FARMERS ADOPTION OF SELECTED RECOMMENDED RICE PRODUCTION PRACTICES: A CASE OF KILOMBERO DISTRICT OF MOROGORO REGION, TANZANIA

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ABSTRACT

None or low adoption of recommended rice production practices like recommended fertilizer and recommended rice varieties have influenced to conduct this study. The study investigated the adoption level and factors that influence the adoption of recommended fertilizer package and recommended rice varieties in Kilombero District. Primary data were collected by the use of pretested interview questionnaire from 120 respondents selected at random to represent farmers of Kilombero District. Data were analyzed by using statistical package for social science (SPSS 16.0) computer program, where frequency and percentage were used to determine distribution of the study variables. Correlation was used to determine relationship between independent and dependent variables while Chi – square tested the significance difference between variables. Findings reveal that the level of adoption of recommended fertilizer package and recommended rice varieties in the study area is low. Respondents who applied fertilizers (68.4%) applied at different levels, that is (21.7%) fall under low adoption level, (20.0%) fall under medium adoption and (6.7%) of the respondents fall under high adoption level. Only (43.3%) of the respondents planted recommended rice variety that is TXD 306, the rest of respondents planted other rice varieties which are local and improved but not recommended. Several factors influenced the adoption and these are the independent factors like area under rice and the intervening factors namely the Efficiency Misperception (EM), Need tension (NT), Awareness and Prominence. Other factors that hinder adoption of recommended fertilizers includes, destroys soil, high cost and affect flowering and for recommended rice variety includes, susceptibility to diseases, needs great care, poor market and much water is needed. In general, the adoption of recommended fertilizer package and recommended rice variety in the study area is

strongly influenced by the intervening variables. Therefore the intervening variables which need to be focused in enhancing the adoption of recommended fertilizer package and recommended rice variety in the study area are need, perception and knowledge.

DECLARATION

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

_____ _____

Elitha H. Furahisha Date

(MSc. student)

The above declaration is confirmed by

_____ _____

Dr. Msuya Bengesi C. P. Date

Supervisor

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DEDICATION

This work is dedicated to my late beloved parents, my father Hilary Henry Furahisha and my mother Maria Sengaga – Furahisha who laid the foundation of my study.

TABLE OF CONTENTS

LIST OF TABLES

APPENDIX

LIST OF ABREVIATIONS

CAN	Calcium Ammonium Nitrate
CIMMYT	Centro Internacional de mejoramiento de maizy trigo (International Maize and wheat improvement centre)
COSTECH	Commission for Science and Technology
DALDO	District Agriculture and Livestock Development Officer
DAP	Diammonium Phosphate
DED	District Executive Director
EM	Efficiency Misperception
ILO	International Labor Organization
kg	kilogram
MAC	Ministry of Agriculture and Cooperative
MAFC	Ministry of Agriculture Food and Cooperative
MRP	Minjingu Rock Phosphate
MUVEC	Muvek Development Solutions Ltd
N	Nitrogen
NAIV	National Agricultural Input Voucher Scheme
NT	Need Tension
P	Phosphate
SA	Sulphate of Ammonia
SNAL	Sokoine National Agricultural Library
SPSS	Statistical Package for Social Science
SUA	Sokoine University of Agriculture
TSP	Triple Super phosphate
TXD	Tanzania Cross Dakawa
URT	United Republic of Tanzania

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Like in other sub – Saharan African countries, agriculture plays a significant role in Tanzanian social- economic context. In Tanzania the majority of the population directly depends on agriculture as a source of food, income, and employment (Lazaro and Mtenga, 1993). Agriculture in Tanzania employs about 80% of the entire population. The main agricultural contributors of these economies are small- scale farmers who use limited resources and simple farm inputs for crop production (Shekiangio, 2008).

The main food crops grown include maize, rice, sorghum, millet, legumes, roots and tubers, horticultural crops, and coconuts, all largely produced by smallholder farmers. Maize and rice are the most important staple food crops grown in most parts of the country. The main cash crops grown include sisal, sugarcane, tea, cotton, oil seeds, coffee, and cashew nuts. The first three cash crops are mainly grown in plantations, while the others are smallholder crops. Over the years crop production in Tanzania has not been promising. This is partly attributed by the low or non adoption of recommended agricultural production practices, like recommended varieties and fertilizers. Farmers use local varieties that are planted in same land without adding fertilizers, the practice that has resulted into low soil fertility in most parts of the country.

At the low level of soil nutrients, it has been noted that inorganic fertilizer is highly needed to reverse the declining soil fertility (Palm *et al.*, 1997; Sanders and Ahmed, 2001). Most other methods such as manure are available to many farmers in quantities that are insufficient to resolve nutrient deficiencies (Sanders and Ahmed, 2001). Everywhere

else in the World where crop yields have been substantially increased, inorganic fertilizer complemented with other agronomic practices like use of improved seed varieties, spacing, and weeding has been noted as a basic component in increasing crop production and productivity (Sanders and Ahmed, 2001).

In realization of this much effort has been undertaken by the government of Tanzania in order to achieve sufficiency in food production (Kimaro, 2003). For example during the 1970s and 1980s, the government of Tanzania used to import and manufacture fertilizer. It was distributed free of charge, or at heavily subsidized prices, an attempt to boost agricultural production (Jayne e*t al.*, 2002). In 2003/07 the government reintroduced subsidies for transport of fertilizer, the objective was to facilitate fertilizer use in remote areas and in 2005 the government decided to expand the fertilizer subsidy program to all regions including Morogoro.

In 2008 to date the government introduced the National Agricultural Input Voucher Scheme (NAIV) in order to facilitate fertilizer use in high-potential areas, offset rising cost of fertilizer, stimulate production to reduce food prices, stimulate (rather than displace) private distribution network to selected farmers in selected districts. In this scheme farmers are given three input vouchers, one for 10 kg improved maize seeds or 15 kg rice seed. Second voucher is for 1 bag of DAP of 50 kg or 2 bags of Minjingu Rock Phosphate (MRP) of 50 kg each for planting. Third voucher is for 1 bag of urea of 50 kg for top dressing. The subsidy from the government for each voucher worth an average of 50% of prevailing market price, so remained cost which is normally the market price of inputs is co-financed by farmers. The input given through this voucher system is only enough for one acre (Minot, 2009).

Despite all the efforts done by the government of Tanzania to increase adoption of recommended agricultural production practices like fertilizer and seeds in order to increase average production of major food crops like rice, still adoption of these practices is very low as highlighted in the subsequent section.

1.2 Problem Statement

Low or non adoption of recommended agricultural production practices is one of the major problems currently facing most parts of Tanzania. The recommended agricultural production practices (innovations) like improved varieties and fertilizer have not significantly been adopted by farmers who continue to use traditional technologies. Literature shows that less than 30 % of the land in Tanzania is planted to new varieties of rice, sorghum and pearl millet, and less than 10 % of farmers have ready access to seed of new varieties (Rohrbach *et al*., 2002). This means that more than 90% of farmers in Tanzania use local seeds, including those of rice.

As far as fertilizer application is concerned, Sokoine memorial lecture (2008) contends that in 2005 to 2006 seasons only 15 % of all farmers used fertilizers in Tanzania. Evidence shows that among the farmers who apply fertilizer in their fields, majority of them apply at very low level about 8 kg/hectare (Isaac, 2007). This culminates into inadequate food production for the rapid growing population. For example, the average national rice yield is as low as 1 to 1.5 tons per hectare instead of 3.1 to 4.3 tons per hectare expected under good management (URT, 2009; Kato, 2007; RLDC, 2009; Match Maker associates Ltd, 2010).

In Kilombero District where this study was expected to be conducted, an average rice production is about 1.3 tons per hectare (URT, 2002/03)**.** Kilombero District is one of the

districts benefiting from efforts done to increase agricultural production like subsidized inputs system. In addition most of extension programmes and projects like SASAKAWA 2000 and others that had the purpose of promoting rice production practices in a package form were initiated in the District. A package consists of recommended rice variety, fertilizer for planting and top dressing, spacing, weeding and pesticide application. Since many practices are promoted there is a need to assess their utilization by farmers and determine factors that influence their adoption.

Several factors have been associated with the adoption behavior. These are the independent factors like personal, institution, environmental and socio – economic factors (Matata *et al.,* 2001; Mtenga, 1999 and Nanai, 1993). However, very few studies have been conducted to determine the influence of intervening factors like needs, perception and knowledge on the adoption behavior (Duvel, 1991; Koch, 1987; Duvel and Botha, 1999; Msuya, 2007). According to Duvel (1991) the intervening variables are the key determinants of the adoption behavior. Considering poor adoption of the recommended rice production practices in Kilombero District, this study intends to determine the intervening and independent factors that influence the adoption of recommended rice production practices in Kilombero District.

1.3 Justification of the Study

Rice is the second to maize as the most important food and commercial crop in Tanzania (Relief web report, 2010). It is a major source of employment, income and food security for many rural households. The crop is extensively produced in Tabora, Shinyanga and Morogoro in Tanzania's central corridor. Manyara, Singida and Dodoma have supplementary production in their low lands. Rice production accounts for 13% of all cereals produced and consumed as food in Tanzania (Investment Potential in the Grain

Industry, n.d). Tanzania has the potential to double the record of rice produced per hectare with increased yields alone through adoption of improved technologies like use of fertilizers and improved seeds.

This study therefore assessed the level of farmers' adoption of recommended rice production practices and factors influencing their adoption in Kilombero District. The results of this study will provide in depth information to all stakeholders, namely farmers, researchers, extensionist and policy makers on the level of adoption of recommended rice production practices and the factors that influence their adoption. These will form the basis for recommending measures to be taken in order to facilitate farmers' adoption of recommended rice production practices and ultimately increased rice production, improved food security and income in Kilombero District.

1.4 Research Objectives

1.4.1 General objective

The general objective was to assess adoption of selected recommended rice production practices in Kilombero District of Morogoro Region.

1.4.2 Specific objectives

i) To assess the level of adoption of identified practices recommended in rice production in Kilombero District.

ii) To identify factors influencing the adoption of identified practices recommended in rice production in Kilombero District.

1.5 Conceptual Framework

The conceptual framework of this study (Fig.1) is based on the assumption that the adoption of recommended rice production practices such as recommended fertilizers and

recommended rice seed varieties is influenced by a number of independent factors (variables); like personal factors (age, sex, level of education, income, marital status, number of people in household, farm size and area under rice) and the intervening factors such as knowledge, perception and needs. The intervening factors (variables) are assumed to have direct influence on the adoption of recommended rice production practices, while the independent variables are hypothesized to influence the adoption behavior via intervening variables.

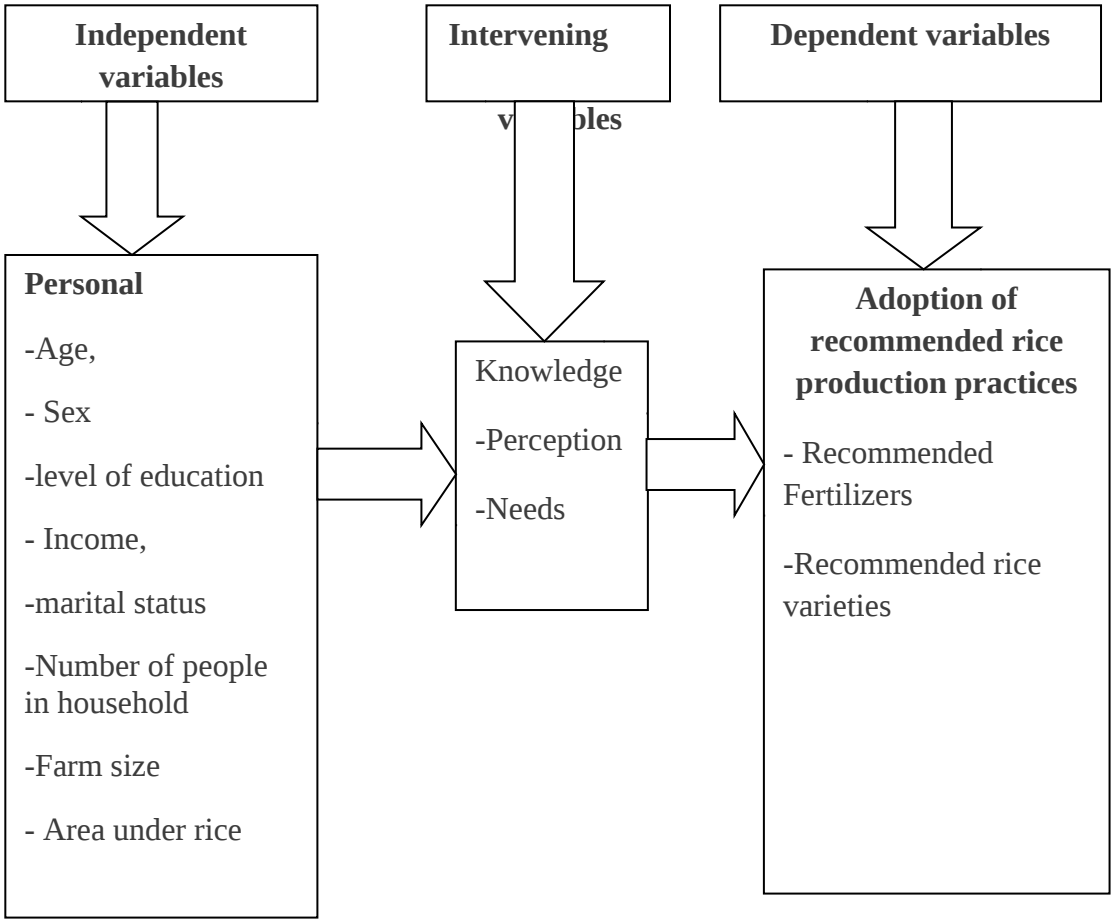

Figure 1: The conceptual framework adapted from Duvel (1991) model.

