka, 1988).

A shift towards self-sufficiency in food production in Tanzania depends to a greater extent on the improvement of

maize production. Since 1971 when shortages of food became more evident, the government has conceived ambitious maize production programmes. These programmes aim at increasing production of maize per unit area. For example, the National Maize Project and National Food Crops Credit Programme of 1974 and 1975 respectively aimed at assisting 0smallholder farmers to adopt improved production technologies and practices through provision of farm inputs on credit basis.

Despite all these efforts, average yield per hectare of maize is still low compared to neighbouring countries (Table 1.0). Insufficiency and delay in supply of improved seed, fertilizers and other agrochemicals coupled with inefficient extension system are among the reasons that caused low production for most food crops in the country (Marandu et al., 1988).

Table 1.0 Maize average yield in kg/ha of selected countries in the World, 1970-1985

Year	Tanzania	Zimbabwe	Kenya	Africa average	U.S.A
1970	1857	1202	1486	1108	4544
1975	1121	1758	1728	1358	5421
1980	1233	1340	1200	1443	5712
1985	1218	1782	1736	1476	7406

SOURCE: FAO (1985).

1.4 PROBLEM STATEMENT

Although Tanzania has committed resources to agricultural research and extension, the ensuing technologies have not significantly been adopted by farmers who continue to use traditional agricultural techniques (Wambura, 1988). For example, farmers in Mwanga district have not adopted the use of hybrid maize. Subsequently, low maize yields are a common feature. Similarly, about 60% of the households harvested approximately 400-600 kg of maize grown in 1994 (Msuya, 1995). The author found that about 62% of the households had large families with about 7-10 children. This situation forces people in Mwanga district to buy maize from Tanga and Moshi districts.

In September 1992, about 68,727 persons out of 98,260 of the total population of Mwanga district experienced food shortages (Ikeno, 1995). The author found that although more than two third of the population had food shortages, most people could afford to buy food at that time. The condition of food shortages in Mwanga district became worse in 1994/95. About 54,510 persons experienced food shortages in July 1994 (Ikeno, 1995). This study found that one third (162,280) of those who suffered from food shortages in Kilimanjaro region in July 1994 were residents of Mwanga district. Moreover, out of 64,259 who could not afford to buy food in Kilimanjaro region, 47,330 are residents of Mwanga district (Ikeno, 1995). Hybrid maize was selected in this study because the villages studied are located in the highlands where hybrid maize performs well.

Innovation studies have been conducted in Tanzania in order to establish their impact on modernization of the agricultural sector (Wambura, 1988; Lyatuu, 1994; Machumu, 1995). However, no studies have been done in Mwanga district to find out why people of the same social-economic status adopt hybrid maize and others do not.

1.5 JUSTIFICATION OF THE STUDY

This study generated information on factors that affect adoption of hybrid maize in Mwanga district. The identification of the constraining factors would aid the government and other agencies responsible for extension, planning and policy formulation to promote the adoption of hybrid maize seed. This would hopefully increase maize yields in the district.

1.6 OBJECTIVES OF THE STUDY

The broad objective of this study was to examine factors that affect the adoption of hybrid maize in Mwanga district.

1.6.1 Specific Objectives

1. To determine the level of adoption of hybrid maize in Mwanga district.
2. To identify and describe factors that affect the adoption of hybrid maize in Mwanga district.
3. To determine the relationship between farmers', innovation, institutional, environmental characteristics and other factors on one hand and the adoption of hybrid maize.

4. To recommend ways which can increase the adoption of hybrid maize in Mwanga district.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 HYBRID MAIZE SEED AND AGRICULTURE DEVELOPMENT

Hybrid maize varieties give a yield increase of perhaps 20% over open pollinated and their use was introduced in the U.S.A in the middle 1930s (Purselgrove, 1988). Hybrid maize has almost completely replaced open-pollinated forms in all of the more advanced maize-growing areas of the world.

In Tanzania, the introduction of hybrid maize varieties in the mid 1960s has witnessed a shift in maize production (James, 1989). In spite of the adoption of hybrid maize, the local varieties abound and are often preferred to the hybrids because of their taste, resistant to pests and low input requirement. Hella (1992) found that 95% of people in Iringa region were aware of the existence of high yielding hybrid maize varieties, only 53% grew hybrid maize seed.

In most cases, agricultural technologies and practices are introduced in packages that include several components such as, high yielding varieties, fertilizers, pesticides, herbicides, and corresponding land preparation practices. While the components of a package may complement each other, some of them can be adopted independently of the other. Thus farmers may face several distinct technological options. They may adopt the complete package of innovations introduced in the region or subset of the package (Feder et al., 1985).

2.1.1 Fertilizer application in maize

Small maize plants are like children, they must be fed and protected until they can take care of themselves (Tanzania Agricultural Research Organization (TARO, 1987). The maize plant has a relatively high demand for nutrients, particularly for nitrogen, phosphorus and potassium for obtaining high yields. These important plant nutrients may be obtained through application of inorganic fertilizers or farm yard manure. For instance, farm yard manure should be used at 10-15 ton/ha (TARO, 1987). Maize fertilizer demonstrations managed by Kilimo/FAO fertilizer programme have proved that lack of fertilizer use generally results in poor yields, sometimes leading to no yield at all (United Republic of Tanzania, 1991). The research carried

out in Mbeya, Tanzania show that when 120kg N and 20kg P/ha are applied in maize, and a yield of 1,850 kg/ha of grain is obtained (Jaka, 1988).

2.1.2 Weeding

Weeds interfere with crop growth through competition for water, light and nutrients. Some weeds may also harbour insect pests and diseases that directly infect the crop plants, consequently causing enormous losses in yield (Temu, 1988). It is important that the field should be weed free in the first 40 days after germination (TARO, 1987). TARO recommends that two hand weedings are sufficient in the low, intermediate and high elevation areas. In the southern highlands of Tanzania, yield reductions resulting from weeds were recorded to range from 60-75% of potential yield (Croon et al., 1984). Thus the question of effective weed control in maize is not only important, but absolutely necessary to maximize yields.

2.1.3 Spacing

Recommended spacing for full season varieties of maize are 75 by 30 cm or 90 by 25 cm with one plant per hill, giving a plant population of 44,000 plants per hectare (TARO,

1987). In the southern highlands area with an altitude of over 1,500 m and reliable rainfall, planting two plants of maize per hill at 90 by 50 cm gives the same yields

similar to a single plant per hill at 90 by 25 cm (TARO, 1987).

2.1.4 Pesticides application

For good maize production, it is essential to be aware of pests and know how to control them. There are three major stalk borers in Tanzania: Chilo partellus, Busseola fusca and Sesamia calamistis (TARO, 1997). Stalk borers can be controlled fairly easily with endosulfan, malathion, sevin and sumithion, if the materials are applied at the correct time. It is recommended that when the plants have about seven leaves, pesticides should be applied into the whorl of the leaves and done again after 2 weeks from the first application (TARO, 1987). Only in cases of extreme attacks will a third application be needed. It is recommended that every plant in the field should get pesticides and not just those which show damages on them.

2.2 FACTORS THAT AFFECT ADOPTION OF INNOVATIONS

The development of appropriate technology is a necessary but insufficient condition for ensuring its adoption (Byerlee and Heisey, 1992). One must also design a system of technology transfer that provide farmers with the inputs and information they need to enhance adoption.
van den Ban and Hawkins (1996) identified five stages of adoption process as: 1) Awareness or first hear about the innovation; 2) Interest or seek further information about it; 3) Evaluation or weigh up the advantages and disadvantages of using it; 4) Trial or test the innovation on small scale for your self and 5) Adoption or apply the innovation on a large scale in preference to old methods. It is useful to distinguish between adoption which is measured at one time, and diffusion which is the spread of a new technology across a given population over time (CIMMYT, 1993). The introduction of many new technologies has met only partial success, as measured by observed rates of adoption (Byerlee and Heisey, 1992). The conventional wisdom is that constraints to the rapid adoption of innovations involve factors such as the lack of credit, limited access to information, aversion to risk, inadequate farm size and inadequate incentives associated with farm tenure arrangements (Feder et al., 1985). He added that, other factors include insufficient

human capital, absence of equipment to relieve labour shortage and inappropriate transportation infrastructure. Likewise, chaotic supply of complementary inputs such as seed, chemicals, and water are among constraints to the rapid adoption of innovations (Feder et al., 1985). Constraints such as lack of cash, high costs of the technology, labour constraints have been identified as major factors constraining adoption of innovations in Tanzania (Benad, 1988). Considering that there are many factors which affect farmers' decision to adopt or reject innovations, this study classifies the limiting factors into four main categories: innovation, environmental, farmer and institutional characteristics. Each of these factors is discussed below.

2.2.1 Institutional characteristics

Weak and inefficient agricultural institutions such as research extension, credit, and marketing institutions have been mentioned as the reasons for stagnation of the agricultural sector.

2.2.1.1 Research

In any country, the agricultural research establishment is concerned with agricultural technology development and

adoption. The objective is to ensure that new agricultural technology is developed and used by farmers. Many developing countries lack adequate research infrastructure or even a coherent and logical research policy. Within the research system some of the problems include lack of understanding by researchers of the complexities of smallholder agriculture, and the lack of impact by newly developed technologies. Mvena and Mattee (1988) grouped such problems into four categories:

a) Lack of knowledge and understanding of the farming systems.
b) Insufficient feed back from the farmers to research programmes.
c) Insufficient understanding of the environment in which farmers work.
d) Lack of mechanisms for testing and adopting technology on farmers' fields.

This means that the process of technology development is fraught with problems which render it less effective. Agricultural research in developing countries is based on a technical perspective of agricultural problems and provides a product which is unfinished in terms of the needs of the small farmers it seeks to serve. Furthermore, farmers may not have access to the resources required for the technology adoption. In Iringa Tanzania, for example, the extension and research institutions were found to be

insignificant in promoting adoption of hybrid maize seed (Hella, 1992).

2.2.1.2 Extension contact

In the context of farming, extension is defined as an assistance to farmers to enable them identify and analyze their production problems and become aware of opportunities for improvement by changing their outlook towards their difficulties.

Tanzania being an agricultural oriented country, requires farming techniques that assure high production. Agricultural extension as a link between research and peasants has an important role to play in enhancing this productivity. In most countries, the key person to give farm level training is the extension agent. A change agent is an individual who influences clients' innovation decisions in a direction deemed desirable by a change agency (Rogers, 1983). The extension agent's aim is to explain characteristics of the technology to farmers and identify social implications of the innovation (Minjas et al., 1990). Some of the constraints to the adoption of innovations are of extension nature. The ineffective of extension system in respect to adoption of improved technologies and practices may be attributed to a number

of reasons such as ineffective extension methodology, unaffordable innovations by farmers and poor supervision.