CHAPTER TWO

2.0 LITERATURE REVIEW

This chapter reviews the concept of adoption, adoption of Agricultural Innovation, rice production, rice production practices and factors affecting adoption which are the independent and the intervening factors.

2.1 The Concept of Adoption

According to Feder *et al*. (1985), adoption is "the degree of use of new innovation in long run equilibrium when a farmer has full information about the new technology and its potential". However, the equilibrium level of adoption will not be achieved if the technology is still being experimented by the farmers. Rodgers (1995) defines innovation as an idea, practice, or object that is perceived as new by an individual or other unit of adoption. This wide definition captures any idea or process that is perceived to have utility. Lionberger (1968) and Van den Ban and Hawkins (1996) contended that, adoption is a process, which the decision to adopt usually takes time. People do not adopt new practice or idea as soon as they hear about it; they may wait several years before trying it. Therefore, the adoption and diffusion of innovation process has been characterized as the acceptance overtime of some specific items by individuals (or adoption unit) linked to specific channels of communication. In this study the word innovation, technology and recommended practices will be used interchangeably.

2.2 Levels of Adoption of Agricultural Innovation

Agriculture is a way of life to many subsistence farmers and other farmers are in constant search of ways in which to improve upon their lives. In agriculture context, adoption is a decision made by an individual to start using new agricultural innovations with the aim to

increase productivity. This might be a new crop variety or management practices adopted by an individual, family or corporation. Adoption of agricultural technologies is considered as one of the ways that offer opportunities for improved agricultural production and hence improved life (Niyegela, 2007).

The technology must be widely adopted in order to self-sustain. Within the rate of adoption, there is a point at which agricultural technology reaches critical mass**.** The categories of adopters are: innovators, early adopters, early majority, late majority, and laggard. Innovators (2.5%) – had larger farms, were more educated, more prosperous and more risk-oriented, early adopters (13.5%) – younger, more educated, tended to be community leaders, less prosperous, early majority (34%) – more conservative but open to new ideas, active in community and influence to neighbours, late majority (34%) – older, less educated, fairly conservative and less socially active, laggards (16%) – very conservative, had small farms and capital, oldest and least educated. Level of adoption of technology manifests itself in different ways in various cultures and fields and is highly subject to the type of adopters and innovation-decision process (Rogers, 1983).

2.3 Rice Production

Rice is a staple food that provides energy, protein, and vitamins for about half of the world population **(**Kathuria *et al.*, 2007). Rice is the second most important food and commercial crop in Tanzania after maize. The crop is grown in three agro-ecosystems namely rainfed lowland (74%), rainfed upland (20%) and irrigated lowland (6%). It is among the major sources of employment, income and food security for Tanzania farming households. The cultivated area is 681,000 ha; this represents 18 % of Tanzania's cultivated land. About 71 % of the rice grown in Tanzania is produced under rain fed conditions. Irrigated land presents 29 % of the total with most of it in small village level traditional irrigations

(RLDC, 2009). In Central Corridor, Rice is extensively produced in the three regions Tabora, Shinyanga and Morogoro where there are more favorable growing conditions. Rice is a particularly important crop in Central Corridor where by 48 % of rice cultivated land in Tanzania is found in the Central Corridor (RLDC, 2009).

More than 80% of farmers in Tanzania grow the late maturing aromatic cultivar, Super India (160-170 days), established by broadcasting of dry seed with less than 15% using fertilizer and 95% relying on hand weeding. In order to improve rice production, adoption of recommended rice production practices is imperative. These include recommended rice varieties, fertilizers, spacing, weeding, and pest management (Indrajith, 2005).

2.4 Rice Production Practices

2.4.1 Rice variety

Tanzania has traditionally grown local varieties of rice which have descended from the seeds originally imported by Arab traders before 1960. These varieties are like Kilombero, Kihoko, Kula na bwana, Kalamata and many others which are well adapted to the climate and the taste preference of the Tanzanians, but they are relatively low yielding, averaging 1.5– 2.1 tons per acre (Tulole *et al.*, 2011).

Many efforts are put in place to make sure farmers are using the recommended varieties which are economically viable. Such varities are like TXD 306 and NERICA (New Rice For Africa). NERICA is an upland rice variety which is result of the Asiatic type of rice, *Oryza sativa,* and the African rice, *O. glaberrima.* As reported by Mghase *et al.* (2010), NERICA combines the high yield potential, responsiveness to improved and short stracture for lodging resistance from sativa and the resistance to diseases, and drought resistance has potential for high yield, matures early 30-50 days earlier than the other

upland varieties and is resistant to common environmental stresses of upland rice such as low moisture stress.

TXD 306 on the other hand has recently been released and is in high demand from farmers. Tulole e*t al.* (2011) mentioned some major attributes of TXD 306 rice variety like early maturing; produce many tillers, resistance to water lodging and high yield. At Kilombero District the Recommended rice variety is TXD 306.

2.4.2 Fertilizers

Fertilizer is very important input for intensive rice production. Common fertilizers used particularly in rice fields range from organic to inorganic. The organic fertilizers are farm yard manure and compost which are found locally and not very widely used. Inorganic fertilizers such as Urea, Triple Super Phosphate (TSP), Di-Ammonium Phosphate (DAP), Sulphate of Ammonium (SA) and Calcium Ammonium Nitrate (CAN) are widely recommended. DAP and TSP are recommended to be applied during planting as basal fertilizers while CAN, SA and Urea are recommended to be applied during top dressing.

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

(Mustapha, 2004). The recommended fertilizers at Kilombero District are DAP for planting and Urea for top dressing and both are recommended to be applied at the rate of 50 kg per acre.

2.4.3 Spacing

To avoid nutrient competition sufficient spacing between plants and rows is vital to get maximum yield in given plot of land. Appropriate spacing enables the farmer to keep appropriate plant population in his field. Hence, a farmer can avoid over and less population in a given plot of land which has negative effect on yield (Baloch *at el.,* 2002).

Enough space, along with other favorable conditions, allows the plant roots to grow profusely both vertically in deeper parts of the soil and horizontally to cover a larger area, and when roots are spread to a larger volume of soil, they tap more nutrients, which results in the development of larger plants with larger numbers of tillers and grains. The optimum spacing essential for proper rice crop development and high grain yields depends on cultivar, soil fertility, and season. No single spacing recommendation, however, is best for all rice cultivars (IRRI, 1991). The recommended spacing at Kilombero District is 20 cm x 20 cm for single row and 10 cm x 20 cm x 40 cm for double rows spacing

2.4.4 Weed control

Weeds are the most important biological barriers in rice production in a way that a noticeable part of the Production costs are allocated to them and are among the most important inhibiting factors with regards to increasing rice production (Mudge, 2004). Weeds also serve as alternative hosts for many plant diseases and animal pests that attack crops, they also harbour various bacterial and fungal diseases (Akobundu, 1980). Losses caused by weeds exceed the losses from any category of agricultural pests. Of the total

annual loss of agricultural produce from various pests, weeds account for 45%, insects 25%, diseases 25% and other pests 5% (Rao, 2000). Unsuccessful weed control can result in the almost total loss of rice yield. In view of these encouraging results, the application of herbicides suitable for every floristic situation led to minimization of yield losses, and at the same time, to an increase in the quality and quantity of rice crops (Zvonko, 2009).

The frequency of weeding is an important factor of weed control in rice production; the recommended weeding frequency depends on number of factors like plant spacing, time of planting, location of the field and rice variety. Weeding twice per cropping seasons is more appropriate although early weed removal, when the rice is still at the early vegetative phase, is desirable to maximize yields (IRRI, 1991). Most of farms in Kilombero District are located in flood plains; therefore the recommended weeding frequency in this area is two times per cropping season. Whereby the first weeding is recommended to be done at 2-3 weeks after emergence and the second weeding be done 6 to 7 weeks after emergence; before panicle initiation and topdressing to minimize the effect of the weeding process on panicle initiation and utilization of fertilizers by weeds, respectively.

2.5 Factors Influencing Adoption of Recommended Practices

It is hypothesized that once a technology is developed, adoption will take place in a stepwise manner, this depend on a number of factors like the available information about the technology, the complexity of the technology components and associated risks. These factors that influence whether a farmer to adopt the technology or not has been the focus of earlier adoption studies and have been crucial for the development of techniques for studying adoption.

Generally, there are several factors influencing adoption of recommended agricultural technology practices. These can be broadly categorized into independent factors (like farmer's characteristics, institutional, environmental factors) and the intervening factors (like knowledge, perception and needs). The following section provides an overview of independent factors influencing the adoption of recommended agricultural practices.

2.5.1 The independent factors

There are numerous independent factors influencing adoption of recommended agricultural practices. The independent factors discussed in this section includes; personal factors like sex, age, level of education, household income, number of people in a household, marital status, farm size and area under rice.

2.5.1.1 Age

Byron *et al.* (2005) reports that, elderly farmers seem to be somewhat less inclined to adopt new practices than younger farmers. It is also well known that, in general, the older the farmers the less their willingness to try new innovations or take risks. Older farmers may have more experience, resources, or authority that can allow them more possibilities for trying recommended production practices (CIMMYT, 1993). Some studies indicate that the number of farming years has a positive and significant relationship with the use of recommended production practices at least in early years (Mattee, 2009). Furthermore, some of the studies found there are no relationship between age and the use of recommended production practices (Mattee, 2009). Still other studies show that younger farmers are more likely to adopt recommended production practices (Van den Ban and Hawkins, 1996).

2.5.1.2 Sex

Discrimination against women in agricultural technology generation and dissemination inevitably affect women negatively leading to inefficient use of resources (as women fail to adopt improved technologies) and lower levels of agricultural production (Matata *et al.*, 2010). Also due to long lasted cultural and social grounds in many societies of developing countries, women have less access to household resources and also have less access to institutional services.

In most cultures, women are responsible for planting, weeding, watering, harvesting, transporting and storage of crops (International Labour Organization (ILO), (2007). Although the contribution of women farmers in agricultural production is highly recognized, in practice they are less represented in most agricultural oriented development plans. This is attributed by lack of education, decision-making power and rights and they lack access to equipment required for food production on large scale. Women often have more difficult than men in getting good land, credit, training and access to markets. In addition, they are also affected by social and traditional factors. Due to this, they become a disadvantaged group in adoption especially when it comes to the introduction of innovation in their areas (ILO, 2007; Ibrahim and Evans, 2002).

2.5.1.3 Level of education

Education improves human capital, farm management capacity, the ability to understand and adopt recommended agricultural practices (Bezuayehu *et al.,* 2002). It is expected that better educated farmers are more likely to adopt recommended agricultural practices than less educated farmers (Cary *et al.*, 2002 and Nina, 1993). Mwaseba *at el*. (2006) reported that, education of household head have influence on adoption of recommended

agricultural practices especially when the recommended agricultural practices require managerial skills.

2.5.1.4 Income

Income may enhance labour and ability to purchase and therefore low level of income implies difficulties in buying farm inputs like improved seed, fertilizers and herbicides (Msuya, 2005). Many studies report positive contribution of income to household's adoption of recommended agricultural practices like use of improved seed varieties, fertilizers application, spacing, weeding, and pest management. For instance, different recommended agricultural practices adoption studies conducted by Kidane (2001) indicated positive relationship between income and adoption of recommended agricultural practices.

2.5.1.5 The number of people in a household

The number of people in a household is another factor that can influence the adoption of recommended agricultural practices. Fivawo (1976) noted that the bigger the size of a family in a household the higher the chance of adopting recommended agricultural practices. Mussei *et al.* (2001) adds that large household sizes are able to provide the necessary labour required to adopt the recommended practice.

2.5.1.6 Marital status

Overholt *et al.* (1984) observes that married women are rarely consulted when new farming technologies are introduced. Whatever agricultural information that exists in a village, is passed over to husbands and neither to wives nor to single women who are busy working on the fields. On the other hand Van den Ban and Hawkins, (1996) contend that married couples tend to share experience of technologies.

2.5.1.7 Farm size

According to CIMMYT, (1993) farm size is a common variable in determining the adoption of an innovation. It has been recognized that, small and large farm operators differ in the speed of adoption of innovations (Polson and Spencer, 1991). Rogers (1983) averts that those farmers who own large farms enjoy a high socio economic status. They also have ample mass communication opportunities, and are more innovative in adopting new agricultural technologies (Okwell *et al.,* 1991).

2.5.2 The intervening factors

The intervening factors include various aspects of needs, knowledge and perception. They refer to the forces that energies behavior and give it direction (Duvel, 1991 and Msuya, 2007). The following section provides a description of each intervening variable investigated in this study.

2.5.2.1 Needs related factors

Needs for improving agricultural productivity are an important drives for somebody to adopt the recommended agricultural practices. An innovation that is compatible with the already known ideas, beliefs, values and needs would be quickly assessed and adopted (Rogers, 2003 and Duvel, 1991). Research results show existence of relationship between adoption behavior and need related aspects like efficiency misperception (EM) and need tension (NT) (Duvel, 1991).

(a) Efficiency misperception

The efficiency misperception is one of the results of insufficient or absent aspiration. The insufficient aspiration is a function of overrating own efficiency. Therefore efficiency

misperception refers to the degree to which individuals incorrectly (usually overrate) their efficiency (Duvel, 2004 and Duvel, 1991) noted that, there is a tendency of individuals to overrating (or underrating) their own production and/or practice adoption efficiency. This has been argued by the author to have a tremendously effect on adoption behaviour due to the fact that the more the current efficiency is overrated, the smaller the problem scope or need tension becomes and thus the smaller the incentive to adopt recommended agricultural practices.

(b) Need Tension

Need Tension is defined as a perceived discrepancy between the present situation and the desired situation or level of aspiration. This variable has been shown by different research studies to have a direct and positive relationship with the adoption behaviour (Koch, 1987; Duvel and Botha, 1999; Duvel and Scholtz, 1986; Msuya, 2007; Mlyuka, 2011). Distorted problem perceptions around the factual situation could lead to irrational decision-making that may include non-adoption, under adoption or even over adoption (Duvel, 1995).

2.5.2.2 Farmers knowledge to recommended practices

In this study knowledge refers to as an awareness of recommended practices or the optimum that is achievable in terms of efficiency. In this case refer to as awareness of recommended rice production practices in the study area. A lack of understanding or knowledge about the recommended practices is often cited as a strong barrier to the adoption of recommended practices or innovations (Duvel, 1991).

2.5.3 Farmers' perception

Perception is the process by which a person receives information or stimuli from the environment and transforms it into psychological awareness (Van de Ban and Hawkin,

1988). According to Duvel (1991) perception is understood to be of more specific nature and is analyzed based on attribute of innovation. The attributes that can be directly associated with field forces are; prominence and relative advantages.

2.5.3.1 Prominence

Prominence is a measure of how prominent or how much more or less advantageous or attractive the innovation as a whole is, relative to the other alternative. The necessity for this global comparison lies in the phenomenon that innovation are frequently perceived very positively but nevertheless not implemented, simply because another alternative is preferred, that is perceived to be more prominent (Duvel, 1991 and Msuya, 2007). For instance, different recommended agricultural practices adoption studies conducted by (Msuya, 2007 and Mlyuka, 2011) indicated positive relationship between Prominence and adoption of recommended agricultural practices.

2.5.3.2 Relative advantages

Unfavorable perception concerning the relative advantages refers to both advantages as well as disadvantages of the innovation or practices as such. The possible causes of non-adoption could thus be; unawareness of the advantages and/ or awareness of disadvantages. Both advantages and disadvantages are need related in the sense that both contribute to the overall attractiveness (or unattractiveness), which can only come about in the contexts of a relevant need disposition. Innovation attributes such as advantages and disadvantages in a certain need context can be accepted to constitute positive (driving) and negative (change impeding) forces, respectively. The imbalance of negative or positive forces as cause of non-adoption would then be the result of the mentioned unawareness of advantages (Duvel, 1991).

CHAPTER THREE

3.0 METHODOLOGY

This chapter describes the methodology used for obtaining and analyzing data relevant to this study. This chapter includes a description of study area, rationale for choosing Kilombero District, research design, population and sampling procedure, sample size**,** methods of data collection and data analysis.

3.1 Description of the Study Area

The study was done in Kilombero District of Morogoro Region located in Tanzania. Kilombero District is one of six Districts of Morogoro Region, located in Southwest of the region. It is bordered with Morogoro Rural to the East and Kilosa to North-East. The North and West borders are shared by Mufindi and Njombe Districts of Iringa Region while at its South and South-East it shares the border with Songea - Rural (Ruvuma Region) and Ulanga District, respectively.

The district comprises of 19 Wards of Chisano, Chita, Idete, Ifakara, Kibaoni, Kiberege, Kidatu, Kisawasawa, Lumelo, Mang'ula, Masagati, Mbingu, Mchombe, Mkula, Mlimba, Mofu, Sanje, Uchindila, and Utengule with a population of 321 611 (2002 census). The main economic activity of the district is agriculture and is potential for production of rice, maize, sugarcane, banana, beans and to some extent simsim and sunflower. The major food crops grown are rice and maize while sugarcane is the major cash crop (Kilombero - Wikipedia, 2011). The study was done in three wards which were purposively selected namely Kisawasawa, Mang'ula, and Mkula. Six villages were involved in this study, namely Mang'ula A and Mang'ula B from Mang'ula Ward and

Kisawasawa and Ichonde villages from Kisawasawa Ward. Other villages were Mkula and Sonjo from Mkula ward.

Rationale for choosing Kilombero District

The reasons why Kilombero District was chosen as survey and study area are the following:

(i) It is famous and important for production of rice and is one of the areas that the country mainly depends on for supplying food grains like rice.

(ii) It is one of the districts where the recommended rice production practices have been introduced.

(iii) It is easily accessible for the researcher and thus more affordable as far as traveling expenses are concerned. The area also has fair good roads that are passable throughout the year.

3.2 Research Design

Data for this study were collected by using a cross-sectional research design. In cross sectional design data are collected at single point in time from a sample selected to represent some large population (Creswell, 1994). The design is suitable for purpose of description as well as for determination of relations between variables (Babbie, 2010). The design is also considered favorable due to limited resources like manpower, finance and time, for collecting data.

3.3 The Population and Sampling Procedure

The population for this study consisted of the small holder rice growers in selected villages of Kilombero District council of Morogoro Region. In order to obtain three (3) wards that are mostly involved in rice production the purposive sampling method was

employed. From each ward two (2) villages were purposeful sampled based on their accessibility and involvement in rice production, making a total of six (6) villages. A Simple random sampling was also used to obtain the required respondents from each village.

3.4 Sample Size Determination

Matata *et al.* (2001) argued that having 80 - 120 respondents are adequate for most socio-economic studies in Sub-Saharan Africa household. A simple random sampling was also used to obtain 20 respondents from each of 6 villages. Therefore the sample size for this study was 120 household respondents. A sample of 120 is regarded desirable in this study due to limited time, financial constraints and is enough for statistical analysis such as descriptive, correlation and chi – square test (Mandenhall, 1982).

3.5 Instrumentation

Primary data were collected using questionnaire supported by personal observation. The questionnaire was used to solicit quantitative data from farmers. The instrument measured the level of adoption of recommended rice production practices and determined the independent and intervening factors that influence the adoption of recommended rice production practices in the selected villages in Kilombero District.

3.6 Pre-testing

Questionnaire after being developed was tested before their actual use in the research. The pre testing was done in Mbasa village, which is outside of the study area where randomly selected 10 small scale rice farmers were interviewed. The pre testing of the questionnaire was necessary to check validity, reliability and practicality of the instrument

prepared (Kothari, 2004). After pre-testing, the instrument was revised to accommodate identified changes.

3.7 Data Collection Methods

3.7.1 Primary data collection

Primary data were collected using questionnaire comprised of both open and close ended questions (Appendix 1). Data were collected from the respondents by the researcher assisted by three enumerators and each response was carefully recorded in the questionnaire. The enumerators were trained before and during pre testing of the research instrument.

3.7.2 Secondary data

Secondary data for this study were obtained from various sources such as, district agricultural offices, journals, websites, Sokoine National Agriculture Library (SNAL), Extension Department, Library and other related sources.

3.8 Variables and their Measurement

3.8.1 The independent variables

The following subsection describes the measurement of independent variables used in this study like sex, age, education level, marital status, income level, number of people in a household, farm size and area under rice crop.

3.8.2 Intervening variables

The intervening variables (factors) considered in this study include the need related factors like efficiency misperception (EM), need tension (NT), knowledge (the awareness) and the perception (prominence).

3.8.3 Dependent Variable

In this study the dependent variables was the adoption of recommended rice varieties and fertilizer package that is the use of Phosphates and Nitrogen fertilizers.

3.8.3.1 Rice seed varieties

This variable was measured by asking the respondents to indicate rice seed varieties they used for the 2010/11 season and therefore the categorization was according to the variety used.

3.8.3.2 Phosphate fertilization

Phosphate fertilizer is the most important nutrient in rice production. The use of phosphate fertilizers such as Triple Super Phosphate (TSP), Di-Ammonium Phosphate (DAP) and Minjingu Rock Phosphate (MRP) are widely recommended to be applied during planting as basal fertilizers (URT, 2000). In the study area the recommended phosphate fertilizer for planting rice is 100 kg/acre of MRP. In order to measure this variable respondent were asked the type and amount of fertilizer used for planting in their rice fields for season 2010/11. The answers obtained were categorized as shown below

0) Nill
1) ≤ 25 kg / acre
2) 26 – 50 kg/acre
3) 51 – 75 kg/acre
4) ≥ 76 kg/acre

3.8.3.3 Nitrogen fertilization

Nitrogen fertilizer also is the most important nutrients in rice production. The use of nitrogen fertilizers such as Urea, Sulphate of Ammonium (SA), and Calcium Ammonium Nitrate (CAN) are widely recommended. In the study area Urea is recommended to be applied as top dressing in rice production at the rate of 50 kg/acre. The variable was measured by asking the respondents to indicate the type and amount of nitrogen fertilizer used in their rice fields as top dressing and the answers were categorized as:

0) Nill
1) ≤ 25 kg/acre
2) 26 – 49 kg/acre
3) ≥ 50 kg/acre

3.8.3.4 Recommended fertilizer package

In this study recommended fertilizer package means the use of 100 kg/acre of MRP and 50 kg/acre of Urea in rice production. The adoption of recommended fertilizer package was captured by adding the scale point for phosphate fertilizer in part (3.8.3.2) and that of nitrogen in part (3.8.3.3) which makes a total of 7 scale points. The scale for recommended fertilizer package obtained were then categorized into

0) nil, 1) low 2) medium and 3) high adoption

3.9 Data Analysis

The collected primary data were coded, entered, cleansed, and analyzed using the Statistical Package for Social Science (SPSS) version 16, computer programme at Sokoine University of agriculture (SUA). Descriptive statistics such as frequency and percentage were calculated to determine distribution of the study variables. Correlation was used to determine relationship between the independent and dependent variables, while the

Chi – square was used to test the significance difference between variables under investigation. The significant level of 0.05 (95%) was selected as a criterion for determining significances.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

This chapter presents the findings of the study. It describes the level of adoption of selected rice production practices, namely recommended fertilizers and seeds. Thereafter it will explore the independent and intervening factors that influence the adoption of these practices in Kilombero District. For the matter of maintaining presentation flow, the first subsection will describe the level of adoption of fertilizer followed by factors influencing adoption of this practice. Another section will explain the level of adoption of recommended rice seed varieties and factors influencing its adoption.

4.1 Level of Adoption of Recommended Fertilizers in Rice Production

According to Mnkeni (1989) most soils are highly weathered and generally deficient in most nutrients, particularly nitrogen and phosphorus. The problem is also aggravated by inadequate use of fertilizers. In order to obtain reasonable rice yield in Kilombero District, farmers are recommended to use phosphate fertilizers during planting and Nitrogen fertilizers during topdressing. But the recommended phosphate fertilizer in the Kilombero District is Minjingu at the rate of 100 kg per acre and the recommended nitrogen fertilizer is urea at a rate of 50 kg per acre (DALDO, 2011). The following sections describe the level of adoption of recommended Phosphate and Nitrogen fertilizers as well as the level of adoption of fertilizer package in the study area.

4.1.1 Phosphate fertilizers

Phosphate fertilizers stimulate root development, promote early flowering and ripening, it also provides more grains and more active tillers (Chatterjee, 1983). In 2010/11 cropping season the majority of farmers who used Phosphate fertilizers in Kilombero District

applied MRP at planting. The findings obtained on level of adoption of recommended Phosphate fertilizer are summarized in Table 1.

Table 1: Distribution of respondents by their adoption of recommended Phosphates fertilizer (N=120)

Scale point	Phosphates fertilizer (Kg/ acre)	Frequency	Percent
0	Nil	101	84.2
1	≤ 25 kg/acre	2	1.7
2	26 – 50 kg/acre	8	6.7
3	51 – 75 kg/acre	0	0.0
	≥76 kg/acre	9	7.4
	Total	**120**	**100.0**

It is evident from the study as shown in Table 1 that the majority 84.2% of respondents did not use Phosphate fertilizer as shown in the results. Others 8.4% used 25 – 75 kg/acre of phosphate fertilizer. Also it was found that only 7.4% applied more than 75 kg/acre of Phosphate fertilizer.

4.1.2 Nitrogen fertilizer

Nitrogen fertilizers were among the component of the package which farmers at Kilombero District were recommended to apply in order to increase their rice production. Results of analysis from the study area on the level of adoption of recommended nitrogen fertilizer are as summarized in Table 2.