Others include poor coordination in the extension organization, lack of incentives and motivation of extension agents, and financial constraints that lead to poor transport facilities. In addition, poor infrastructure and low salaries for extension agents contribute to the ineffective extension system. Some of the indirect constraints to the transfer of technology by extension officers are that wealthier farmers in any area have a tendency to dominate the activities and time of extension officers at the expense of the less powerful and needy families (Kauzeni, 1988; Wambura, 1988; Wambura, 1993). Studies also reveal that failure of many extension programmes to reach the majority of smallholder farmers is due to neglect of extension services for women who contribute a major proportion of the family farm labour (Shayo, 1990; Njiku, 1991; CIMMYT, 1993;).

2.2.1.3 Credit

Credit is an important element in modernizing agriculture because it allows the use of other factors of production produced off the farm, for example, fertilizers and land. The demand for credit exists because farmers do not have

access to all inputs required at the beginning of the season, and therefore, need to borrow money to acquire them.

The demand for credit has increased over time relative to the degree of specialization of farm activities and reliance on purchased inputs. The need for credit has been identified as an important factor in promotion of new necessary influence to promote new technologies if they are to be adopted quickly (Islam, 1991; Kashuliza, 1992; Lyatuu, 1994). Capital in the form of either accumulated savings or access to capital markets is required to finance many new agricultural technologies. Thus, differential access to capital is often cited as a factor in differential rates of adoption (Feder et al., 1985). Banks and other formal lending institutions often pose problems to small farmers. In Africa, many of these institutions especially commercial banks, are not keen to lend to the rural sector as the latter has a reputation for poor loan repayments.

For example, the cooperative and Rural Development Bank had defaults on loans of over 50% between 1971 and 1989 (Kashuliza, 1992) of which the majority were agriculture in nature. Kashuliza (1992) further found that maize growers in the southern highlands of Tanzania showed that

some farmers are informed of the existence of credit giving institutions. However, few farmers have benefitted from institutional credit.

This study found that friends and relatives constituted the main sources of informal credit for the majority of respondents. The complicated lending procedures and demands by the banks from the farmers seeking credit have largely contributed to the limited access to credit to majority of small farmers (Lyatuu, 1994).

2.2.2 Innovation characteristics

Innovations have properties that affect their rates of adoption. By using standard classification for describing the perceived attribute of innovations in universal terms, Rogers (1983) came up with five attributes that are mutually exclusive. They are 1) Relative advantage 2) Compatibility 3) Complexity 4) Triability 5) Observability.

2.2.2.1 Relative advantage

Relative advantage is the degree to which an innovation is perceived as better than what it is intended to replace, advantageous to the adopter relative to the old way of

doing things. Relative advantage may include reduced labour costs, and reduction in demand for labour to do unpleasant tasks.

The greater the perceived relative advantage of an innovation, the more rapid its rate of adoption. A technology which can show obvious and quick profit in combination with reduced risks can be readly accepted (Kashweka and Johnson, 1987). Due to this, the new innovation may be perceived as a threat to some of the farmers. It is likely that, when the price of an innovation decreases dramatically during its diffusion process, a rapid rate of adoption is facilitated.

2.2.2.2 Compatibility

Compatibility is the degree to which the technology is consistent with existing values, past experiences, and needs of potential adopters. A technology that is clearly compatible, profitable and reliable with farmers' farming systems will be adopted relatively faster and its diffusion rate will be higher. Farmers are likely to adopt technologies that are more visible and have positive attributes. An incompatible innovation often requires prior adoption of a new value system (Rogers, 1983).

2.2.2.3 Complexity

Complexity is the degree to which an innovation is perceived relatively difficult to understand and use. There are innovations which appear in simplified packages that farmers could easily adopt and there are those that

are complex and can not easily be understood and adopted. Innovations that are simpler to understand, can be adopted more rapidly than innovations that require the adopter to develop new skills and understandings (CIMMYT, 1993).

2.2.2.4. Triability

Triability is the degree to which an innovation may be experimented on a limited basis. New ideas that can be tried on small scale will generally be adopted more rapidly than innovations that can not be tried.

2.2.2.5 Observability

Observability is the degree to which the results of an innovation are visible to others. The results of some ideas are easily observed and communicated to others, whereas some innovations are difficult to explain to others. The easier it is for individuals to see the

results of an innovation, the more likely they are to adopt.

2.2.3 Farmers characteristics

Traditionally, the failure by farmers to adopt innovations has been blamed on farmers' socio-cultural milieu of beliefs, attitudes, values and traditional practices (Mvena and Mattee, 1988). However, it has been recognized more recently that there are alternative explanations. For example, characteristics of individual farmers that can be used as explanatory variables in understanding adoption patterns include factors such as education, gender and age that may predispose a farmer to take interest in a new technology, and resources such as size of land, income or access to credit that may make it easier or more profitable for a farmer to change practices (Keregero, 1988; Nkonoki, 1994).

2.2.3.1 Farm size

Farm size can have different effects on the rate of adoption depending on the characteristics of the technology and situational setting. More specifically, the relationship of farm size to adoption depends on such factors as fixed adoption costs, risk preferences, human

capital, credit constraints, labour requirements and tenure arrangements (Feder et al., 1985).

When farmers invest in technology, its acquisition costs have to be dispersed over the farm business and its cost recovered from the farm outputs. Larger farms are more likely to adopt new technology as they can spread the costs over a wider range of outputs than is possible for a small farm (Hussain et al., 1994). The use of high yielding varieties and some modern variable inputs initially tends to lag behind on smaller farms. For example, Jamison and Laurance (1982) found a significant positive relationship between farm size and the adoption of high yielding seed varieties and fertilizer use. Most farmers in developing countries including Tanzania lack resources, and this according to Wambura (1988) is one of the causative factors in delayed adoption of innovations.

2.2.3.2 Education

The majority of small farmers in the villages can neither read nor write, and therefore cannot benefit from written materials. The farmers' education background is an important factor in determining the readiness to accept and properly apply an innovation (Swanson et al., 1984). Education makes a farmer more receptive to advice from an

extension worker or more able to deal with technical recommendations.

The more complex the technology is the more likely it is that education will play a major role (CIMMYT, 1993).

2.2.3.3. Age

Rate of adoption of a new technology is higher among low age members than older ones. Young and energetic people have proved to be more venturesome, active and ready to try innovations (Nanai, 1993), and are called 'innovators' (Rogers, 1983). Older people have more experience but their receptivity to new ideas and technologies typically decreases with age (John, 1995).

Age of respondents was one of the factors which influenced the adoption of hybrid maize seed in Iringa region, Tanzania (Hella, 1992). It was also found that the adoption of hybrid maize seed was high among farmers aged between 26-50 years. This suggests that if extension agents concentrate more on this group, the adoption of innovation can be enhanced.

2.2.3.4 Income

Wealthier farmers may be the first to try a new technology, especially if it involves purchased inputs. This may be because wealthier farmers have better access to extension information or to credit, or they may be able to use their own cash resources to experiment with a new technique (CIMMYT, 1993). Many times, it is farmers with more resources in the form of either land, labour or capital who are able to take advantage of new technologies and practices.

A study on the assessment of transfer and utilization of selected innovations in Musoma district found that the extension system tends to favour certain categories of farmers (Wambura, 1988). He also found that richer, younger and better educated farmers within the surveyed villages had higher levels of extension contact than poorer, older and less educated farmers. In some cases, farmers with a more commercial orientation who sell a large proportion of their harvest are the ones who adopt certain technologies and practices. A farmer may be aware of benefits associated with adoption of improved seed varieties but willingness to adopt this technology may be constrained by either non availability of the inputs (Brylee and Heisey, 1992).

2.2.3.5 Gender

Females are estimated to be the head of one third of household worldwide (Gass and Bigs, 1993).
Similarly, most of the food producers in the world are women and yet most technologies are promoted to men or through them. Most technologies are considered gender neutral in themselves, but often become gender biased during their introduction and use by societies (Stephens, 1992). Furthermore, Jefremovas (1991) asserted that female farmers have restricted or no formal land rights in many countries.

In most rural societies the social status of women is inferior to that of men. Due to this, they become a disadvantaged group especially when it comes to the introduction of new technologies and practices in their areas (Shayo, 1990). Evidence from Tanzania shows that, it is difficult for extension agents to hold meetings or address female farmers freely. Wambura (1992) observed that although rural women receive information on farm practices from various sources, the impact of these sources to womens' access to agricultural information is still low. The study results showed that womens' sources of agricultural information were their husbands and neighbours.

2.2.4 Environmental characteristics

Land quality and soil type may be important factors influencing the acceptance of a new technology. Not only do management practices differ by the type of soil but also other conditions such as slope or moisture retention capacity are often important. On the other hand, climatic factors play an obvious role in the management of farming systems. The possibility of drought or flooding makes farmers worry about investing in some technologies and practices. Climate, soils and other physical factors have a major influence on the levels of technology that are used by farmers for tillage, water application and conservation, type of crops planted and animals raised (Kebede et al., 1990).

CHAPTER THREE

3.0 METHODOLOGY

Data for this study were obtained by using a cross-sectional design. In cross-sectional design data is collected at a single point in time (Creswell, 1994). This design is considered favourable because of the limited time for collecting data.

3.1 Instrumentation

Structured questionnaires were used in data collection. The questionnaires comprised of close and open ended questions. Two types of questionnaires were prepared, one for farmers growing maize and another for extension agents.

3.2 Sampling procedures

The population of the study was farmers who grew maize in Kisanjuni and Masumbeni villages. The sampling units were composed of head of households in the selected villages. Respondents were selected using a table of random numbers. Names of respondents were listed in alphabetical order starting with their first names.

Numbers of respondents that corresponded with their names were randomly selected by matching them with the first number encountered in the table of random numbers. This procedure was used to select 90 respondents, that is 45 farmers per village. In Masumbeni village, 23 females and 22 males were selected and in Kisanjuni village 22 females and 23 males were selected. Only one extension agent from Kisanjuni village was interviewed because there was no extension agent in Masumbeni village.

3.3 Data collection

3.3.1 Primary data

Primary data were collected from respondents employing formal and informal interviews. Collection of primary data was done by the researcher assisted by one enumerator. The enumerator was trained for 2 days on how to administer the questionnaires. Data collection involved visiting individual farmers in their homes and farms and in informal gatherings. The other source of primary data collection was through direct observations.