Table 2: Distribution of respondents by their adoption of recommended nitrogen fertilizer (N=120)

Scale point	Nitrogen fertilizer (kg/ acre)	Frequency	Percent
0	Nil	65	54.2
1	≤ 25 kg/acre	17	14.2
2	26 – 49 kg/acre	7	5.8
3	≥50 kg/acre	31	25.8
Total		**120**	**100.0**

The results of the study in Table 1 and Table 2 show that majority of farmers in the study area use nitrogen fertilizers as compared to phosphate fertilizers. The reason behind is insufficient knowledge on fertilizers, availability is not timely, costly and others say that fertilizer destroys soil.

4.1.3 Fertilizer package

Fertilizer package application indicates the amount of phosphate (P) and nitrogen (N) fertilizers applied by respondents. In order to understand the adoption level of recommended fertilization package the scale points for each individual fertilization practice discussed above were added to obtain the total fertilizer package applied in the rice fields. For example a respondent farmer who applied more than 75 kg/acre of MRP fertilizers for planting and 50 kg/acre of Nitrogen fertilizer as top dressing, his / her level of adoption of the total fertilizer package was obtained by adding the following scale points 4 + 3 = 7 scale points (Refer Table 1 and 2). Similar procedure was used to obtain different scale points that represent certain level of adoption. The scale points were then categorized as 0 for non adoption, 1 to 3 for low adoption, 4 to 6 medium adoption and ≥ 7 for high or full adoption of recommended fertilization package. Table 3 shows the level of adoption of fertilization package in the study area.

Table 3: Distribution of respondents by their adoption of recommended fertilizer package (N=120)

Level of fertilizer application	Scale point	Percentage	Frequency
Nil	(0)	62	51.6
Low	(1 – 3)	26	2 1.7
Medium	(4 – 6)	24	20.0
High	(≥ 7)	8	6.7
Total		**120**	**100.0**

Data from the study indicate that 51.6% of the respondents have not used fertilizer at all. About 21.7% fall under low adoption level represented by 1 to 3 scale point, while 20.0% fall under medium adoption represented by the scale point of 4 to 6. Only 6.7% of respondents fall under high adoption level, represented by the scale point of ≥ 7. The findings are in conformity with the study done by Elala (1999) who found low adoption of recommended fertilizers among maize growers in Ethiopia.

4.2 The Influence of Independent and Intervening Factors on the Adoption of Recommended Fertilizer Package

4.2.1 Independent Factors

This section presents the independent factors considered in this study which are sex, age, level of education, marital status, household income, number of people in a household, farm size and area under rice. The purpose of choosing these characteristics was to get the general picture of what the respondents are composed of and how that influence adoption of recommended fertilizer in rice production in the study area.

4.2.1.1 Sex

Regarding the relationship of household's sex with adoption of agricultural technologies, many previous studies reported that household's gender has positive effect on adoption in favor of males (Tadesse, 2008). The results obtained from this study concerning sex and adoptions of recommended fertilizer package are summarized in Table 4.

Table 4: Distribution of respondents by their sex and adoption of recommended fertilizer package (N=120)

Sex	Fertilizer application package									
	None		Low		Medium		High		Total	
	n	%	n	%	n	%	n	%	n	%
Male	25	46.3	11	20.4	14	25.9	4	7.4	54	45.0
Female	37	56.1	15	22.7	10	15.2	4	6.1	66	55.0
Total	**62**	**51.6**	**26**	**21.7**	**24**	**20.0**	**8**	**6.7**	**120**	**100.0**

$\chi 2 = 2.429$; df = 2; p = 0.488; r = - 0.119; p = 0.197

The result indicates that females are less capable in adopting recommended fertilizer packages as compared to their male counterparts. The negative correlation results indicate that the adoption is higher in male than in women although not significant as indicated in the correlation results in Table 4. These results are in line with Msuya (2007) who found high adoption of fertilizer among men than women farmers.

4.2.1.2 Age

It has been observed that compared with younger farmers the probability of adoption is lower among older farmers because of their planning horizons (Ervin, 1981). A negative relationship is therefore hypothesized between age and the adoption of recommended fertilizer packages (Chianu and Tsujii, 2004). The results of Chilot *et al.* (1996) also indicate that farming experience does not matter in the adoption as age increases, it was expected that farmers become conservative. Table 5 provides the summary of the study results.

Table 5: Distribution of respondents according to their age and adoption of recommended fertilizer package (N=120)

Age	Fertilizer application package									
	None		Low		Medium		High		Total	
	n	%	n	%	n	%	n	%	n	%
< 36	20	51.3	8	20.5	7	17.9	4	10.3	39	32.5
36 - 56	34	50.0	14	20.6	16	23.5	4	5.9	68	56.7
> 56	8	61.5	4	30.8	1	7.7	0	0.0	13	10.8
Total	**62**	**51.6**	**26**	**21.7**	**24**	**20.0**	**8**	**6.7**	**120**	**100.0**

$\chi 2 = 4.014$; df = 6; p = 0.675; r = - 0.093; p = 0.312

Age of the respondents involved in the study ranged between 20 and 78 years. The results from the study indicate that 32.5% of the respondents were less than 36 years and were categorized as youth, others 56.7% were between 36 and 56 years and categorized as adult and 10.8% were above 56 years categorized as old. The results show that not a single respondent from older age category had adopted the recommended fertilizer package but only 10.3% from youth category and 45.9% from adult category have adopted the recommended fertilizer package. As far as non adopters are concerned, the largest percent of them are old 61.5%. The study indicates that there is no statistically significance difference (p = 0.675) between age and adoption of the recommended fertilizer package. This concludes that the adoption of the recommended fertilizer package is not determined by age difference in the study area. Results from correlation also indicate that there is no significant relationship (r = - 0.093, p = 0.312) between age and adoption of recommended fertilizer practice. The results are in line with the studies done by (Mussei *et al*., 1981; Mattee, 2009) who found that there is no relationship between age and the adoption of recommended production practices.

4.2.1.3 Education

It is expected that educated respondents can make better decision to adopt recommended fertilizer practice than non-educated ones. With high level of education of the respondents, most farmers in the study area are likely to adopt new technologies. The findings regarding the relationship between education and adoption of fertilizers package are summarized in Table 6.

Table 6: Distribution of respondents according to their level of education and adoption of recommended fertilizer package (N=120)

Level of education	Fertilizer application package									
	None		Low		Medium		High		Total	
	n	%	n	%	n	%	n	%	n	%
No formal education	6	85.7	1	14.3	0	0.0	0	0.0	7	5.8
Primary education	54	52.9	19	18.6	21	20.6	8	7.8	102	85.0
secondary education	2	18.2	6	54.5	3	27.3	0	0.0	11	9.2
Total	**62**	**51.6**	**26**	**21.7**	**24**	**20.0**	**8**	**6.7**	**120**	**100.0**

$\chi 2 = 13.209$; df = 6; p = 0.040; r = 0.171; p = 0.061

It is noticed from the study findings in (Table 6) that most of the respondents 85.0%, had attained primary education level, and respondents with secondary education were 9.2%, and those with no formal education were only 5.8%. The majority 85.7% of the respondents with no formal education fall under none adoption category and only 18.2% respondents with secondary education fall under none category. These results are supported by chi-square test results ($\chi 2 = 13.209$, df = 6; p = 0.040) which show that there is significant difference between education levels and the adoption of recommended fertilizer practice. This implies that different education levels differ significantly in their level of adopting recommended fertilizer package. But correlation results (r = 0.171;

p = 0.061) indicate that there is slight relationship albeit at 6 percent probability (p = 0.061) between education and adoption of recommended fertilizer package.

4.2.1.4 Marital status

Marital status is an important social factor having manifestation in the social standing and the sense of responsibility of married individuals in society (Samson, 2007). It is assumed that married couples share experience in adoption of recommended agricultural technologies (Mgonzo, 2011). The findings regarding marital status and adoption of recommended fertilizer package are indicated in Table 7 below.

Table 7: Distribution of respondents according to their marital status and adoption of recommended total fertilizer package (N=120)

Marital status	Fertilizer application package									
	None		Low		Medium		High		Total	
	n	%	n	%	n	%	n	%	n	%
Married	50	52.6	19	20.0	20	21.1	6	6.3	95	79.2
Single	3	37.5	2	25.0	1	12.5	2	25.0	8	6.7
Divorce	4	44.4	2	22.2	3	33.3	0	0.0	9	7.5
Widowed	5	62.5	3	37.5	0	0.0	0	0.0	8	6.7
Total	**62**	**51.6**	**26**	**21.7**	**24**	**20.0**	**8**	**6.7**	**120**	**100.0**

$\chi 2 = 9.552$; df = 9; p = 0.388; r = - 0.056; p = 0.543

The results from the study show that married respondents were 79.2%, single were 6.7%, divorced were 7.5% and widowed were 6.7%. However no single respondents from divorced and widowed category applied the recommended fertilizer type and rate in their rice fields, others 25.0% from single and 6.3% from married category adopted the recommended fertilizer. Although married couples were expected to have high adoption due to shared experience on rice production, the study results show that as compared to other marital status categories, 52.6% of them did not use fertilizer at all in their rice fields. However the results of the chi – square ($\chi 2 = 9.552$, df = 9; p = 0.388) show that there is no significant difference between marital status and the adoption of recommended fertilizers package. The correlation findings also indicate that there is no significant

relationship (r = - 0.056; p = 0.543) between marital status and adoption of recommended fertilizer package. This implies that adoption of fertilization package is not determined by marital status in the study area. These results are supported by findings obtained by Mlyuka (2011) who found that adoption of fertilization package is not determined by marital status.

4.2.1.5 Income

Income is the main source of capital to purchase farm inputs and other household consumable goods (Tadesse, 2008). Farmers who are well off can afford the prices of new improved technology than low income farmers (Roger, 2003). The results of analysis carried out to examine the influence of income on the adoption of recommended fertilizer package are presented in Table 8.

Table 8: Distribution of respondents according to their annual income and adoption of recommended total fertilizer package (N=120)

	Fertilizer application package									
	None		Low		Medium		High		Total	
	n	%	n	%	n	%	n	%	n	%
Less than 500 000	13	56.5	8	34.8	1	4.3	1	4.3	23	19.2
500 000 – 1 million	18	78.3	9	24.3	8	21.6	2	5.4	37	30.8
1 000 001- 1 500 000	9	39.1	4	21.1	3	15.8	3	15. 8	19	15.8
1 500 001- 2 million	5	21.7	2	18.2	3	27.3	1	9.1	11	9.2
More than 2 million	17	73.9	3	10.0	9	30.0	1	3.3	30	25.0
Total	**62**	**51.6**	**26**	**24.2**	**24**	**20.0**	**8**	**6.7**	**120**	**100.0**

$\chi 2 = 12.430$; df = 12; p = 0.412; r = 0.069; p = 0.456

The results from the study show that respondents from the income category of less than Tshs 500 000 were 19.2%, respondents with income of Tshs 500 000 to 1 million were 30.8%, respondents with income of Tshs 1 000 001 to 1 500 000 were 15.8%, others Tshs 1 500 001 to 2 million were 9.2% and those with high income that is more than 2 million were 25.0%. Only 3.3% of the respondents with income more than 2 million adopted the

recommended fertilizer package although it was expected that many respondents from high income category would have high adoption of the recommended fertilizer package. The chi – square ($\chi 2 = 12.430$, df = 12; p = 0.412) reveals that there is no significant difference between income and adoption of recommended fertilizer package. The correlation test result (r = 0.069; p = 0.456) also proves the existence of no relationship between adoption of recommended fertilizer package and annual income. This might be attributed by the fact that the majority of respondents with high income more than 2 million had not adopted the recommended fertilizer package similar to low income earners.

4.2.1.6 Number of people in a household

Large family size is assumed as an indicator of labour availability in the family. Based on this fact this variable was hypothesized to have positive and significant relationship with adoption of recommended fertilizer package. Table 9 summarizes the results.

Table 9: Distribution of respondents according to their household size and adoption of recommended fertilizer package (N=120)

Category of household size	Fertilizer application package									
	None		Low		Medium		High		Total	
	n	%	n	%	n	%	n	%	n	%
1 - 3	8	44.4	7	38.9	2	11.1	1	5.6	18	15.0
4 - 6	36	50.7	15	21.1	15	21.1	5	7.0	71	59.2
More than 6	18	58.1	4	12.9	7	22.6	2	6.5	31	25.8
Total	**62**	**51.7**	**26**	**21.7**	**24**	**20.0**	**8**	**6.7**	**120**	**100.0**

$\chi 2 = 4.922$; df = 6; p = 0.554; r = - 0.008; p = 0.928

The results from the study show that 59.2% of respondents had 4 to 6 people in their household, the rest 15.0% had 1 to 3 people in their household and 25.8% had more than 6

people in their household. The findings reveal that only 6.5% respondents with more than 6 people fall under the category of high adoption compared with 5.6% with 1 to 3 people and 7.0% from household with 4 to 6 number of people of the same category. At the same time slightly more than a half 58.1% respondents with more than 6 people in their house hold, fall under the category of none adoption as compared with other household size in the same category. According to chi square results, there is no significant difference ($\chi 2 = 4.922$, df = 6; p = 0.554) between household size and the adoption of recommended fertilization package. This implies that in this study adoption of recommended fertilizer package (type and rate) does not differ with the number of people in a household. The findings also reveal that, there is no significant correlation (r = - 0.008; p = 0.928) between household size and the adoption of recommended fertilizer package. This implies that the adoption of recommended fertilizer package might be influenced by other factors such as needs and perception towards fertilizer package.

4.2.1.7 Farm size

Farm size is one of the independent factors that, in general, have been found to be an important behaviour determinant (Rogers and Shoemaker, 1971). The effect of farm size on farmers' adoption behavior has been mixed. Rosenzweig (1978) observed a positive relationship between farm size and adoption of improved agricultural technologies. However Ruttan (1977) noted that farm size is not a significant factor in explaining the adoption. The size of farm is only a surrogate for other more important factors (Feder *et al.*, 1985). The distribution of respondents' farm size in relation to their adoption of recommended fertilizer package is as presented in Table 10.

Table 10: Distribution of respondents according to their farm size and adoption of recommended fertilizer package (N=120)

Farm size category	Fertilizer application package				
	None	Low	Medium	High	Total

	n	%	n	%	n	%	n	%	n	%
1 - 3	36	48.6	16	21.6	15	20.3	7	9.5	74	61.7
4 - 6	19	59.4	6	18.8	7	21.9	0	0.0	32	26.7
More than 6	7	50.0	4	28.6	2	14.3	1	7.1	14	11.7
Total	**62**	**51.7**	**26**	**21.7**	**24**	**20.0**	**8**	**6.7**	**12 0**	**100.0**

$\chi 2 = 4.231$; df = 6; p = 0.645; r = - 0.086; p = 0.350

Basing on the study results 61.7% of respondents have farm size ranging between 1 – 3 acres, others 26.7% their farm size range between 4 – 6 acres and 11.7% have farm size more than 6 acres. It is expected that farmers with large farm size have high chance to adopt recommended fertilizer package due to the reason that larger farm size means more resources and greater ability to take the risk involved in the adoption of recommended practices, but the findings from Table 10 show that, only 7.1% respondent adopted the recommended fertilizer package from this category. Not a single respondent has adopted the recommended fertilizer package from those farmers who own the farm size ranging from 4 to 6 acres. High adoption of recommended fertilizer package seems to be among small holder farmers, with farm size ranging between 1 to 3 acres. The correlation results show that there is no relationship between farm size and adoption (r = - 0.086; p = 0.350). This might be attributed by the fact that the relationship is not linear for all adoption categories. However, the negative sign indicates that the adoption is higher among small farm holders than among large farm holders. Similar results were reported by Nanyeenya *et al.* (1997) who found farm size to have no significant influence on the adoption of inorganic fertilizers.

4.2.1.8 Area under rice

Research findings from area under rice in relation to the adoption of recommended fertilizer package is presented in Table 11. The study shows that 42.5% of respondents had

area under rice below 1 acre, others 25.0% owned between 1 and 3 acres, and the rest 32.5% had more than 3 acres. Adoption of recommended fertilizer package is high 13.7% for those with small area under rice production (below 1 acre) and only 2.6% respondents from the category of high adopters owned more than 3 acres.

Table 11: Distribution of respondents according to their area under rice and adoption of recommended fertilizer package (N=120)

Area under rice	Fertilizer application package									
	None		Low		Medium		High		Total	
	n	%	n	%	n	%	n	%	n	%
Less than 1	23	45.1	10	19.6	11	21.6	7	13.7	51	42.5
1 - 3	14	46.7	9	30.0	7	23.3	0	0.0	30	25.0
More than 3	25	64.1	7	17.9	6	15.4	1	2.6	39	32.5
Total	**62**	**51.7**	**26**	**21.7**	**24**	**20.0**	**8**	**6.7**	**120**	**100.0**

$\chi 2 = 10.490$; df = 6; p = 0.105; r = - 0.211; p = 0.021

On the other hand the majority of respondents 64.1% with more than 3 acres had not adopted the recommended fertilizer package. These findings are supported by the correlation results that show negative relationship (r = - 0.211; P = 0.021) between area under rice and the adoption of recommended fertilizers. This implies that the smaller the area under rice is, the higher the adoption tends to be.

Generally most of the investigated independent variables in this study (except area under rice production) seemed to have no significant association with the adoption of fertilizer package as supported by other literature (Matata *et al.,* 2001; Mtenga, 1999 and Nanai, 1993). The adoption could be influenced by other factors like needs, perception and knowledge. According to Duvel, 1991; Koch, 1987; Duvel and Botha, 1999;

Habtemariam, 2004; Msuya, 2007; Mlyuka, 2011, these are the intervening variables regarded to be the most determinants of the adoption behaviour. The following section therefore examined the influence of intervening variables in the adoption of recommended fertilizer package in the study area.

4.2.2 Intervening Factors

Intervening variables discussed in this study include efficiency misperception; need tension, prominence and awareness (knowledge).

4.2.2.1 Efficiency Misperception (EM)

How a farmer perceives the efficiency of fertilizer package adoption is expected to have influence in his/ her adoption behavior in several ways. These include none, low, medium or high adoption. The relationship between EM and adoption of recommended fertilizer package is summarized in Table 12.

Table 12: Distribution of respondents according to their Efficiency Misperception (EM) and adoption of recommended fertilizer package (N=120)

Efficiency misperception	**Fertilizer application package**									
Medium	**None**		**Low**				**High**		**Total**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Underrate	0	0.0	0	0.0	1	100.0	0	0.0	1	0.8
Slight underrate	32	52.5	12	19.7	10	16.4	7	11.5	61	50.8
Asses correct	16	59.3	4	14.8	6	22.2	1	3.7	27	22.5
Slight overrate	0	0.0	5	45.5	6	54.5	0	0.0	11	9.2
Overrate	14	70.0	5	25.0	1	5.0	0	0.0	20	16.7
Total	**62**	**51.6**	**26**	**21.7**	**24**	**20.0**	**8**	**6.7**	**120**	**100.0**

$\chi 2 = 28.781$; df = 12; p = 0.004; r = - 0.122; p = 0.184

According to study findings as shown in Table 12, about 52.0% of respondents underrated their EM, 22.5% assessed correct, while 25.9% overrated. The findings reveal that the largest percentage 70.0% of the respondents who overrate their fertilizer adoption efficiency fall under non adopters category compared to 52.5% who underrated their efficiency on the same category. On the other hand 11.5% of respondents who underrate and 3.7% who assessed correctly adopted the recommended fertilizer package while not a single respondent who overrated his/her EM did so. The underrating situation of respondents indicates their need to improve the practice they are doing now to more recommended practices and therefore overrating may be have contributed to their non adoption of recommended fertilizer package. Although correlation results show that there is no relationship between efficiency misperception and adoption ($r = - 0.122$; $p = 0.184$). The negative sign of the correlation coefficient indicates that the adoption rate decreases as the current efficiency of recommended fertilizers adoption is overrated and vice versa. The chi – square test results ($\chi 2 = 28.781$, $df = 12$; $p = 0.004$) indicate that there is significant difference between various categories of efficiency misperception and adoption of recommended total fertilization package in the study area.

4.2.2.2 Need Tension

As stated earlier, need tension is defined as the problem scope or perceived discrepancy between the current and the desired or potential situation (Duvel, 1991). This is an intervening variable, which has been found to have positive influence on the adoption behavior (Koch, 1987; Duvel and Botha, 1999; Duvel and Scholtz, 1986; Msuya, 2007). In this study need tension is also assumed to have positive relationship with adoption of recommended fertilizer package. Table 13 summarizes the results.

Table 13: Distribution of respondents according to their Need Tension (NT) and adoption of recommended fertilizer package (N=120)

Need Tension	Fertilizer application package									
	None		Low		Medium		High		Total	
	n	%	n	%	n	%	n	%	n	%
Low	40	50.0	12	15.0	20	25.0	8	10.0	80	66.7
Medium	14	45.2	13	41.9	4	12.9	0	0.0	31	25.8
High	8	88.9	1	11.1	0	0.0	0	0.0	9	7.5
Total	**62**	**51.6**	**26**	**21.7**	**24**	**20.0**	**8**	**6.7**	**120**	**100.0**

$\chi 2 = 18.273$; df = 6; p = 0.006; r = - 0.233; p = 0.011

Study findings indicate that 66.7% of the respondents had low need tension (NT), 25.8% had medium need tension and 7.5% had high need tension. The results also show that none of the respondents from medium and high need tension have adopted the recommended fertilizer package, only 10.0% respondents with low need tension adopted the recommended fertilizer package. On the other hand, 88.9% of respondents with high need tension fall under none adoption category, while 50.0% with low need tension and 45.2% with medium need tension fall under the same category. The findings are supported by negative correlation (r = - 0.233; p = 0.011) which indicates that there is negative significant relationship between NT and adoption of recommended fertilizer application against what is expected. According to Habtemariam and Düvel (2004) negative correlations in the case of several variables related with the perceived problem discrepancy (need tension) between the current and desired situation can be attributed to especially the less effective respondents over - rating their own efficiency and/or need satisfaction.

4.2.2.3 Prominence

Prominence is synonymous with Rodgers (1983) concept of relative advantage, which he defines as the degree to which an innovation is perceived as being better than the idea it supersedes. It is another intervening variable which was used to determine the adoption behaviour of the recommended fertilizer package in this study. It is hypothesized that, the more innovation is being perceived to be better than the one it supersedes, the higher the adoption is likely to be (Duvel, 1991; Msuya, 2007 and Mlyuka, 2011). Table 14 summarizes the survey results on the relationship between prominence and adoption of recommended fertilizers package in the study area.

Table 14: Distribution of respondents according to their Prominence (Pr) and adoption of recommended fertilizer package (N=120)

Prominence	Fertilizer application package									
	None		Low		Medium		High		Total	
	n	%	n	%	n	%	n	%	n	%
Low	10	100.0	0	0.0	0	0.0	0	0.0	10	8.3
Medium	29	50.9	17	29.8	11	19.3	0	0.0	57	47.5
High	23	43.4	9	17.0	13	24.5	8	15.1	53	44.2
Total	**62**	**51.6**	**26**	**21.7**	**24**	**20.0**	**8**	**6.7**	**120**	**100.0**

$\chi 2 = 22.355$; df = 6; p = 0.001; r = 0.324; p = 0.000

According to findings, about 8.0% of respondents perceived the recommended fertilizer package to have low prominence relative to their own practices, while 47.5% perceive it to have medium prominence and 44.2% perceive it to have high prominence. Only the respondents with high prominence 15.1% have adopted the recommended fertilizer package while none of the respondents with low and medium prominence adopted the recommended fertilizer package. All respondents 100% with low prominence did not use fertilizer at all, while only 43.4% of respondents with high prominence and 50.9% with medium prominence fall under same category of none adopters. This is supported by

highly positive significant correlation (r = 0.324; p = 0.000) implying that the adoption of fertilizer package in rice production in the study area is influenced by perceived prominence. The chi – square (χ2 = 22.355, df = 6; p = 0.001) also indicates significant difference between different prominence categories and adoption of recommended fertilizer package.

4.2.2.5 Awareness

This is defined as the awareness of the recommended solution or optimum level that is achievable in terms of efficiency (Duvel, 2004). The respondents were asked to indicate their awareness of recommended fertilizer package for rice production in their area. The findings show that the majority of respondents are not aware as shown in Table 15.

Table 15: Distribution of respondents according to their awareness and adoption of recommended fertilizer package (N=120)

Awareness	**Fertilizer application package**									
	None		**Low**		**Medium**		**High**		**Total**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Not aware	52	61.2	19	22.4	13	15.3	1	1.2	85	70.8
Aware	10	28.6	7	20.0	11	31.4	7	20.0	35	29.2
Total	**62**	**51.6**	**26**	**21.7**	**24**	**20.0**	**8**	**6.7**	**120**	**100.0**

χ2 = 21.568; df = 3; p = 0.000; r = 0.403; p = 0.000

The chi - square indicates that there is significant difference (χ2 = 21.568, df = 3; p = 0.000) between awareness and adoption of recommended fertilizers package. The correlation results also show that there is significant relationship (r = 0.403; p = 0.000) between awareness and adoption of recommended fertilizer package. This implies that awareness has influence on adoption of recommended fertilizer package in rice production, in the study area.

4.2.2.6 Awareness of advantages and disadvantages of recommended fertilizer package

The awareness of advantages and disadvantages of recommended fertilizer package are assumed to have influence on adoption behavior of recommended fertilizer package in rice production. The awareness of advantages is discussed first followed by awareness of disadvantages.

(a) Awareness on advantages of recommended fertilizer package

Farmers were asked to mention the advantages of applying recommended fertilizer package in their rice fields. The advantages mentioned were high yield, health plant, many tillers, green colour, fast growth and pest reduction. But the most important advantage which was mentioned by many of respondents was high yield, other advantages were mentioned by very few respondents as shown in Table 16.

Table 16: Distribution of respondents according to their awareness of advantages on recommended fertilization package (N=120)

Advantage	Frequency	Percentage
High yield	114	95.0
Many tillers	23	19.2
Fast growth	13	10.8
Health plant	41	34.2
Green colour	4	3.3
Reduce pest	1	0.8

According to study findings as shown in Table 16 majority of respondents 95% were aware of high yield as one of the advantage of using recommended fertilizer package as

compared to other advantages like many tillers 19.2%, fast growth 10.8%, health plant 34.2%, green colour 3.3% and reduce pest 0.8%.