3.3.2 Secondary data

Secondary data were obtained from agricultural offices in Mwanga district and village extension offices.

3.4 Data analysis

In order to draw conclusions, the data collected from the primary sources were coded and analyzed using the Statistical Package for Social Sciences (SPSS) computer programme. From the analysis, descriptive statistics such as frequencies and percentages were determined. The cross-tabulation sub-program was used to determine whether or not the variables were statistically independent.

3.5 Location of the study area

The study was confined in Kilimanjaro region, specifically in Mwanga district. Mwanga district is located between 3^0 to 4^0 south and 36^0 to 38^0 East. Mwanga district is in the North East of Tanzania and is bordered by Kenya, Tsavo National Park, lake Jipe in the North East, Same and Simanjiro districts in the South. On its west is Arusha region and Moshi rural district in the North. The district is composed of lowlands in the East and West which are separated by the Tanga-Moshi road and the North Pare

mountains. The study was done in two villages in Ugweno division: Masumbeni and Kisanjuni. These villages were chosen because they are accessible by roads throughout the year.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSIONS

4.1 Farmers characteristics

Farmers characteristics which were identified as important for this study included: gender, age, education level, farm size and income.

Despite the major role played by women in the agricultural system, they scarcely feature in the official agricultural statistics. It is, therefore important for adoption studies to consider the degree to which a new technology reaches women farmers (CIMMYT, 1993). Of the 90 farmers interviewed, 45 were males and 45 females. About 19 (21.1%) of the respondents had age ranges between 31 to 37 years, 22 (24.4%) between 38 to 44 years, 33 (36.7%) between 45 to 50 years and 16 (17.8%) were above 50 years. This implied that most of the respondents were middle aged (31 to 50 years) (Table 4.1).

The non involvement of youths (between 18 to 30 years) in the interview was among others, due to the traditional customs and values that do not allow youth to own land. In addition, few youths were engaged in farming.

Table 4.1. Distribution of respondents by age (N=90)

Age (years)	Number	Frequency / Percent (%)
31-37	19	21.1
38-44	22	24.4
45-50	33	36.7
>50	16	17.8
TOTAL	90	100.0

Education may enhance a farmer to adopt technical recommendations that require a certain level of literacy or increase their receptive to advice that an extension worker can offer. Informal education may be important, and in some cases their attendance at training sessions organized by extension agents such as demonstrations may also be crucial in increasing adoption. Most respondents 76 (84.4%) had completed primary level education. Although this kind of education enabled them to read and write, it was probably not helpful in the adoption of technologies and practices that required comprehension of the extension leaflets. The other 12 (13.3%) farmers had attended adult education classes and only 2 (2.2%) had no formal education. This implied that low level of education to farmers in the area could be one of the factors that hindered adoption of hybrid maize.

It was assumed that the total number of hectares owned by a respondent would influence his/her adoption of hybrid maize. It is known that farmers with large farms perform different managerial practices such as mechanization, and readly adopt recommendations which are appropriate for them. Farm size was measured in total hectares currently in operation, owned or rented by farmers (Table 4.2).

Table 4.2. Distribution of respondents by farm size (N=90)

Farm size (ha)	Frequency	Percentage
<1	15	16.7
1-3	62	68.9
4-6	13	14.4
TOTAL	90	100.0

Results in Table 4.2 show that most farmers, 62 (68.9%) had farm sizes from 1 to 3 ha. About 13 (14.4%) had farms ranging from 4 to 6 ha. and 15 (16.7%) had farms of less than 1 ha. Observations showed that most farmers practiced mixed cropping consisting of maize, beans, plantains and cassava. Other farmers mixed food and cash crops. When asked about the source of farm labour, all respondents, 90 (100%) reported that family members were an important source of labour in their farms.

Of the 90 respondents, 44 (48.9%) reported that apart from growing maize, the most important food crop on their farms were plantains and, 30 (33.3%) reported planting maize, beans and plantains as the most important food crops. However, only 16 (17.8%) of the total respondents indicated that maize was an important food crop. Of the 90 respondents, 87 (96.7%) grew coffee implying that it was an important cash crop in the study area. Respondents were asked to show their total income earned per year. Table 4.3 summarizes the distribution of respondents' total income per year.

Table 4.3. Distribution of the respondents' total income per year (N=90)

Income (T shs)	Number	Percent
60,000-70,000/=	24	26.7
70,001-80,000/=	6	6.7
80,001-90,000/=	5	5.6
90,001-100,000/=	9	10.0
100,001-110,000/=	30	33.3
>110,000/=	16	17.8
Total	90	100.0

Study results in Table 4.3 reveal that few respondents, 30 (33.3%) had an annual income ranging between T shs 100,001

to 110,000; 24 (26.7%) respondents had an annual income ranging between T shs 60,000 to 70,000 and 20 (22.3%) had an annual income ranging between T shs 70,001 to 100,000. Fewer respondents, 16 (17.8%) earned annual income of more than T shs 110,000. Of the 90 interviewees, 72 (80%) reported that they mostly spent their money to buy food for the family and only 18 (20%) interviewees said that they spent most of their annual income to pay for their childrens' school fees. This implied that most farmers in the study area did not consider buying farm inputs (i.e., improved seed, fertilizers) as a priority. Apart from farm income, it was expected that engagement in off-farm activities or casual employment would generate extra income to support farmers' adoption of hybrid maize. Respondents were asked to say the types of off-farm income generating activities which they did. Of the 90 respondents who grew maize, 11 (12%) said that they did off-farm activities such as operating a shop, carpentry and building houses to earn extra income.

4.2 Level of adoption of hybrid maize

All 90 respondents said that they had heard about the hybrid maize, but only 53 (58.9%) had planted hybrid maize immediately after hearing about it. Of the 53 (58.9%) respondents who grew hybrid maize, 24 (45.2%) said that

they had been growing hybrid maize for 4 to 7 years, and 29 (54.8%) for 8 to 11 years. Of the 53 (58.9%) respondents who grew hybrid maize, only 17 (32.1%) said that they bought new hybrid maize seed every season. Other respondents, 36 (67.9%) did not buy hybrid maize every season, of which 32 (88.9%) selected good seeds from maize harvested in other seasons and 4 (11.1%) reported that they got hybrid maize seed from hybrid maize produce of the previous seasons. Hybrid maize face a problem of loss in yielding ability and uniformity when grown in their second and subsequent generations (TARO, 1987). Due to this, farmers must obtain fresh supplies of hybrid maize seed every season.

All 53 (58.9%) respondents who grew hybrid maize in the 1995/96, had bought seed from the Cargil Seed Company (i.e; C4141 and C4142). Over half of these respondents, 31 (58.5%) had grown C4141, and 22 (41.4%) C4142. Yields obtained from hybrid maize in the 1995/96 season is summarized in Table 4.4.

Table 4.4. Yield from growing hybrid maize seed in the 1995/96 season (N=53)

Yield (bag/ha)	Number	Percent
1-3	22	41.5
4-6	19	35.8
7-9	8	15.1
10-12	4	7.5
Total	90	100.0

1 bag = 100 Kilograms.

Results in Table 4.4 show that 22 (41.5%) of the respondents harvested between 1 to 3 bags, 19 (35.8%) harvested between 4 to 6 bags, 8 (15.1%) harvested between 7 to 9 bags and only 4 (7.5%) respondents harvested between 10 to 12 bags per hectare. This implied that most respondents got insufficient amounts of maize compared to the number of people in the household to feed. Most of the households, 52 (57.8%) had family members ranging from 7 to 9 persons and 20 (22.2%) had family members ranging from 10 to 12 persons, impliying large family sizes per household.

Respondents who had not yet adopted hybrid maize seed were asked to indicate other varieties of maize that they grew on their farms. Of the 37 respondents who had not adopted hybrid maize, 35 (94.6%) said that they grew other local varieties of maize and only 2 respondents grew tuxpeno maize variety. Of the 35 respondents who grew local varieties, all said that it was because of its good taste, easy to mill, and to store. Others, 33 (94.35) said that seeds were easily available, and not expensive. Thirty-one (88.6%) of these respondents said that they grew local varieties because they were not attacked by insect pests and diseases. However, 28 (80%) of these respondents agreed that yields obtained from local varieties did not cover the cost of production. This implied that farmers knew that growing local varieties of maize was not profitable. Reasons for adoption and non adoption of local variety are summarized in Table 4.5.

Table 4.5. Reasons for adoption/ non adoption of local variety (N=35)

Reasons	Agree		Uncertain		Disagree	
	N	%	N	%	N	%
Availability of seeds	33	94.3	-	-	2	5.7
Farmers have knowledge	22	62.8	1	2.9	12	34.3
Seeds not expensive	33	94.3	-	-	2	5.7
Yields cover the costs	7	20.0	-	-	28	80.0
Good taste	35	100.0	-	-	-	-
Not attacked by pests	31	88.6	-	-	4	11.4
Not attacked by diseases	31	88.6	1	2.7	3	8.6
Easy to store	35	100.0	-	-	-	-
Easy to mill	35	100.0	-	-	-	-

Yields obtained from local varieties are summarized in Table 4.6. The study results show that 13 (37.1%) of the respondents harvested less than one bag, 18 (51.4%) harvested between 1 to 3 bags and few farmers, 4 (11.5%) harvested between 4 to 6 bags. The amount of maize harvested was small and could not sustain farmers until the next harvesting season.

Table 4.6. Yield from local maize variety harvested in the 1995/96 season (N=35)

Yield (bag/ha)	Number	Percentage
<1	13	37.1
1-3	18	51.4
4-6	4	11.5
Total	35	100.0

1 bag = 100 Kilograms.

4.3 Adoption of hybrid maize practices

4.3.1 Application of inorganic fertilizer and organic manure

Study results show that only 8 (8.9%) of the respondents applied Urea in their maize fields and used less than 50 kg/ha. Only two (25%) respondents had used 50 kg of Urea per ha. This implied that farmers did not apply the recommended amount of Urea for Mwanga district that was 60 kg/ha (Mowo et al., 1993). Not all respondents who had adopted the use of Urea applied it in every growing season because only three respondents showed that they applied Urea in every growing season. Respondents who did not apply Urea in every growing season gave the following reasons: Urea was expensive and they preferred to apply

organic manure. This implied that some farmers preferred other alternatives of improving soil fertility than using Urea - - an artificial fertilizer. Although 17 kg/ha of phosphorus was recommended for Mwanga district (Mowo et al., 1993), no farmer applied it in the maize field.