(b) Awareness of disadvantages on recommended fertilizer package

It is expected that awareness of disadvantages associated with the implementation of fertilizer package will hinder its adoption. Farmers were therefore asked to list the disadvantages of applying the recommended fertilizer package in their rice fields. Disadvantages mentioned were high cost, affect flowering, not available on time, destroys soil and labour requirement. But the most important attribute which was mentioned by many of the respondents is that fertilizer destroys soil as shown in Table 17.

Table 17: Distribution of respondents according to their awareness of disadvantages on recommended fertilizer package (N=120)

Disadvantage	Frequency	Percentage
High cost	35	29.2
Affect flowering	13	10.8
Not timely available	3	2.5
Destroys soil	39	32.5
Labour requirement	1	0.8
Don’t know	9	7.5

The results from the study indicate that 32.5% of respondents are aware that the recommended fertilizer package destroys soil. Others indicated that the cost of fertilizers is very high 29.2%, affect flowering 10.8%, it is not timely available 2.5% and it requires labour during application 0.8%.

4.3 Recommended Rice Seed Varieties

The following section presents the findings of the level of adoption of recommended rice seed varieties and thereafter it will explore factors influencing adoption in the study area.

4.3.1 Level of adoption of recommended rice seed varieties

Varieties characteristics play a vital role in influencing farmer's adoption behavior. If the characteristics satisfy the need and interest of the farmers they will adopt (Tadesse, 2008). Farmers in Kilombero District grow different varieties like, TXD 306, Kilombero, Kihoko, Local variety and Super India, but the recommended rice variety is TXD 306. During data collection respondents were requested to indicate rice varieties they grew in 2010/11 cropping season. Table 18 show the distribution of respondents according to type of rice varieties planted.

Table 18: Distribution of respondents according to rice seed varieties planted in 2010/11 season (N=120)

Scale	Rice seed varieties	Frequency	Percent
1	Local varieties	54	45.0
2	Improved but not recommended	14	11.7
3	Recommended Variety	52	43.3
	Total	**120**	**100.0**

Out of 120 respondents 45.0% planted local rice seed varieties (Afaa Mwanza, Tule na bwana, Moshi wa sigara, Shingo ya mwali, Kalimata, Zambia, Mbawambili, Kisegese, Mwarabu, Rangi mbili, Dunduli, Kalinang'aula, Likanyaga and Ngome), 43.3% planted recommended rice varieties that is TXD 306 rice seed variety. Others, 11.7% planted varieties which are improved but not recommended (TXD 88, super India, Kilombero and Kihoko red (Sindano) rice seed varieties). This implies that large number of respondents did not plant the recommended rice seed variety which is TXD 306. The study went further to investigate the independent and intervening factors influencing adoption of recommended rice seed variety in the study area as explained below.

4.3.2 The Influence of Independent Variables on Adoption of Recommended Rice Variety

4.3.2.1 Sex

Gender difference is found to be one of the factors influencing adoption of new technologies. Due to many socio-cultural values and norms males have freedom of mobility and participation in different meetings and consequently have greater access to information (Tadesse, 2008). So in this study sex is hypothesized to influence adoption in favour of males. The findings regarding sex and adoption of recommended rice seed variety are summarized in Table 19.

Table 19: Distribution of respondents according to their sex and adoption of recommended rice seed variety (N=120)

Sex	Rice varieties adopted							
	Local		Improved not recommended		Recommended		Total	
	n	%	n	%	n	%	n	%
Male	21	38.9	7	13.0	26	48.1	54	45.0
Female	33	50.0	7	10.6	26	39.4	66	55.0
Total	**54**	**45.0**	**14**	**11.7**	**52**	**43.3**	**120**	**100.0**

$\chi 2 = 1.481$; df = 2; p = 0.477; r = - 0.105; p = 0.253

The results from the study show that the adoption of recommended rice seed variety are high in male 48.1% while in female are only 39.4%. High percentage of female 50.0% used local seed varieties as compared to male 38.9%. The differences between gender categories are not significant as proved by chi-square test results. Also there is no correlation between sex of the respondents and adoption of recommended rice seed variety (r = - 0.105; p = 0.253). The negative correlation (r = - 0.105) implies that female respondents are less inclined than the male respondents to adopt the recommended rice seed variety.

4.3.2.2 Age

Age of a farmer can generate or erode confidence on technologies. In other words, older farmers will be in a position to experience much with their traditional farming practices. With age a farmer can become more risk averse to new technologies and are expected to be less responsive to newly introduced agricultural technologies. However there are mixed results as to the direction of influence. For example (Rahmeto, 2006) contends that younger farmers have more probability of adopting improved rice varieties technologies than older farmer. Study results showing the relationship between age and adoption of recommended rice seed variety are presented in Table 20.

Table 20: Distribution of respondents according to their age and adoption of recommended rice seed variety (N=120)

	Rice varieties adopted							
	Local		Improved not recommended		Recommended		Total	
	n	%	n	%	n	%	n	%
< 36	24	61.5	4	10.3	11	28.2	39	32.5
36 – 56	23	33.8	9	13.2	36	52.9	68	56.7
> 56	7	53.8	1	7.7	5	38.5	13	10.8
Total	**54**	**45.0**	**14**	**11.7**	**52**	**43.3**	**120**	**100.0**

$\chi 2 = 8.450$; df = 4; p = 0.076; r = 0.151; p = 0.100

The results as presented in Table 20 shows that high percentage of youth 61.5% with (<36) years used local rice seed varieties, while 52.9% of the adult (36 to 56 years) respondents adopted the recommended rice seed variety. The results also show that there is no significant difference between age groups in terms of adoption of recommended rice seed variety ($\chi 2 = 8.450$; df = 4; p = 0.076). This concludes that the adoption of recommended rice seed varieties is not determined by age difference in the study area. Also the results from correlation indicates that there is no significant relationship (r = 0.151 p = 0.100) between age and adoption of recommended rice seed varieties. The

findings are supported by CIMMYT (1993) which contends that adoption of a given innovation may not be strictly correlated with age.

4.3.2.3 Education

Level of education increases farmers' ability to obtain, process, and use information relevant to adoption of improved rice seed varieties. Education is therefore expected to increase the probability of adoption of improved rice seed varieties in the study area (Rahmeto, 2006). An overview of respondent's education with respect to adoption is shown in Table 21.

Table 21: Distribution of respondents according to their education and adoption of recommended rice seed variety (N=120)

Level of education	Rice varieties adopted							
	Local		Improved not recommended		Recommended		Total	
	n	%	n	%	n	%	n	%
Non formal education	4	57.1	1	14.3	2	28.6	7	5.8
Primary education	46	45.1	13	12.7	43	42.2	102	85.0
secondary education	4	36.4	0	0.0	7	63.6	11	9.2
Total	**54**	**45.0**	**14**	**11.7**	**52**	**43.3**	**120**	**100.0**

$\chi 2=3.269$; df = 4; p = 0.514; r = 0.116; p = 0.205

As far as education is concerned very few 5.8% of the respondents have no formal education and the majority 85.0% have primary education, which is common in Tanzania, the rest 9.2% have attained secondary education (Table 21). High percentage of respondents with no formal education 57.1% planted local varieties and the percentage with secondary education 36.4% fall under the same category. The largest percentage 63.6% of respondents with secondary education level adopted the recommended rice seed variety compared with other percentages in the same category. However, the chi-square test ($\chi 2=3.269$; df = 4; p = 0.514) indicate that there is no significant difference between

education levels and the adoption of recommended rice seed variety. This implies that different education levels do not differ in their levels of adopting recommended rice seed varieties. The results from correlation also indicates that there is no relationship (r = 0.116; p = 0.205) between education and adoption of recommended rice seed variety.

4.3.2.4 Marital status

Marital status is an important social factor having manifestation in the social standing and the sense of responsibility of married individuals in society (Samson, 2007). It is assumed that married couples share experience in adoption of recommended rice variety in the study area. Table 22 summarizes the study results.

Table 22: Distribution of respondents according to their marital status and adoption of recommended rice seed variety (N=120)

Marital status	Rice varieties adopted							
	Local		Improved not recommended		Recommended		Total	
	n	%	n	%	n	%	n	%
Married	41	43.2	11	11.6	43	45.3	95	79.2
Single	2	25.0	1	12.5	5	62.5	8	6.7
Divorce	6	66.7	0	0.0	3	33.3	9	7.5
Widowed	5	62.5	2	25.0	1	12.5	8	6.7
Total	**54**	**45.0**	**14**	**11.7**	**52**	**43.3**	**120**	**100.0**

$\chi 2$ =7.263; df = 6; p = 0.297; r = - 0.141; p = 0.124

High percentage of single respondents 62.5% adopted the recommended rice seed variety as compared to married couples 45.3%, although married couples were expected to have high adoption due to shared experience on rice production. Divorced is the only category with high percentage 66.7% of respondents who used local seed varieties as compared to other categories. The results of the chi – square ($\chi 2$ =7.263; df = 6; p = 0.297) shows that there is no significant difference (p > 0.05) between marital status and the adoption of recommended rice seed variety. Further the correlation findings reveals that there is no significant relationship (r = - 0.141; p = 0.124) between marital status and adoption of

recommended rice seed variety. This implies that adoption of recommended rice seed variety is not determined by marital status in the study area.

4.3.2.5 Income

Income has a direct correlation with adoption of technologies (Roger, 2003). Farmers who are well off can afford the prices of new improved technology than low income farmers. Farm income is the main source of capital to purchase farm inputs and other household consumable goods. Thus, those households with a relatively higher level of farm income are likely to purchase improved rice seeds or other essential agricultural inputs (Rahmeto, 2006). The findings regarding income and adoption of recommended rice seed variety are summarized in Table 23.

Table 23: Distribution of respondents according to their income and adoption of recommended rice seed variety (N=120)

Category of annual income	Rice varieties adopted							
	Local		Improved not recommended		Recommended		Total	
	n	%	n	%	n	%	n	%
Less than 500 000	14	60.9	3	13.0	6	26.1	23	19.2
500 001 – 1 million	14	37.8	5	13.5	18	48.6	37	30.8
1 000 001-1 500 000	4	21.1	2	10.5	13	68.4	19	15.8
1 500 001- 2 million	4	36.4	1	9.1	6	54.5	11	9.2
More than 2 million	18	60.0	3	10.0	9	30.0	30	25.0
Total	**54**	**45.0**	**14**	**11.7**	**52**	**43.3**	**120**	**100.0**

$\chi 2=12.243$; df = 8; p = 0.141; r = - 0.025; p = 0.783

The results indicated in Table 23 show that low percentage 30.0% of the respondents with high income more than 2 million adopted the recommended rice seed variety, although it was expected that many respondents from high income category would have high adoption of the recommended rice seed variety. The chi – square ($\chi 2=12.243$; df = 8; p = 0.141) reveals that there is no significant difference between income and adoption of recommended rice seed variety. The correlation test results (r = - 0.025; p = 0.783)

indicates no relationship between adoption of recommended rice seed variety and annual income. This might be attributed by the fact that high percentage of respondents with high income more than 2 million had not adopted the recommended rice seed variety similar to low income earners.

4.3.2.6 Number of people in the household

Number of people in the household in this study is considered as the number of individuals who resides in the respondent's household. Large family size is assumed as an indicator of labour availability in the family (Tadesse, 2008). A household with large working labor force will be in a position to manage the labor intensive agricultural activities. Moreover, large working labor force in a family means, the household may not need to hire more additional labor and the money saved due to use of own labor force could be used for purchasing other crop production inputs. This will increase household's possibility to adopt improved rice varieties production package (Rahmeto, 2006). The results are as presented in Table 24.

Table 24: Distribution of respondents according to their number of people in the household and adoption of recommended rice seed variety (N=120)

Category of household	Rice varieties adopted							
	Local		Improved not recommended		Recommended		Total	
	n	%	n	%	n	%	n	%
1 - 3	10	55.6	2	11.1	6	33.3	18	15.0
4 - 6	20	42.6	3	6.4	24	51.1	47	39.2
More than 6	24	43.6	9	16.4	22	40.0	55	45.8
Total	**54**	**45.0**	**14**	**11.7**	**52**	**43.3**	**120**	**100.0**

$\chi 2 = 3.905$; df = 4; p = 0.419; r = 0.032; p = 0.725

The results as presented in Table 24 indicate that high percentage 55.6% of respondents with 1 to 3 numbers of people used local varieties as compared to 43.6% with more than 6 number of people in their household. At the same time 51.1% from the household with 4 to 6 number of people used recommended rice seed variety as compared to 40.0% with more than 6 numbers of people in their household. According to chi square results, there is no significant difference ($\chi 2 = 3.905$; df = 4; p = 0.419) between household size and the adoption of recommended rice seed variety. This implies that in this study adoption of recommended rice seed variety does not differ with the number of people in a household. The findings also reveal that, there is no significant correlation (r = 0.032; p = 0.725) between household size and the adoption of recommended rice seed variety. This implies that the adoption of recommended rice seed variety might be influenced by other factors such as, needs and perception towards recommended rice seed variety.