Of the 90 respondents, 73 (81.1%) reported that they applied farm yard manure obtained from cattle kraals. Twenty five (34%) respondents said that they applied up to 1 bag/ha of farm yard manure, 28 (38.3%) applied from 2 to 3 bags/ha, and 10 (13.7%) applied from 4 to 5 bags/ha. Ten respondents (13.7%) said that they applied from 6 to 7 bags/ha of farm yard manure. Table 4.7 summarizes the quantity of farm yard manure obtained from cattle kraals applied in maize fields.

Table 4.7. Quantity of farm yard manure from cattle kraals applied in maize fields (N=73)

Quantity (bag/ha)	Number	Percentage
<1-1	25	34.3
2-3	28	38.3
4-5	10	13.7
6-7	10	13.7
Total	73	100.0

All interviewees who applied farm yard manure, 73 (100%) agreed that farm yard manure was easily available in the village, cheap, and was compatible with the indigenous farming practices. Most, 70 (95.9%) of the respondents agreed that yields of maize per hectare obtained from fields applied with farm yard manure covered costs of production. However, these respondents agreed that labour constrained the application of farm yard manure in maize fields. Most respondents, 60 (82.2%) who had applied farm yard manure in their maize fields said that it was not the extension agents who advised them to do so, but their relatives, neighbours and friends. When respondents were asked about the complexity of the farm yard manure application, 64 (87.7%) agreed that it was not difficult to apply.

Seventeen farmers who did not apply farm yard manure in their maize fields gave the following reasons: not enough to cover the whole field, required more time to apply and not interested to use it.

4.3.2 Use of recommended spacing

All respondents, 90 (100%) said that they had not adopted the recommended spacing for growing maize. Respondents were asked to indicate their reasons for not adopting proper spacing. Of the 90 respondents, 18 (20%) respondents said that they lacked knowledge, 16 (17.8%) said that extension agents did not advice them on the recommended spacing. However, 21 (23.3%) respondents showed that adopting recommended spacing was not compatible with their indigenous farming practices. Still, 35 (38.9%) respondents said that adopting recommended spacing was costly and time consuming. When respondents were asked to show the number of plants they left per hill, 46 (51.1%) said that they left 2 plants per hill, 23 (25.6%) 3 plants per hill and 21 (13.4%) 4 to 5 plants per hill. Observations showed that most farmers left 3 to 5 plants per hill for local varieties and 2 to 3 plants for hybrid maize. This was because some seeds from local varieties died before germination or were eaten by insects before germinating as they were not treated.

During planting time, holes were dug randomly without considering the space between one hole to another. Thus the use of recommended spacing of 90 by 50 cm was not followed in Mwanga district.

4.3.3. The use of pesticides and herbicides

All respondents showed that they applied blue copper mixed with ash to kill stalk borers in their maize fields. The amount of insecticides applied varied from one respondent to another. Study results revealed that of the 90 respondents, 31 (34.4%) respondents applied one table spoonful, 25 (27.8%) applied one tea spoonful and 34 (37.8%) failed to estimate the amount of pesticides they used. Farmers applied pesticide immediately when they saw stalk borers in the field.

All respondents reported that they had not adopted the use of herbicides in the maize fields. Interviewees gave the following reasons: 41 (45.6%) said that herbicides were expensive, 24 (26.7%) showed that they lacked knowledge on how to apply them, and 25 (27.8%) did not want to use herbicides. All respondents interviewed reported that they weeded their maize fields instead of applying herbicides. Of the 90 interviewees, 52 (57.8%) said that they weeded

their farms once per growing season and 38 (42.2%) twice per growing season.

4.4 Factors associated with the adoption and non adoption

Respondents were asked their opinions about factors that affected the adoption of hybrid maize. These included farmers characteristics, innovation, institutional, environmental and other factors. Each individual factor is discussed below.

4.4.1 Farmers' characteristics affecting adoption

All respondents, 90 (100%) reported that they were aware of the hybrid maize. Of these, 76 (84.4%) and 55 (61.1%) respondents agreed that they had no negative attitude towards hybrid maize and were not reluctant to plant hybrid maize, respectively. But, 77 (85.5%) , 53 (58.9%) and 48 (53.3%) of the respondents agreed that they did not adopt hybrid maize because of their low income, not involving women in decision making and low level of education, respectively. Table 4.8 summarizes farmers characteristics that affected the adoption of hybrid maize.

Table 4.8. Farmers characteristics that affected adoption

(N=90)

Factors	Agree		Uncertain		Disagree	
	N	%	N	%	N	%
Low education	48	53.3	3	3.3	39	43.3
Low income	77	85.5	1	1.1	12	13.3
Women have no decision	53	58.9	16	17.8	21	23.3
Negative attitude	6	6.8	8	8.9	76	84.4
Lack of awareness	-	-	-	-	90	100.0
Farmers' reluctance	25	27.8	10	11.1	55	61.1

4.4.2 Technical factors that affect adoption

Of the 90 respondents, 81 (90%), 78 (86.6%) and 59 (65.6%) revealed that they had not adopted hybrid maize because it is easily damaged by pests, costly and required high labour, respectively. Also 58 (64.5%), 54 (60.0%) and 51 (56.6%) of the respondents agreed that they had not adopted hybrid maize because it is easily attacked by birds in the field, was complex to grow and it easily lodged due to their tallness, respectively. All interviewees, 90 (100%) agreed that growing hybrid maize was profitable, however, 73 (81.1%) of the respondents agreed that getting hybrid maize was not a problem.

Table 4.9 Technical factors affecting adoption (N=90)

Factors	Agree		Uncertain		Disagree	
	N	%	N	%	N	%
Seeds not available	17	18.9	-	-	73	81.1
Labour requirement	59	65.6	-	-	31	34.5
High costs	78	86.6	-	-	12	13.3
No profit	-	-	-	-	90	100.0
Complexity	54	60.0	2	2.2	34	37.8
Damaged by pests	81	90.0	2	2.2	7	7.8
Attacked by birds	58	64.5	11	12.2	21	23.3
Lodges Easily	51	56.6	7	7.8	32	35.6

4.4.3 Institutional factors affecting adoption

Of the 90 respondents, 82 (91.1%), 79 (87.8%), and 37 (82.3%) said that they had not adopted hybrid maize because of the absence of field tours, credit facilities and inadequate information from extension agents, respectively. In Kisanjuni village, for example, there was one extension agent who served the whole village. Evidence showed that the extension agent did not demonstrate the recommended technologies and practices to all farmers.

This problem was serious in Masumbeni village that had no extension agent to advice farmers. Respondents also revealed that there was a private seed company (i.e., Cargill) that sold hybrid maize seed to farmers, and 58 (64.4%) of all the respondents were of the opinion that the seed company met their seed requirements.

4.4.4. Environmental factors that affect adoption

Of the 90 respondents, 83 (92.2%) and 39 (43.3%) agreed that environmental factors that hindered them to adopt hybrid maize were infertile soils and insufficient rains in their area, respectively. All respondents revealed that soil depth in their area was not a problem. However, of the 90 respondents 76, (84.4%) reported that they did not irrigate their maize fields. Table 4.10 summarizes environmental factors affecting the adoption of hybrid maize.

Table 4.10 Environmental factors that affect adoption (N=90)

Factors	Agree		Uncertain		Disagree	
	N	%	N	%	N	%
Insufficient rains	39	43.3	-	-	51	56.7
Not irrigating farms	76	84.4	-	-	14	15.5
Infertile soil	83	92.2	-	-	7	7.7
Poor soil depth	-	-	-	-	90	100.0

Respondents also mentioned other factors that affected their adoption of hybrid maize. Of the 90 respondents, 82 (91.1%) reported that they had not adopted hybrid maize because most of them could not plough their fields. Secondly, 81 (90.0%) said that they did not adopt hybrid maize because of its poor de-husking quality for cooking kande, an important food in the village. Thirdly, 76 (84.5%) said that a tin of hybrid maize grain produced less flour when milled compared to local varieties. However, of the 90 respondents, 72 (80%) agreed that the presence of plantains in their village affected the adoption of hybrid maize. This implied that farmers had other alternative food sources. Other respondents, 68 (75.6%) agreed that the presence of coffee as a cash crop hindered the adoption of hybrid maize.

This might be because farmers got money from selling coffee that was used to buy grain maize and other requirements. Also, 67 (74.4%) of the respondents agreed that the inter-cropping system practiced in their area hindered the adoption of hybrid maize. Table 4.11 summarizes other reasons that affected the adoption of hybrid maize.

Table 4.11. Other reasons that affect adoption of hybrid maize (N=90)

Reasons	Agree		Uncertain		Disagree	
	N	%	N	%	N	%
Presence of coffee	68	75.6	-	-	22	24.4
Inter-cropping	67	74.4	-	-	23	25.5
Not ploughing	82	91.1	-	-	8	8.9
Presence of plantains	72	80.0	-	-	18	20.0
Poor de-husking	81	90.0	-	-	9	10.0
Less flour produced	76	84.5	3	3.3	11	12.3

4.5 Factors influencing the adoption of hybrid maize

One way of assessing adoption is to look at those factors that influence the adoption rate of the introduced technology. In this study cross-tabulation was used to examine the relationship between different factors and the

adoption of hybrid maize. Factors identified and investigated included farmers characteristics, technical, institutional, environmental and other factors.

4.5.1 Relationship between farmers' characteristics and adoption

Of the 90 interviewees, 53 (58.9%) agreed that they grew hybrid maize and of these, 41 (77.3%) had finished primary level education, 10 (18.9%) had attended adult education classes (Table 4.12).

Table 4.12 Adoption of hybrid maize and education level (N=90)

Education level	Adopted		Not adopted	
	N	%	N	%
No education	2	3.8	-	-
Adult education	10	18.9	2	5.4
Primary education	41	77.3	35	94.6
Total	53	100.0	37	100.0

Chi-square test=5.123 DF=2 Significance=0.077

The chi-square test on this variable was not statistically significant at $p>0.05$. This means that there was no association between adoption of hybrid maize and level of education. This does not relate to what was reported by Levinger and Drahman (1980) who claimed that there is a

relationship between the adoption of technology and the level of education. However since the highest level of education attained was primary education, it does not distinguish farmers much from those without formal education at all especially in technical recommendation that require little formal schooling skills such as simple arithmetics. The adoption of a new variety among farmers may not depend at all on their education level, while the adoption of a chemical inputs (if it needs computations) may be rapid among farmers who have a certain minimum level of education (CIMMYT, 1993).

Of the 53 interviewees who grew hybrid maize, 35 (66.0%) were males and 18 (34.0%) were females. The relationship between the respondents' gender and adoption of hybrid maize was statistically significant at $p<0.05$ (Table 4.13). This implied that there was an association between gender and the adoption of hybrid maize.

Table 4.13. Adoption of hybrid maize and gender (N=90)

Gender	Adopted		Not adopted	
	N	%	N	%
Female	18	34.0	27	72.8
Male	35	66.0	10	27.2
TOTAL	53	100.0	37	100.0

Chi-square test=13.264 DF=1 Significance=0.0003

It is sometimes unlikely that the demonstration of a relation between age and adoption will be of immediate importance. However, it could be of interest to examine if the association with age is more of a reflection of characteristics of the farm household that includes access to resources, labour availability or source of income. Table 4.14 shows that of the 53 respondents who grew hybrid maize, 21 (39.6%) were in the age range of 45 to 50, 14 (26.4%) in 38 to 44 and 10 (18.9%) in 31 to 37 years. Study results of the relationship between age and adoption of hybrid maize show that there is no statistically significant association between farmers' age and the adoption of hybrid maize at $p>0.05$. Furthermore, the results suggest that farmers between 45 to 50 years had higher adoption frequencies. Based on these results, we can perhaps conclude that respondents of this age group had more experience and resources that offered a chance for them to try new technologies and practices.

Table 4.14: Adoption of hybrid maize and age of the respondents (N=90)

Age group	Adopted		Not adopted	
	N	%	N	%
31-37	10	18.9	9	24.3
38-44	14	26.4	8	21.6
45-50	21	39.6	12	32.5
>50	8	15.1	8	21.6
TOTAL	53	100.0	37	100.0

Chi-square test=1.342 DF=3 Significance=0.72

Farm size is a common variable examined in adoption studies and is often a good indicator of wealth. It is often assumed that large scale farmers will be more likely to adopt a technology especially if the innovation requires an extra cash investment. Of the 53 respondents who grew hybrid maize, 37 (69.8%) had farm size between 1 to 3, 13 (24.5%) had 4 to 6 hectares (Table 4.15). This variable was statistically significant at $p<0.05$. This meant that there was an association between farm size and the adoption of hybrid maize. These results may lead to speculations that farmers think that their small farms are unprofitable to use innovations since the incremental yields may not cover the added costs.

The same issue can be attributed to risk and uncertainities in farming conditions. Since farmers in the study area had small farms, it is possible that the non-use of hybrid maize gave them relief from uncertain returns. This may be due to the fact that smallholder farmers are less wealthier and hence are risk averters. This relates to what Polson and Spencer (1991) who contend that there is a relationship between adoption of new technology and farm size. Sometimes a certain threshold of farm size is necessary before the investment in a technology is worthwhile (CIMMYT, 1993).

Table 4.15. Adoption of hybrid maize and farm size (N=90)

Farm size (ha)	Adopted		Not adopted	
	N	%	N	%
<1	3	5.7	12	32.4
1-3	37	69.8	25	67.6
4-6	13	24.5	-	-
TOTAL	53	100.0	37	100.0

Chi-square test = 18.46 DF = 2 Significance= 0.0001

Of the 53 respondents who grew hybrid maize, 22 (41.5%) had their income levels ranging from T shs 100,001 to 110,000 and 19 (35.9%) from T shs 60,000 to 100,000.

Few respondents, 12 (22.6%) had their income above Tshs 110,000. These results were found to be statistically significant at $p<0.05$ (Table 4.16). This means that there was an association between the adoption of hybrid maize and farmers' estimated annual income. These results implied that farmers with high income levels adopted hybrid maize more easily than those with low income levels because the latter could afford to buy hybrid maize seed. Wealthier farmers may be the first to try a new technology, especially if it involves purchase inputs (CIMMYT, 1993).

Table 4.16. Adoption of hybrid maize and estimated level of income per year (N=90)

Level of income (T shs)	Adopted N	Adopted %	Not adopted N	Not adopted %
60,000-70,000/=	7	13.2	17	46.0
70,001-80,000/=	2	3.8	4	10.8
80,001-90,000/=	4	7.6	1	2.7
90,001-100,000/=	6	11.3	3	8.1
100,001-110,000/=	22	41.5	8	21.6
>110,000/=	12	22.6	4	10.8
TOTAL	53	100.0	37	100.0
Chi-square test=15.822	DF=5		Significance=0.01	

4.5.2 Relationship between technical factors and adoption

All respondents who grew hybrid maize agreed that it was profitable. However, the chi-square test on this variable showed no statistical significance at $p>0.05$. This means that there was no association between adoption of hybrid maize and the statement that it was not profitable (Table 4.17). Of the 53 interviewees who grew hybrid maize, 34 (64.2%) respondents agreed that although they had adopted hybrid maize, they believed that it required more labour. The other proposed hypothesis that the adoption rate of hybrid maize was independent of farm labour requirement was tested by chi-square. From the results presented in Table 4.17, we failed to reject this hypothesis. This means that the chi-square test on this variable was not statistically significant at $p>0.05$. This signified that there was no association between labour requirements and the adoption of hybrid maize. This contradicts Feder et al., (1985) findings which showed that high yielding varieties generally requires more labour inputs. The contradiction might be due to the fact that most farmers in the study area had small farm sizes and used family members as labour.

Table 4.17: Technical factors and adoption (N=90)

Variable	Agree N	Agree %	Uncertain N	Uncertain %	Disagree N	Disagree %	Significance
High labour							
Adopt	34	64.2	-	-	19	35.9	0.75
Not adopt	25	67.6	-	-	12	32.4	
No profit							
Adopt	-	-	-	-	53	100.0	0.95
Not adopt	-	-	-	-	37	100.0	
Complex							
Adopt	27	50.9	2	3.8	24	45.3	0.02
Not adopt	27	73.0	-	-	10	27.0	
High cost							
Adopt	41	77.4	-	-	12	22.6	0.0001
Not adopt	37	100.0	-	-	-	-	

Of the 90 respondents, 37 had not adopted hybrid maize and reported that, it was costly to implement. From the chi-square test the results showed that there was a statistical significance at $p<0.05$ meaning that there was an association between non adoption of hybrid maize and the cost to implement it (Table 4.17). Of these respondents, 27 (73%) agreed that adopting hybrid maize was complex and the chi-square test on this variable was statistically significant at $p<0.05$. This means that there was an association between non-adoption of hybrid maize and its complexity (Table 4.17). These results are similar with what Rogers (1983) found in which he reported that some innovations are readily understood by members of a social system and so are adopted readily and others are

more complicated and adopted slowly.

4.5.3 Relationship between adoption of hybrid maize and Institutional factors

Institutional characteristics are derived from those publicly and privately operated systems for providing support services such as extension, research, credit and input supply. Of the 53 respondents who had adopted hybrid maize, 49 (92.5%) revealed that there were no credit facilities to motivate them adopt hybrid maize (Table 4.18). The chi-square test on this variable yielded an insignificant coefficient at $p>0.05$. This implied that there was no statistical significant association between adoption of hybrid maize and absence of credit facilities. Likewise, 24 (45.3%) respondents reported that there were no extension agents to advice them on how to grow hybrid maize (Table 4.18). Most of these respondents came from Masumbeni village which had no extension agent. The chi-square test on this variable was not statistically significant at $p>0.05$. This means that there was no statistical significant association between adoption of hybrid maize and the absence of an extension agent. This contradicts Lugeye (1994) who observed that information from extension agents is important to enable farmers to adopt new innovations. This disagreement is in agreement

with some farmers' observation. Farmers observed that you may have an extension agent to offer advice, but then no cash to buy farm inputs (e.g, seed, fertilizers, insecticides) to implement the technology effectively.

Table 4.18 Institutional factors and adoption (N=90)

Variable	Agree		Uncertain		Disagree		Significance
	N	%	N	%	N	%	
No credit:							
Adopted	49	92.5	3	5.7	1	1.9	
Not adopted	30	81.1	7	18.9	-	-	0.11
No exten. agents:							
Adopt	24	45.3	-	-	29	54.7	
Not adopted	22	59.5	-	-	15	40.5	0.29

4.5.4 Relationship between environmental factors and adoption

Of the 53 respondents who grew hybrid maize, 49 (92.4%) convinced that the soil type in their area supported the growing of maize. The chi-square test on this variable was statistically insignificant at P>0.05 (Table 4.19). This means that there was no statistical significant association between adoption of hybrid maize and the soil type.

This does not relate to what was reported by CIMMYT (1993)

in which it was said that there is an association between adoption of new technology and soil type. However, 23 (43.4%) respondents reported that there was insufficient rain to support the growing of hybrid maize. The chi-square test on this variable was not statistically significant at p>0.05 (Table 4.19).

Table 4.19 Environmental factors and adoption (N=90)

Variable	Agree N	Agree %	Uncertain N	Uncertain %	Disagree N	Disagree %	Significance
Insuffient rains:							
Adopted	23	43.4	-	-	30	56.6	
Not adopted	16	43.2	-	-	21	56.8	0.88
Poor soil:							
Adopted	4	7.6	-	-	49	92.4	
Not adopted	3	8.1	-	-	34	91.9	0.98

4.5.5 Relationship between adoption of hybrid maize and other factors

Of the 90 respondents, 37 agreed that they had not adopted hybrid maize because of its poor de-husking quality for cooking kande. The results from the chi-square test showed that there was a statistical significance at P<0.05 between adoption of hybrid maize and its de-husking quality (Table 4.20). Of the 37 respondents who had not adopted hybrid maize, 36 (97.3%) agreed that the presence

of coffee plants contributed to their non-adoption of hybrid maize. The chi-square test on this variable was statistically significant at $P<0.05$ (Table 4.20). This means that there was an association between not adopting hybrid maize and the presence of coffee plants. This implied that farmers knew that they had a cash crop that enabled them to get money for buying food and other requirements.

Of the 37 respondents who had not adopted hybrid maize, 34 (91.9%) agreed that a tin of hybrid maize grain when milled produced less flour than local varieties. Results from a chi-square test showed that there was no statistical significance at $P>0.05$ between the adoption of hybrid maize and the amount of flour produced (Table 4.20). Furthermore, 33 (89.2%) respondents reported that presence of plantains in the village was one of the factors affecting their not adopting of hybrid maize. This might be because some farmers knew that even if they did not grow hybrid maize there was an alternative food crop such as bananas for food. The results from the chi-square test showed that there was no statistical significance at $P>0.05$ between the adoption of hybrid maize and the presence of plantains.