4.3.2.7 Farm size

Empirical studies show that land is one of the factors that affect adoption of recommended technologies among farmers. Those farmers who have land are likely to adopt technologies than the landless farmers (Samson, 2007). Hence, land holding was hypothesized to have positive and significant relationship with adoption of recommended rice seed variety in the study area. Table 25 summarizes the results.

Table 25: Distribution of respondents according to their farm size and adoption of recommended rice seed variety (N=120)

Farm size category	Rice varieties adopted							
	Local		Improved not recommended		Recommended		Total	
	n	%	n	%	n	%	n	%
1 - 3	28	37.8	9	12.2	37	50.0	74	61.7
4 - 6	17	53.1	3	9.4	12	37.5	32	26.7
More than 6	9	64.3	2	14.3	3	21.4	14	11.7
Total	**54**	**45.0**	**14**	**11.7**	**52**	**43.3**	**120**	**100.0**

$\chi 2 = 5.273$; df = 4; p = 0.260; r = - 0.204; p = 0.025

Although it is expected that farmers with large farm size have high chance to adopt recommended rice seed variety, the findings show that high percentage 64.3% from this category used local varieties and only 21.4% respondents in this category had adopted recommended rice seed variety as compared to 50.0% and 37.5% for those owning 1 to 3 acres and 4 to 6 acres respectively in the same category. High adoption of recommended rice seed variety seems to be higher among small holder respondents, with farm size ranging between 1 to 3 acres. The correlation results show that there is relationship between farm size and adoption ($r = - 0.204$; $p = 0.025$). This might be attributed by the fact that the relationship is linear for adoption categories. The negative sign indicates that the adoption is higher among small farm holders than among large farm holders.

4.3.2.8 Area under rice

The survey went further to assess the influence of area under rice on adoption of recommended rice seed variety. The results obtained are presented in Table 26. Results as presented in Table 26 shows that high percentage 66.7% of respondents owned more than 3 acres used local varieties than it was expected, at the same time adoption is high 58.8% for those with small area under rice production (below 1 acre) and only 20.5% respondents owned more than 3 acres adopted the recommended rice variety. These findings are supported by the correlation results that show negative relationship ($r = - 0.332$; $p = 0.000$) between area under rice and the adoption of recommended rice seed variety. This implies that the smaller the area under rice is, the higher the adoption tends to be.

Table 26: Distribution of respondents according to their area under rice and adoption of recommended rice seed variety (N=120)

Area under rice	Rice varieties adopted

	Local		Improved not recommended		Recommended		Total	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Less than 1	16	31.4	5	9.8	30	58.8	51	42.5
1 - 3	12	40.0	4	13.3	14	46.7	30	25.0
More than 3	26	66.7	5	12.8	8	20.5	39	32.5
Total	**54**	**45.0**	**14**	**11.7**	**52**	**43.3**	**120**	**100.0**

$\chi 2=14.195$; df = 4; p = 0.007; r = - 0.332; p = 0.000

Generally most of the investigated independent variables in this study (except area under rice production) seemed to have no significant association with the adoption of recommended rice seed variety which actually leady to low production per acre as supported by other literature (Matata *et al.*, 2001; Mtenga, 1999 and Nanai, 1993). The adoption could be influenced by other factors like needs, perception and knowledge. According to (Duvel, 1991; Koch, 1987; Duvel and Botha, 1999; Habtemariam, 2004; Msuya, 2007; Mlyuka, 2011), these are the intervening variables regarded to be the most determinants of the adoption behaviour. The following section therefore examined the influence of intervening variables in the adoption of recommended rice seed variety in the study area.

4.3.3 Intervening variables

The intervening variables considered in this study include various aspects of needs, perception and knowledge. Each intervening variable relationship with adoption of recommended rice seed variety was analyzed separately in this section.

4.3.3.1 Efficiency misperception

Efficiency misperception is one of the intervening variables that Duvel (1991) identified to be one of the behavior determinants. There is a tendency for individual to overrate their production and or practice adoption efficiency. This is bound to have significant effect on adoption due to the fact that the more the efficiency is overrated, the smaller the problem

scope or need tension becomes and thus the smaller the incentive to adopt the recommended innovation. Table 27 summarizes the relationship between the efficiency misperception and adoption of recommended rice seed variety.

Table 27: Distribution of respondents according to their efficiency misperception and adoption of recommended rice seed variety (N=120)

Efficiency misperception	Rice varieties adopted							
	Local		Improved not recommended		Recommended		Total	
	n	%	n	%	n	%	n	%
Underrate	0	0.0	7	58.3	5	41.7	12	10.0
Slight underrate	0	0.0	2	18.2	9	81.8	11	9.2
Asses correct	17	29.3	5	8.6	36	62.1	58	48.3
Slight overrate	8	88.9	0	0.0	1	11.1	9	7.5
Overrate	29	96.7	0	0.0	1	3.3	30	25.0
Total	**54**	**45.0**	**14**	**11.7**	**52**	**43.3**	**120**	**100.0**

$\chi 2 = 84.682$; df = 8; p = 0.000; r = - 0.592; p = 0.000

According to the findings shown in Table 27, 19.2% of respondents underrated their EM, 48.3% assessed correct, while 32.5% overrated. The results further reveal that, high percentages of respondents 96.7% who overrate and 88.9% of respondents who slightly overrate their rice varieties adoption used local seed varieties, while not a single respondent who underrate did so. On the other hand high percentage of respondents who slightly underrate 81.8% and who assessed correctly 62.1%, adopted the recommended rice seed variety, while low percentage of respondents who overrated 14.4% did so. The reason for this is their high assessment (overrating), and consequent they are satisfied

with their current choice and thus the little or no need to change. This significant relationship between efficiency misperception and adoption of recommended rice seed variety is reflected in the highly significant negative correlation (r = - 0.592; p = 0.000). The negative correlation coefficient implies that the adoption rate decreases as the current efficiency of recommended rice seed variety is overrated and vice versa. The chi – square findings further reveal that, there is a significant difference ($\chi 2$ = 84.682; df = 8; p = 0.000) between various categories of efficiency misperception (EM) and adoption of recommended rice seed variety in the study area.

4.3.3.2 Need Tension

Need tension is another key intervening variable that is expected to have an influence on adoption behavior. Duvel (1991) defines need tension as problem scope or perceived discrepancy between the current and desired or potential situation. This was assumed also to be positively related with adoption of recommended rice seed variety. Table 28 summarizes the survey results.

Table 28: Distribution of respondents according to their need tension and adoption of recommended rice seed variety (N=120)

Need Tension	Rice varieties adopted							
	Local		Improved not recommended		Recommended		Total	
	n	%	n	%	n	%	n	%
Low	24	29.3	6	7.3	52	63.4	82	68.3
Medium	2	20.0	8	80.0	0	0.0	10	8.3
High	28	100.0	0	0.0	0	0.0	28	23.3
Total	**54**	**45.0**	**14**	**11.7**	**52**	**43.3**	**120**	**100.0**

$\chi 2$ = 93.439; df = 4; p = 0.000; r = - 0.597; p = 0.000

The results presented in Table 28, indicate that 68.3% of the respondent had low need tension (NT), 8.3% had medium need tension and 23.3% had high need tension.

The results show that all respondents 100% from high need tension planted local varieties than it was expected, as compared to medium and low need tension in the same category. At the same time none of the respondents from high and medium need tension adopted the recommended rice seed variety, while 63.4 of respondents with low need tension adopted the recommended rice seed variety. The findings are supported by negative correlation ($r = -0.597$; $p = 0.000$) which indicates that there is negative significant relationship between NT and adoption of recommended rice varieties against what is expected. According to Habtemariam and Düvel (2004) negative correlations in the case of several variables related with the perceived problem discrepancy (need tension) between the current and desired situation can be attributed to especially the less effective respondents over-rating their own efficiency and/or need satisfaction. The results also show that there is a significant difference ($\chi 2 = 93.439$; $df = 4$; $p = 0.000$) between different need tension categories and adoption of recommended rice variety.

4.3.3.3 Prominence

Prominence is synonymous with Rodgers (1983) concept of relative advantage, which he defines as the degree to which an innovation is perceived as being better than the idea it supersedes. It is another intervening variable which was used to determine the adoption behavior of the recommended rice seed varieties in this study. Table 29 summarizes the survey results.

Table 29: Distribution of respondents according to their prominence and adoption of recommended rice seed variety (N=120)

Prominence	Rice varieties adopted							
	Local		Improved not recommended		Recommended		Total	
	n	%	n	%	n	%	n	%
Low	10	83.3	0	0.0	2	16.7	12	10.0
Medium	2	66.7	1	33.3	0	0.0	3	2.5

High	42	40.0	13	12.4	50	47.6	105	87.5
Total	**54**	**45.0**	**14**	**11.7**	**52**	**43.3**	**120**	**100.0**

$\chi 2$ =11.182; df = 4; p = 0.025; r = 0.254; p = 0.005

The summarized survey results show that, majority 87.5% of respondents perceived the recommended rice seed variety to have high prominence relative to their own practices, while 10.0% perceive it to have low prominence and the rest 2.5% perceive to have medium prominence. High percentage 83.3% of respondents from low prominence planted local seed varieties as compared to low percentage of respondents with medium and high prominence who also planted local varieties. On the other hand 47.6% respondents with high prominence adopted the recommended rice seed variety, while 16.7% with low prominence and no one from medium prominence adopted the recommended rice seed variety. This is supported by positive significant correlation (r = 0.254; p = 0.005) implying that the adoption of recommended rice seed variety in rice production in the study area is influenced by perceived prominence. The chi – square ($\chi 2$ =11.182; df = 4; p = 0.025) also indicates significant difference between different prominence categories and adoption of recommended of rice seed variety.

4.3.3.4 Awareness

Awareness is another intervening variable that have been found to have positive influence on adoption behavior (Duvel, 2004). This is defined as the awareness of the recommended solution or optimum level that is achievable in terms of efficiency. The respondents were asked to indicate their awareness of recommended rice seed varieties production in their area. The findings show that the majority of respondents are aware as summarized in Table 30.

Table 30: Distribution of respondents according to their awareness and adoption of recommended rice seed variety (N=120)

Awareness	**Rice verities adopted**

	Local		Improved not recommended		Recommended		Total	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Not aware	3	100	0	0.0	0	0.0	3	2.5
Aware	51	43.6	14	12.0	52	44.4	117	97.5
Total	**54**	**45.0**	**14**	**11.7**	**52**	**43.3**	**120**	**100**

$\chi 2=3.761$; df =2; p = 0.153; r = 0.168; p = 0.067

The results as indicated in Table 30 show that, majority 97.5% of respondents were aware of recommended rice seed variety. The results further show that all respondents 100.0% who were not aware of recommended rice seed variety used local seed varieties, compared to those who were aware 43.6%. On the other hand about 44.0% of the respondents who were aware adopted the recommended rice seed variety while not a single respondent from those who were not aware did so. The chi - square indicates that there is no significant difference ($\chi 2=3.761$; df =2; p = 0.153) between awareness and adoption of recommended rice seed variety. The correlation results also show that there is no significant relationship (r = 0.168; p = 0.067) between awareness and adoption of recommended rice seed variety. This implies that awareness has no influence on adoption of recommended rice seed variety in the study area.

4.3.3.5 Perceived advantages and disadvantages of recommended rice seed variety

The perceived advantages and disadvantages of recommended rice seed variety are assumed to have influence on adoption behavior of recommended rice seed variety in rice production. The perceived advantages are discussed first followed by perceived disadvantages.

(a) Perceived advantages

Respondents were asked to mention the advantages of recommended rice seed variety in their rice fields. The advantages mentioned were high yield, many tillers, Resistance to

water logging, early maturing, Good market, good milling and ratoon crop. But the most important advantage which was mentioned by many of respondents was high yield. Therefore Table 31 summarizes the advantages mentioned.

Table 31: Distribution of respondents according to their awareness of advantages on recommended rice seed variety (N=120)

Advantage	Frequency	Percentage
High yield	118	98.3
Many tillers	18	15.0
Resistance to water logging	15	12.5
Early maturing	61	50.8
Good market	23	19.2
Good milling	10	8.3
Ratoon crop	18	15.0

According to the findings from Table 31 majority of respondents 98.3% were aware of high yield as one of the advantages of using recommended rice seed variety as compared to other advantages like many tillers 15.0%, Resistance to water logging 12.5%, early maturing 50.8%, Good market 19.2%, good milling 8.3% and ratoon crop 15.0%.

(b) Awareness of disadvantages on recommended rice seed variety

It is expected that awareness of disadvantages associated with the implementation of recommended rice seed variety will hinder its adoption. Respondents were therefore asked to list the disadvantages of using the recommended rice seed variety in their rice fields. Disadvantages mentioned were great care is needed, susceptible to diseases, low yield, poor market, logging; it needs much water, sinks in flooding plain, not palatable and no aroma. But the most important attribute which was mentioned by many of the respondents is susceptible to diseases as shown in Table 32.