Of the 37 respondents who had not adopted hybrid maize, 34 (91.9%) agreed that most farmers did not plough their fields with tractors, an agronomic practice necessary for hybrid maize. Observations showed that most farmers had fields on the slopes and tractors could not be used. The chi-square test on this variable was not statistically significant at $P>0.05$ impliying that there was no association between non- adoption of hybrid maize and ploughing fields using tractors.

In addition, 31 (83.8%) respondents agreed that inter-cropping system hindered the adoption of hybrid maize. The results from a chi-square test showed that there was a statistical significance at $P<0.05$ between the adoption of hybrid maize and inter-cropping (Table 4.20). This means that there was an association between the adoption of hybrid maize and inter-cropping system practiced.

Table 4.20 Other factors and adoption (N=90)

Variable	Agree N	%	Uncertain N	%	Disagree N	%	Significance
Precence of coffee							
Adopt	32	60.4	-	-	21	39.6	
Not adopt	36	97.3	-	-	1	2.7	0.0005
Inter-cropping							
Adopt	36	67.9	-	-	17	32.1	
Not adopt	31	83.8	-	-	6	16.2	0.05
Presence of banana							
Adopt	39	73.6	-	-	14	26.4	
Not adopt	33	89.2	-	-	4	10.8	0.31
Poor-dehusking							
Adopt	44	83.1	-	-	9	16.9	
Not adopt	37	100.0	-	-	-	-	0.004
Less flour							
Adopt	42	79.2	3	5.7	8	15.1	
Not adopt	34	91.9	-	-	3	8.1	0.39
Failure to plough	48	90.6					
Adopt	34	91.9	-	-	5	9.4	0.63
Not adopt			-	-	3	8.1	

4.6. Reasons for low adoption given by the extension agent

The extension agent was asked to give reasons that are responsible for the low adoption rate of hybrid maize in the village. Among the reasons were: first, the high prices paid for hybrid maize and other inputs. For example, the price of buying Cargil hybrid maize (C 4141) was Tanzanian shillings (T shs) 2,500 per 2kg and Cargil hybrid maize (C 4142) was T shs 2,200 per 2kg. The price of inorganic fertilizer like Urea was T shs 280 per kg. Most farmers considered these prices high. Second, the presence of plantains as the supplement food crop. Third,

drought that made most farmers not adopt hybrid maize. She also mentioned inter-cropping systems as one of the factor affecting the adoption of proper spacing. The village extension officer said that some farmers were conservative and felt comfortable with the local varieties of maize.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 CONCLUSIONS

Based on the results of this study the follwing conclusions are made.

1. On the level of adoption of hybrid maize, the study revealed that all respondents were aware of the existence of hybrid maize. However, of the 90 respondents, 53 (58.9%) showed that they had adopted hybrid maize. Furthermore, of the 53 respondents who had adopted hybrid maize only 17 (32.1%) reported that they bought new hybrid maize seed every season. Other respondents who did not buy hybrid maize every season said that in some seasons they got hybrid maize seed from maize harvested from previous seasons. This contributed to low yields that farmers obtained.

2. Respondents who reported not adopting hybrid maize, used local varieties because seeds were easily available, not easily attacked by insect pests and diseases.

3. The study revealed that high prices of both fertilizers and herbicides are beyond farmers reach. The problem is compounded by government's continuous removal of subsidies on these items. This has a negative effect on the adoption of hybrid maize.

4. Other farmers applied small amounts of organic manure like farm yard manure. This showed that farmers preferred other alternatives of improving soil fertility than using artificial fertilizers.

5. The study found that all farmers had not adopted the proper spacing for hybrid maize because they lacked knowledge and extension agents did not advice them on this. The study also revealed that proper spacing was time-consuming and costly as such incompatible with the indigenous farming practices. The number of plants per hill were found to be between 2 to 3 for hybrid maize and 3 to 5 plants for local varieties.

6. All respondents weeded their maize fields, mostly once per growing season. Blue copper mixed with ash was used to control stalk borers in the maize fields.

7. Farmers characteristics were assessed with regard to their impact on the adoption of hybrid maize.

There was statistically significant relationship between gender and the adoption of hybrid maize. Most men adopted hybrid maize than women, and this may be because most women were not involved in the decision making.

The study also revealed that there is a significant association between farm size and the adoption of hybrid maize. This was also true in respect to income and adoption of hybrid maize. Other farmers characteristics (i.e., education level, age) had no significant influence on the adoption of hybrid maize in this study.

8. Although farmers perceived that growing hybrid maize was profitable, the adoption and non-adoption depended on other factors such as high cost of adopting hybrid maize, complexity, labour requirements, and whether the crop was attacked by insect pests. The results also showed that there was a statistical significant association between cost of implementing and the adoption of hybrid maize.

9. The study found that institutional factors like absence of field tours, lack of credit, and inadequate information from extension agents affected

the adoption of hybrid maize. Other factors included lack of extension agents to disseminate information to farmers.

10. Environmental factors that affected the adoption of hybrid maize included insufficient rains, absence of alternative ways for irrigating farms and infertile soils. However, most farmers said that soil depth, supported the growth of hybrid maize in the area.

11. Presence of coffee, inter-cropping system and lack of tractors to plough maize fields affected the adoption of hybrid maize. The study also found that other factors such as the presence of plantains, poor de-husking quality and the small amount of flour produced per tin did affect the adoption of hybrid maize in the area.

5.2 RECOMMENDATIONS

Several recommendations can be drawn on the basis of the above conclusions to assist the Ministry of Agriculture and Cooperatives, policy makers, planners and other development agencies for increased agricultural development.

1. Farmers be encouraged to buy fresh supplies of hybrid maize seed every season because hybrid maize looses its yielding ability and uniformity when grown in second and subsequent years.

2. Farmers be given subsidies and credits to enable them to buy agricultural inputs.

3. Since agricultural extension information influences farmers' adoption of innovations, there is a need to strengthen agricultural extension services in the villages. The focus should be on training more extension agents capable of reaching each village. These agents should demonstrate, use extension aids and organize meetings to educate farmers on how to plant hybrid maize. Farmers' field tours should be organized for farmers to learn the practices of growing hybrid maize.

4. Women should be involved in the decision- making process so that they can decide which agricultural activities to choose.

5. Farmers should be encouraged to find alternative land to cultivate, especially in the low lands of Mwanga district or else intensify their agriculture by

adopting modern agricultural practices. The practices may include field water retention technique, agroforestry and proper crop selection.

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APPENDICES

APPENDIX: 1 FARMERS' QUESTIONNAIRE

TITLE: A STUDY OF FACTORS THAT AFFECT THE ADOPTION OF HYBRID MAIZE IN MWANGA DISTRICT.

QUESTIONNAIRE OF MWANGA DISTRICT

Respondent's number..... Village.....

District.....

I. **GENERAL INFORMATION**

1) Gender .....Female .....Male.

2) How old are you?

.....1) 18-24 yrs

.....2) 25-30 yrs

.....3) 31-37 yrs

.....4) 38-44 yrs

.....5) 45-50

.....6) Above 50 yrs.

3) How many people live in the household?

.....1) 1-3

.....2) 4-6

.....3) 7-9

.....4) 10-12

.....5) Above 12.

4) What is your highest level of formal education attained?

.....1) No education

.....2) Adult education

.....3) Primary education

.....4) Secondary education

II. INFORMATION ABOUT AGRICULTURE

5) How big is your farm?

.....1) Less than 1 acre

.....2) 1-3 acres

.....3) 4-6 acres

.....4) 7-9 acres

.....5) More than 9 acres.

6) What is the source of farm labour ?

.....1) Family members

.....2) Neighbours

.....3) Work groups

.....4) Hired labour

.....5) Other source, specify.....

7) Which food crops do most people grow in this village? Please rate them on a scale from 1-6, where 1 is most important and 6 the least important.

..... Maize

..... Beans

..... Plantains

..... Cassava

..... Wheat

8) How many acres of maize did you grow in the 1995/96 season?

.....1) Less than 1 acres

.....2) 1-3 acres

.....3) 4-6 acres

.....4) 7-9 acres

.....5) 10-12 acres

.....6) Above 12 acres

9) Do you grow any cash crops?

.....Yes .....No

10) If you grow cash crops, tick five of them, where 1 is most important and 5 least important.

.....coffee

.....cotton

.....Tobacco

.....Tea

.....Others, specify.....

11) How much money did you get in the 1995/96 from the sale of cash crops?

..... 1) Less than T. shs. 10,000

..... 2) T. shs 10,000-20,000

..... 3) T. shs 20,001-30,000

..... 4) T. shs 30,001-40,000

..... 5) T. shs 40,001-50,000

..... 6) Others specify.....

12) When did you get paid after selling your cash crops?

.....1) immediately after selling crops

.....2) 1-2 months after selling crops

.....3) 3-4 months after selling crops

.....4) Others specify.....

III INFORMATION ABOUT LIVESTOCK

13) Do you raise livestock?

.....Yes .....No

14) What kind and number of livestock do you raise? Please, rate them on a scale from 1-8,where 1 is most important and 8 the least important

Type of livestock	Number of animals kept
.....TSZ Cattle	.....
.....Cross breed cattle	.....
.....Goats	.....
.....Lockal fowls	.....
.....Others, specify	.....

15) How much money did you get in the 1995/96 season from the sale of livestock or their products?

.....1) Less than 10,000/=

.....2) 10,000-20,000/=

.....3) 20,001-30,000/=

.....4) 30,001-40,000/=

.....5) 40,001-50,000/=

.....6) 50,001-60,000/=

.....7) Others, specify.....

IV INFORMATION ABOUT OTHER SOURCES OF INCOME

16) What other income generating activities do you have?

.....1) Operates a shop

.....2) Brews local beer

.....3) Operates a carpentry

.....4) Others, specify.....

17) How much money did you get in the 1995/96 season from other income generating activities mentioned in question 16?

.....1) 10,000-20,000/=

.....2) 20,001-30,000/=

.....3) 30,001-40,000/=

.....4) 40,001-50,000/=

.....5) 50,001-60,000/=

6) Others, specify.....

18) What was your total household income in 1995/96?

.....1) Less than 10,000/=

.....2) 10,000-20,0000/=

.....3) 20,001-30,000/=

.....4) 30,001-40,000/=

.....5) 40,001-50,000/=

.....6) 50,001-60,000/=

.....7) 60,001-70,000/=

.....8) 70,001-80,000/=

.....9) 80,001-90,000/=

.....10) More than 90,000/=

11) Others, specify.....

19) For what did you use the money obtained from crop farming, raising livestock and/or other income generating activities? Please, rate them on a scale from 1-4, where 1 is most important and 4 the least important.

.....1) To buy food for the family

.....2) To buy livestock inputs

.....3) To buy crop inputs

.....4) To pay school fees

.....5) Others, specify.....

V. RATE OF ADOPTION OF HYBRID MAIZE

20) Have you heard of hybrid maize?

..... Yes ..... No

21) If you have heard about hybrid maize, have you ever grown it in your farm?

..... Yes ..... No.

22) If yes, when did you start growing hybrid maize in your farm?

.....1) Immediately after getting the information about hybrid maize.

.....2) One month later after getting the information.

.....3) Six months later after getting the information

.....4) One year later after getting the information

.....5) One and a half years after getting the information

.....6) Two years later after getting the information

.....7) Two and a half years later after getting the information

....8) Three years later after getting the information

.....9) Others, specify.....

23) For how long have you been growing hybrid maize in your farm?

.....1) One year

.....2) Two years

.....3) Three years

.....4) Four years

.....5) Five years

.....6) Six years

.....7)Others,specify.....

24) Do you buy hybrid maize in all seasons?

.....Yes ..... No

25) If not, where do you get hybrid maize in other seasons?

1) From the neighbours

2) Hybrid seed remained from other seasons

3) Selecting good seeds from the harvested maize

4) Others, specify .....

26) Did you grow hybrid maize in 1995/96 season?

.....Yes .....No

27) If yes, what variety of hybrid maize did you grow?

..... 1) MH12

..... 2) MH14

.....3) MH16

..... 4) NSCM41

.....5) Others specify.....

28) If you grew hybrid maize in the 1995/96 season how much yield did you get per acre?

.....1) 1-3 bags

.....2) 4-6 bags

.....3) 7-9 bags

.....4) 10-12 bags

.....5) Others, specify.....

29) If you do not grow hybrid maize in your farm, what other varieties of maize do you grow?

.....1) Staha

.....2) Ilonga composite

.....3) Cholima

.....4) Katumani

.....5) local varieties

.....6) Others, specify.....

30) Please indicate your agreement or disagreement with the following statements by circling the response that most nearly coincides with your own about the variety of maize you indicated in question number 27.

1 SA= Strongly Agree

2 A=Agree

3 U=Uncertain.

4 D=Disagree

5 SD=Strongly Disagree

Statement	Opinion
1) Farmers grow this variety of maize because seed is easily available.	1 2 3 4 5
2) Farmers have knowledge on how to grow this variety of maize	1 2 3 4 5
3) Farmers grow this variety because seed is not expensive	1 2 3 4 5
4) The seed of this maize variety is available in the village	1 2 3 4 5
5) Yields obtained from this variety covers the costs of growing it	1 2 3 4 5
6) The taste of this maize variety is preferred by most people	1 2 3 4 5
7) This variety is not easily attacked by insect pests	1 2 3 4 5

8) This variety is not easily attacked by diseases 1 2 3 4 5

9) The storage of this maize variety is not difficult 1 2 3 4 5

10) This maize variety is easy to mill 1 2 3 4 5

31) How much yield did you get in 1995/96 season from the variety of maize you indicated in question 27?

.....1) Less than 1 bag

.....2) 1-3 bags

.....3) 4-6 bags

.....4) 7-9 bags

.....5) 10-12 bags

.....6) Other(s)specify.....

VI APPLICATION OF INORGANIC FERTILIZER

32) Have you ever applied inorganic fertilizers in your farm when growing maize?

.....Yes .....No

33) If yes, what type and amount of fertilizer do you use in your farm in growing maize?

Type	Amount (bag/kg)
.....1) NPK	.....
.....2) TSP	.....
.....3) SA	.....
.....4) Urea	.....

34) When did you start using inorganic fertilizer you indicated in question 33 for growing maize in your farm?

.....1) Immediately after getting the information about fertilizers

.....2) One month later after getting the information

.....3) Six months later after getting the information

.....4) One year later after getting the information

.....5) One and a half year after getting the information

.....6) Two years later after getting the information

.....7) Two and a half years after getting the information

.....8) Three years later after getting the information.....

.....9) Other(s) specify.....

35) For how long have you been applying inorganic fertilizer you indicated in question 33 in your farm?

.....1) One year

.....2) Two years

.....3) Three years

.....4) Four years

.....5) Five years

.....6) Other(s) specify.....

36) Do you apply fertilizer(s) you indicated in question 33 in all seasons in your farm?

.....Yes .....No

37) If not, why do you not apply fertilizer in other seasons.

.....1) Fertilizer is not available in other seasons

.....2) Fertilizer is expensive in other seasons

.....3) I use other organic fertilizers

.....4) Lack of labour to apply the fertilizer in other seasons

38) Did you apply the fertilizer you indicated in question 33 in the 1995/96 season?

.....Yes ..... No

39) If answered yes in question 38, how much yield did you get per acre?

.....1) 1-3 bags

.....2) 4-6 bags

.....3) 7-9 bags

.....4) 10-12 bags

.....5) Other(s) specify.....

VII APPLICATION OF ORGANIC MANURE

40) Have you ever applied organic manure in your field when growing maize?

.....1)Yes .....2)No

41) If yes what type and amount of manure do you apply in your farm when growing maize?

Type of manure	Amount (bag/ha)
.....1) Marejea	.....
.....2) Compost manure	.....
.....3) Others, specify	.....

42) Please indicate your agreement or disagreement with the following statements by circling the response that most nearly coincides with your own about other alternatives you use in your farm for growing maize mentioned in question 41.

1 SA=Strongly Agree

2 A =Agree

3 U=Uncertain

4 D=Disagree

5 SD=Strongly Disagree

	Statement	**Opinion**
1)	Farmers apply this type of organic manure in maize because it is easily obtained	1 2 3 4 5
2)	Farmers know how to apply this type of manure in maize	1 2 3 4 5
3)	Farmers apply this manure in growing maize because it is not expensive	1 2 3 4 5
4)	This type of manure is available in the village	1 2 3 4 5
5)	Yields obtained cover the costs of applying the organic manure	1 2 3 4 5
6)	Farmers apply this type of manure because extension agents advise us to do so	1 2 3 4 5

7) Farmers apply this manure because it does not damage the soil 1 2 3 4 5

8) The use of this manure is compatible with indigenous farming practices 1 2 3 4 5

9) The use of this manure is not complex 1 2 3 4 5

10) Farmers use this manure because it does not require much labour 1 2 3 4 5

43) If you do not use manure in your farm, what are the reasons for not using it?

.....1) Manure is not available in the village
.....2) Manure is expensive
.....3) Lack of labour to transport it to the farm
.....4) Lack of manure transportation facilities
.....5) Requires large quantities of it to apply per hectare
.....6) Others, specify.....

44) How much yield did you get in the 1995/96 season when you applied the organic manure you indicated in Q 41?

....1) Less than 1 bag
....2) 1-3 bags
....3) 4-6 bags

....4) 7-9 bags

....5) 10-12 bags

....6) 13-15 bags

....7) Others specify .....

VIII SPACING

45) Do you use proper spacing when growing maize?

.....1) Yes .....2)No

46) If yes, which spacing do you use for your maize?

.....1) 75 x 30 cm

.....2) 90 x 25 cm

.....3) 90 x 75 cm

.....4) 90 x 50 cm

.....5) 75 x 60 cm

.....6) 75 x 30 cm

.....7) 75 x 40 cm

47) How many plants do you leave per hill?

.....1) One plant per hill

.....2) Two plant per hill

.....3) Three plants per hill

.....4) Others, specify.....

48) If you do not use proper spacing what are the reasons for not doing so?

.....1) Lack of labour to work in the field

.....2) Lack of knowledge about proper spacing

.....3) Extension agents do not advice me on the proper spacing

.....4) Proper spacing is not compatible with the indigenous practices

.....5) The use of proper spacing is costly to implement

.....6) Others, specify.....

IX PESTICIDES

49) Have you ever used pesticides in maize ?

....1)Yes .....2)No

50) If yes, what type and quantity of pesticides do you use in your maize?

INSECT PESTS	INSECTICIDE	QUANTITY
1.....	.....	.....
2.....	.....	.....
3.....	.....	.....
4.....	.....	.....

51) When do you start using pesticides in maize farm?

....1) Before the out break of pests in the maize field

....2) Two weeks after the outbreak of insect pests in the maize field

....3) Four weeks after the outbreak of insect pests

....4) Six weeks after the out break of insect pests.

....5) Seven weeks after the out break of insect pests

....6) When plants have reached a certain height

52) If you do not use pesticides in your farm, what are the reasons for not using it?

....1) Pesticides are not available

....2) Pesticides are expensive

.... 3) I do not know how to apply pesticides in maize

.... 4) Lack of labour to apply pesticides

X HERBICIDES

53) Have you ever used herbicides in maize?

.....1)Yes .....2)No

54) What type and quantity of herbicides do you use in your maize?

TYPE OF HERBICIDE	QUANTITY
1.....	.....
2.....	.....
3.....	.....
4.....	.....

55) If you do not use herbicides in your farm, what are the reasons for not using?

.....1) Herbicides are not available

.....2) Herbicides are expensive

.....3) I do not know how to apply herbicides in maize

.....4) Lack of labour to apply herbicides

XI WEEDING

56) Do you weed your maize field?

.....1)Yes .....2)No

57) If yes, how many times do you weed your maize field?

.....1) One time

.....2) Two times

.....3) Three times

.....4) Four times

.....5) Others, specify.....

58) If you do not weed your maize field, what are the reasons for not weeding?

.....1) Lack of labour to weed the field

.....2) I do not know when to start weeding

.....3) Others, specify.....

XII FACTORS THAT AFFECT THE ADOPTION OF HYBRID MAIZE

59) Please indicate your agreement or disagreement with the following statements by circling the response that most nearly coincides with your own.