Table 32: Distribution of respondents according to their awareness of disadvantages on recommended rice seed variety (N=120)

Advantage	Frequency	Percentage

Great care is needed	36	30.0
Susceptible to diseases	76	63.3
Low yield	1	0.8
Poor market	22	18.8
Logging	1	0.8
Need much water	22	18.3
Sinks in flooding plain	7	5.8
Not palatable	2	1.7
No aroma	2	1.7

The results as shown in Table 32 indicate that most of the respondents 63.3% are aware of the disadvantage that recommended rice seed variety (TXD 306) is susceptible to diseases, other disadvantages that were mentioned were high demand for great care 30.0%, low yield 0.8%, poor market 18.3%, logging 0.8%, it needs much water 18.3%, not palatable 1.7% and no aroma 1.7%. It was also mentioned by some of the respondents 5.8% that this is short variety which sinks in flooding plain.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The study assessed the level of adoption of recommended rice variety and fertilizer package that is Phosphate and Nitrogen fertilizers. Also, the study determined the independent and intervening factors that influence the adoption of recommended fertilizer package and recommended rice variety in the study area.

Based on the study the following are the major conclusions drawn from the findings of this study**:**

(i) The level of adoption of the recommended rice seed variety and recommended fertilizers Phosphate, Nitrogen and fertilizer package (P + N) in the study area is low.

(ii) Respondents with different education levels differ significantly in their level of adopting recommended fertilizer package, while area under rice has influence in adopting both recommended fertilizer package and recommended rice variety. This indicates that most of the independent variables investigated in this study that is, sex, income, age, marital status, number of the people in a household and farm size are not important in determining the adoption of recommended fertilizer package and recommended rice variety in Kilombero District.

(iii) The adoption of recommended fertilizer package in the study area is strongly influenced by the intervening factors (variables) namely the Need tension, Prominence and awareness, while efficiency misperception seemed to have no influence in adoption of this practice. As far as rice variety is concerned the intervening variables that seemed to influence adoption are efficiency

misperception, need tension and prominence, in other hand awareness seemed to have no influence in adoption.

Generally this study concludes that most of the investigated intervening variables are more important in determining the adoption of recommended fertilizer package and recommended rice variety than the independent variables in the Kilombero District.

5.2 Recommendations

5.2.1 General recommendations

Recommendations are made based on the study findings as follows:

(i) Recommendations is made to policy makers, administrators, agricultural researchers and extension officers to put more emphasis on area under rice when conducting research or disseminating the knowledge on the recommended fertilizer type, rate, and recommended rice variety.

(ii) It is recommended to policy makers, administrators, agricultural researchers and extension officers that more emphasis should be on the intervening factors in order to address the problem of low adoption in the study area.

(iii) As far as Efficiency Misperception is concerned, the agricultural extension should embark on removing the unfavorable perception that may cause farmers overrating of their efficiency on adoption of recommended rice variety. This can be achieved by a tactful disillusionment that involves the avoidance of public exposure. For example providing convincing evidence about the optimum adoption and production levels that can be attained.

(iv) In the case of Knowledge, the results show that majority of farmers were unaware of the recommended fertilizer package. It is recommended to agricultural extension that knowledge regarding the recommended fertilizer package should be disseminated to create the awareness and skills that will enable farmers to adopt the recommended fertilizer package in their rice fields.

(v) For the prominence, majority of respondents in the study area showed that their own practices were better than the recommended fertilizer package and recommended rice variety. From this point of view, it is recommended to researchers and agricultural extension that constraints that limit the full adoption of the recommended fertilizer package and recommended rice variety should be addressed by training farmers to overcome problems of low knowledge concerning application of the recommended fertilizer package and recommended rice variety.

5.2.2 Recommendation for further research

Numerous studies have been conducted in the area of independent variables (farmers characteristics namely the sex, age, education level, marital status, income level, number of people in the household, family size and area under rice). But few studies have been conducted in the area of intervening factors. This calls a need to researchers to conduct more research on this area.

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APPENDICES

Appendix 1: Questionnaire

TITTLE: FARMERS ADOPTION OF SELECTED RECOMMENDED RICE PRODUCTION PRACTICES: A CASE OF KILOMBERO DISTRICT OF MOROGORO REGION, TANZANIA

General Instructions to Enumerators

Make brief introduction to each respondents before starting any question, get introduced to the farmers (greet them in the local way) get his / her name; tell them yours, the institutions you are working for, and make clear purpose and objective of study (build rapport). Please fill up the questionnaire according to the respondents reply (do not put your own reply/ feeling). Please ask each question so clearly and patiently until the respondent understands clearly (get your points). Please do not try to use technical terms while discussing with the respondents (use local language for better communication).

During the process put the answer of each respondent both on the space provided.

Objectives of the Research

i. To assess the level of adoption of identified recommended rice production practices in Kilombero District.
ii. To identify factors influencing the adoption of identified recommended rice production practices in Kilombero District.

A. General information

Questionnaire No……..…..V1
Respondent's name…… ……...V2
Respondents mobile phone number……...…V3

Interview date……V4

Village…… V5

Ward…… V6

Respondent's personal characteristics

1) Sex of the respondent

1. Male [ ] 2. Female [ ] V7

2) What is your age in years……. V8

3) What is your highest Education level?

1. No formal education [ ]

2. Primary school education [ ] V9

3. Secondary education [ ]

4 others (specify)……..

4) What is your marital status?

1. Married [ ]

2. Single [ ] V10

3. Divorce [ ]

4. Widowed [ ]

5. Others (specify)……..

5) What is your annual income in Tsh. (Actual Tsh……..) V11

6) How many people in your household (Actual number of people……..) V12

7) What is your farm size? (Actual size……acres) V13

8) What area of your farm did you use to grow rice in the 2010/2011 season? (Actual size……acres) V14

Production efficiency

9).a. What yield (in bags / roba) did you obtain in 2010/ 11 season?

Total no. of bags / roba …… V15

b. One bag / roba of rice is equivalent to how many plastics?.....

One plastic is equivalent to…… kg

Adjusted total bags (100 kg) …… V16

Rice yield per acre in bags (100 kgs) ……. V17

c. Total rice yield in kg/acre…… V18

10) Were there any natural hazards that affected your yield in the 2010/2011 season?

1. No [ ] 2 Yes [ ] V19

11) If yes, what were the hazards? V20

1) Flood [ ]

2) Drought [ ]

3) Locust [ ]

4) Arm worms [ ]

5) Others (specify)……..

…….

12) a. If your yield was affected what yield do you normally get? (Total number of bags…….)

V21

b. One bag / roba of rice is equivalent to how many plastics?.....

One plastic is equivalent to…… Kg

Adjusted total bags (100 Kgs**)……..** V22

Rice yield per acre in bags (100 Kgs)……. V23

c. Total rice yield in Kgs/acre…… V24

Adoption of recommended rice production practices

Rice varieties

13) Which rice varieties did you plant in 2010/2011 season**?** ☐ **V25**

	Variety	**Source of seed V26**	**Proportion of planted land**
1)	Local varieties (Afaa Mwanza Tule na bwana, Moshi wa sigara, Shingo ya mwali, Kalimata, Zambia, Mbawambili, Kisegese, Mwarabu, Rangi mbili, Dunduli, Kalinang'aula, Likanyaga, Ngome,)		V27
2)	Kilombero,Kihoko red, sindano		V28
3)	Super India		
4)	TXD 88,		
5)	TXD 306 **(**Saro)		

NEED RELATED FACTORS

Perceived current efficiency

14). How do you rate on the 5 point scale the efficient of your variety choice? ☐ V29

Very low(1)	Low (2)	Medium(3)	High (4)	Very high(5)

NB: Researcher use the scale below to indicate how this farmer is efficient as far as variety choice is concerned

1) Local varieties (Afaa Mwanza Tule na bwana, Moshi wa sigara, Shingo ya mwali, Kalimata, Zambia, Mbawambili, Kisegese, Mwarabu, Rangi mbili, Dunduli, Kalinang'aula, Likanyaga, Ngome,) [ ]

2) Kilombero, kihoko red, sindano [ ] ☐ V30

3) Super India [ ]

4) TXD 88 [ ]

5) TXD 306 (Saro) [ ]

Need Tension

15). Do you intend to change your variety choice?

1) No [ ] 2) Yes [ ] V31

16). If yes, to which variety?

1) Local varieties (Afaa Mwanza, Tule na bwana, Moshi wa sigara, Shingo ya mwali, Kalimata, Zambia, Mbawambili, Kisegese, Mwarabu, Rangi mbili, Dunduli, Kalinang'aula, Likanyaga, Ngome,) [ ]

2) Kilombero, kihoko red, sindano [ ]

3) Super India [ ]

4) TXD 88 [ ] V32

5) TXD 306 (Saro) [ ]

Awareness of the recommended varieties

18. What is the recommended rice variety in your area?

1) Local varieties (Afaa Mwanza Tule na bwana, Moshi wa sigara, Shingo ya mwali, Kalimata, Zambia, Mbawambili, Kisegese, Mwarabu, Rangi mbili, Dunduli, Kalinang'aula, Likanyaga, Ngome,) [ ]

2) Kilombero, kihoko red, sindano [ ]

3) Super India [ ] V33

4) TXD 88 [ ]

5) TXD 306 (Saro) [ ]

Prominence

19).Which variety do you regard to be the best?

1) Local varieties (Afaa Mwanza, Tule na bwana, Moshi wa sigara, Shingo ya mwali, Kalimata, Zambia, Mbawambili, Kisegese, Mwarabu, Rangi mbili, Dunduli, Kalinang'aula, Likanyaga, Ngome,) [ ]

2) Kilombero, kihoko red, sindano [ ]

3) Super India [ ] V34

4) TXD 88 [ ]

5) TXD 306 (Saro) [ ]

Relative advantages and disadvantages

20) What are the advantages of recommended rice varieties that you know?

1. ……V35
2. ……V36
3. ……V37
4. ……V38
5. ……V39
6. ……V40
7. ……V41
8. ……....V42
9. ……....V43
10. ……V44

21) What are the disadvantages of recommended rice varieties that you know?

1. ……V45
2. ……V46
3. ……V47
4. ……V48
5. ……V49
6. ……V50
7. ……....V51
8. ……....V52
9. ……V53

Practice 2: Use of fertilizers

23) Did you use fertilizer in your rice field 2010/2011 season? ☐ V54

1 No

2 Yes

a) If yes, what type of fertilizer did you use?(a) at planting – How much, (b) as top dressing – How much. (*Fill in the table below*)

S/No	Type of fertilizers	Planting		Top dressing	
		Kgs / Acre	Total for the farm (Kgs)	Kgs / Acre	Total for the farm (Kgs)
1.	Nil				
2.	TSP V55	V63			
3.	DAP V56	V64			
4.	MRP V57	V65			
5.	CAN V58			V66	
6.	UREA V59			V67	
7.	S/A V60			V68	
8.	FYD/compost V61				
9.	Others (specify) Booster V62				

b) Please indicate the time when Nitrogen fertilizers are used... **V69**

Need related factors

Perceived current efficiency

24). How do you rate your fertilizers application efficiency? Use the following scale to indicate your rating [ ] **V70**

0	Very low(1)	Low (2)	Medium(3)	High (4)	Very high(5)

Need Tension

25). Do you intend to change your fertilization?

1) No [ ] 2) Yes [ ] [ ] **V71**

26). a) If yes, what type of fertilizer will you use?(a) at planting – How much, (b) as top dressing – How much. (*Fill in the table below*).

S/No	Type of fertilizers	Planting		Top dressing	
		Kgs / Acre	Total for the farm (Kgs)	Kgs / Acre	Total for the farm (Kgs)
1.	Nil				
2.	TSP V72	V80		V87	
3.	DAP V73	V81		V88	
4.	MRP V74	V82		V89	
5.	CAN V75	V83		V90	
6.	UREA V76	V84		V91	
7.	S/A V77	V85		V92	
8.	FYD/compost V78	V86		V93	
9.	Others *(specify)* booster V79				

Awareness of the recommended fertilizers

27. a) What type of fertilizer(s) recommended to be used in your area for planting and top dressing? (Fill in the table below).

S/No	Type of fertilizers	Planting		Top dressing	
		Kgs / Acre	Total for the farm (Kgs)	Kgs / Acre	Total for the farm (Kgs)
1.	Nil				
2.	TSP V94	V101		V108	
3.	DAP V95	V102		V109	
4.	MRP V96	V103		V110	
5.	CAN V97	V104		V111	
6.	UREA V98	V105		V112	
7.	S/A V99	V106		V113	
8.	FYD/compost V100	V107		V114	
9.	Others (specify)				

Prominence

Perception: Prominence

30. a) What in your view is the best fertilization (type, rate and time of application?) **V 115**

S / No.	Type of fertilizers	Planting		Top dressing	
		Kgs / Acre	Total for the farm (Kgs)	Kgs / Acre	Total for the farm (Kgs)
1	Nil V116	V124		V132	
2	TSP V117	V125		V133	
3	DAP V118	V126		V134	
4	MRP V119	V127		V135	
5	CAN V120	V128		V136	

6	UREA V121	V129		V137	
7	S/A V122	V130		V138	
8	FYD/compost V123	V131		V139	
9	Others (specify)				

Relative advantages and disadvantages

29).What is the advantages of using recommended type of Fertilizer?

1……...…V140

2…….....V141

3……...V142

4……...V143

5……...…V144

6……...V145

30) What are the disadvantages of using recommended type of Fertilizer?

1…….V146

2…….....V147

3……..V148

4……...…V149

5……..V150

6……..….V151