1 SA=Strongly Agree

2 A=Agree

3 u=uncertain

4 D=Disagree

5 SD= Strongly Disagree

Farmers' factors that affect the adoption of hybrid maize

Statement	Opinion
1) Farmers have low level of education that hinder the adoption of hybrid maize	1 2 3 4 5
2) Income levels of most farmers is low for them to adopt the use of hybrid maize	1 2 3 4 5
3) Women farmers are not involved in decision making about planting hybrid maize	1 2 3 4 5
4) Most farmers in this village have negative attitudes about growing hybrid maize	1 2 3 4 5
5) Farmers in this village are not aware about the existence of hybrid maize	1 2 3 4 5
6) Farmers in this village are reluctant to adopt hybrid maize	1 2 3 4 5

Innovation factors that affect the adoption of hybrid maize

1)	Farmers do not grow hybrid maize because it is not available	1 2 3 4 5
2)	Farmers do not grow hybrid maize because it requires more labou	1 2 3 4 5
3)	Planting hybrid maize is costly to implement	1 2 3 4 5
4)	Growing hybrid maize is not profitable	1 2 3 4 5
5)	To grow hybrid maize is more complex	1 2 3 4 5
6)	Farmers do not grow hybrid maize because storage pests damage it	1 2 3 4 5
7)	Farmers do not grow hybrid maize because birds easily attack it in the field	1 2 3 4 5
8)	Hybrid maize easily lodges while in the field	1 2 3 4 5

Institutional factors that affect adoption of hybrid maize

1) There are no credit facilities to motivate farmers to adopt the use of hybrid maize 1 2 3 4 5
2) There are no institutions that sell hybrid maize seed to farmers 1 2 3 4 5
3) There are no village extension workers to advice farmers on agronomical practices of growing hybrid maize 1 2 3 4 5
4) The village extension workers do not advice farmers on how to grow hybrid maize 1 2 3 4 5
5) There are few extension agents to advice farmers on how to grow hybrid maize 1 2 3 4 5
6) Extension agents provide inadequate information to farmers on how to grow hybrid maize 1 2 3 4 5
7) Extension agents do not demonstrate to farmers on how to grow hybrid 1 2 3 4 5
8) Most farmers do not attend to field tours 1 2 3 4 5

9) The institutions that sell hybrid maize seed do not supply enough seeds 1 2 3 4 5

Environmental Factors that affect adoption of hybrid maize

1) This village does not get enough rains to support the growing of hybrid maize 1 2 3 4 5
2) There are no other alternatives of irrigating farms to grow hybrid maize 1 2 3 4 5
3) The soils in this village do not support the growing of hybrid maize 1 2 3 4 5
4) Soil depth in this village do not allow growth of hybrid maize 1 2 3 4 5
5) The soil pH in this village does not allow the growth of hybrid maize 1 2 3 4 5

Other factors that affect the adoption of hybrid maize

1) The presence of coffee makes most farmers not to grow hybrid maize 1 2 3 4 5
2) Most people practice inter-cropping that hinders the growing of hybrid maize 1 2 3 4 5

3)	Most farmers do not plough their fields with tractors that is necessary for hybrid maize	1 2 3 4 5
4)	The presence of plantains in the village makes farmers not to grow hybrid maize	1 2 3 4 5
5)	The taste of hybrid maize is not preferred by most people in this village	1 2 3 4 5
6)	Most farmers do not know the importance of growing hybrid maize	1 2 3 4 5
7)	The de-husking quality of hybrid maize is poor for cooking 'kande'	1 2 3 4 5
8)	Farmers do not grow hybrid maize because a 'debe' of grain when milled produces less flour compared to other varieties	1 2 3 4 5

APPENDIX: 2 EXTENSION OFFICERS' QUESTIONNAIRE

TITLE: A STUDY OF FACTORS THAT AFFECT THE ADOPTION OF HYBRID MAIZE IN MWANGA DISTRICT.

Respondent's number..... District.....

village.....

A.CHARACTERISTICS OF EXTENSION OFFICERS

1) What is your gender? .....Female .....Male

2) How old are you?

.....1) 18-24 yrs

.....2) 25-31 yrs

.....3) 32-38 yrs

.....4) 39-45 yrs

.....5) 46-52 yrs

.....6) 53-59 yrs

.....7) 60-66 yrs

..... 8) Others specify.....

3) What is your highest level of education?

.....1) Finished standard seven

.....2) Finished 'O'Level secondary education

.....3) Finished 'A' Level secondary education

.....4) Above 'A'Level education

4) What professional training do you have?

Professional	Duration	Institution	Year
1)Certificate	.....	.....	.....
2)Diploma	.....	.....	.....
3)Digree	.....	.....	.....

5) How long have you been working as an extension agent in this village?..... years.

6) How many villages do you serve?.....

7) Have you attended any in service training in the past two years?

.....Yes .....No

8) If you have attended any in-service training what was the type and duration of the training?

Institution	Type of training	Duration
.....	.....	.....
.....	.....	.....
.....	.....	.....

B. INFORMATION ON ADOPTION OF HYBRID MAIZE

9) Do you advice farmers to plant hybrid maize?

.....Yes .....No

10) How much time per day do you spend advising farmers to plant hybrid maize ?

.....1) Less than an hour/day

..... 2) One hour/day

.....3) Two hours/day

.....4) Three hours/day

.....5) Four hours/day

.....6) Others, specify.....

11) What extension aids do you use in teaching farmers about planting hybrid maize?

.....1) Leaflets

.....2) Handouts

.....3) Books

.....4) Posters

.....5) Publications

.....6) NewsLetters

.....7) News papers

12) What extension methods do you use to pass on information to farmers about planting hybrid maize?

.....1) Demonstration plots

.....2) Field tours

.....3) Home visits

.....4) Farm visits

.....5) Workshops

.....6) Organizing meetings

13) Describe your involvement with farmers in providing information about hybrid maize in the following activities.

Statement	**Always** (1)	**Sometimes** (2)	**Not at all** 3)
1) I Organize meetings			
2) I hold workshops			
3) I hold field days			
4) I conduct demonstrations plots for farmers			

5) I visit farmers in the homes and give advice ----------

6) I visit farmers in the field and give advice ----------

7) I hold farm meetings regularly ----------

C. INFORMATION ON INORGANIC FERTILIZER APPLICATION

14) Do you advice farmers to use inorganic fertilizers when planting hybrid maize?

.....Yes .....No

15) If answered yes in question 14, how much time do you spend per day advising farmers to apply inorganic fertilizer?

.....1) Less than an hour/day

.....2) One hour/day

..... 3) Two hours/day

..... 4) Three hours/day

.....5) Four hours/day

16) What type of inorganic fertilizers do you advice farmers?

.....1) NPK

.....2) TSP

.....3) SA

.....4) CAN

..... 5) UREA

17) What extension aids do you use in teaching farmers about applying inorganic fertilizer?

.....1) Leaflets

.....2) Handouts

..... 3) Books

..... 4) Posters

..... 5) Newsletter

..... 6) News paper

..... 7) Publications

18) What extension methods do you use to pass on information to farmers about applying inorganic fertilizer?

.....1) Demonstrations

..... 2) Field tours

.....3) Home visits

.....4) Farm visits

..... 5) Workshops

..... 6) Holding meeting

19) Describe your involvement with farmers in providing information about inorganic fertilizers in the following activities

Statement	Always (1)	Sometimes (2)	Not at all (3)
1) I organize meetings for farmers			
2) I hold workshops for farmers			
3) I hold field days for farmers			
4) I conduct demonstration plots for farmers			
5) I visit farmers in the homes and give advice			
6) I visit farmers in the field and give advice			
7) I hold farm meetings regularly			

D. INFORMATION ON ORGANIC MANURE APPLICATION

20) Do you advice farmers to apply organic manures when planting hybrid maize?

.....Yes .....No

21) Which organic manure do farmers apply when planting hybrid maize?

.....1) Farm yard manure

.....2) Compost manure

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

22) If yes, how much time do you spend per day advising farmers on the use of manure?

.....1) Less than an hour/day

.....2) One hour/day

..... 3) Two hours/day

..... 4) Three hours/day

.....5) Four hours/day

23) What extension aids do you use in teaching farmers about applying organic manure on hybrid maize?

.....1) Leaflets

.....2) Handouts

..... 3) Books

..... 4) Posters

..... 5) Newsletter

..... 6) News paper

..... 7) Publications

24) What Extension methods do you use to pass information to farmers about applying organic manure on hybrid maize?

.....1) Demonstrations

..... 2) Field tours

..... 3) Home visits

.....4) Farm visits

..... 5) Workshops

..... 6) Hold meetings

25) Describe your involvement with farmers in providing information about organic manure.

Statement	Always (1)	Sometimes (2)	Not at all (3)
1) I organize meetings for farmers			
2) I hold workshops for farmers			
3) I hold field days for farmers			
4) I conduct demonstration plot for farmers			
5) I visit farmers in the homes and give advice			
6) I visit farmers in the field and give advice			

E. INFORMATION ON THE USE OF PROPER SPACING

26) Do you advice farmers to plant hybrid maize to correct spacing?

.....Yes .....No

27) What extension aids do you use in teaching farmers about using the correct spacing for hybrid maize?

.....1) Leaflets

.....2) Handouts

..... 3) Books

..... 4) Posters

..... 5) Newsletter

..... 6) News paper

..... 7) Publications

28) What Extension methods do you use to pass on information to farmers about using the correct spacing for hybrid maize?

.....1) Demonstrations

..... 2) Field tours

..... 3) Home visits

.....4) Farm visits

..... 5) Workshops

..... 6) Holding meeting

29) Describe your involvement with farmers in providing information about proper spacing.

Statement	Always (1)	Sometimes (2)	Not at all (3)
1) I organize meetings for farmers			
2) I hold workshops for farmers			
3) I hold field days for farmers			
4) I conduct demonstration plot for farmers			
5) I visit farmers in the homes and give advice			
6) I visit farmers in the field and give advice			
7) I hold farm meetings regularly			

F. INFORMATION ON THE USE OF PESTICIDES

30) Do you advice farmers to use pesticides to pests that damage hybrid maize in the farm?

.....Yes .....No

31) If answered yes in question number 30, name three pesticides that you recommend farmers to use

1).....

2).....

3).....

4).....

32) How much time do you spend per day advising farmers on the use of pesticides?

.....1) Less than an hour/day

.....2) One hour/day

..... 3) Two hours/day

..... 4) Three hours/day

.....5) Four hours/day

33) What extension aids do you use in teaching farmers about the use of pesticides?

.....1) Leaflets

.....2) Handouts

..... 3) Books

..... 4) Posters

..... 5) Newsletter

..... 6) News paper

..... 7) Publications

34) What extension methods do you use to pass on information to farmers on the use of pesticides?

.....1) Demonstrations

..... 2) Field tours

.. .. 3) Home visits

.....4) Farm visits

..... 5) Workshops

..... 6) Hold meetings

35) Describe your involvement with farmers in providing information about pesticides.

Statement	Always (1)	Some times (2)	Not at all (3)
1) I organize meetings for farmers			
2) I hold workshops for farmers			
3) I hold field days for farmers			
4) I conduct demonstration plots for farmers			
5) I visit farmers in the homes and give advice			
6) I visit farmers in the field and give advice			