EVALUATION OF THE CONTRIBUTION OF FARMER FIELD SCHOOLS IN RICE PRODUCTION IN THE KILOMBERO DISTRICT OF MOROGORO REGION, TANZANIA.

BY

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A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN AGRICULTURAL EDUCATION AND EXTENSION OF SOKOINE UNIVERSITY OF AGRICULTURE. MOROGORO, TANZANIA.

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ABSTRACT

This study investigated the contribution of farmer Field Schools in rice production in Kilombero Districts. Specifically this study determined the level of adoption of rice production practices recommended during Farmers Field School and the average rice yield obtained as a result of FFS participation. Simple random sampling was used to obtain 60 respondents from non FFS participants and 51 respondents from FFS participants making a total of 111 respondents to participate in this study. Data were collected by using structured interview schedule, and thereafter entered and analyzed by using SPSS computer programme. The findings reveal that the level of adoption of recommended rice production practices like rice varieties, fertilizers, spacing and weeding was high among FFS participants than among non FFS participants. However, both groups didn't apply the recommended phosphate fertilizer in their rice fields. Average yield was also high among FFS participants than among non FFS participants. The correlation test results revealed that the level of adoption of recommended rice production practices and average rice were significantly high among FFS participants than among non FFS participants. Also chi – square test indicated a highly significant difference between FFS participants and non FFS participants in terms of adoption of recommended rice participants and non FFS participants in terms of adoption of recommended rice production practices and average yield. Based on study findings it is recommended that FFS facilitators should put more emphasis on the application of phosphate fertilizers in rice fields. Also the Ministry of Agriculture, Food security and cooperatives should insist on the use of FFS approach in all rice growing areas.

DECLARATION

I MGONZO DUNIA ALLY do hereby declare to the senate of neither Sokoine University of Agriculture that this dissertation is my own original work and has neither been submitted nor being concurrently submitted in any other institution.

02-08-2012

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The above declaration is confirmed

13/8/2012

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DEDICATION

I dedicate the work to my father Ally Mbeyela Mgonzo and my late mother Dalina Gonelamatego Mbalinga who made a lot of efforts in laying down the foundation of my education.

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LIST OF ABBREVIATIONS AND SYMBOLS

SA	-	Agro Ecological System Analysis
BMPs	-	Best Management Practices
BTC	-	Belgian Technical Cooperation
CAN	-	Calcium Ammonium Nitrate
DAP	-	Diammonium Phosphate
EA	-	Environmental Alert
FAO	-	Food and Agriculture Organization
FFS	-	Farmer Field Schools
FSR	-	Farming Systems Research
FSR & E	-	Farming System Research and Extension
ICIPE	-	International Centre of Insect Physiology and Ecology
INMASP	-	Integrated Nutrient Management to Attain Sustainable Productivity
IPM	-	Integrated Pest Management
IRRI	-	International Rice Research Institute
MAFC	-	Ministry of Agriculture, Food Security and Cooperatives
N	-	Nitrogen
NCD	-	New Castle Disease
NERICA	-	New Rice for Africa
NPK	-	Nitrogen Phosphorous and Potassium
O&OD	-	Opportunity and Obstacle to Development
PDT	-	Participatory Technology Development
PRA	-	Participatory Rural Appraisals

RLDC	-	Rural Livelihood Development Company
SA	-	Sulphate of Ammonia
SAWAC	-	Subcommittee to Assess Writing Across the Curriculum
SNAL	-	Sokoine National Agricultural Library
SPSS	-	Statistical Package for Social Sciences
SUA	-	Sokoine University of Agriculture
T&V	-	Training and Visit
TARP II	-	Tanzania Agricultural Research Project, Phase Two
ToT	-	Transfer of Technology
TSP	-	Triple Super Phosphate
TXD	-	Tanzania Cross Dakawa
UN	-	United Nations
URT	-	United Republic of Tanzania

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

In the biophysical realm, secure crop production mainly relies on management practices that agricultural practices are central in the struggle to transition to a more fruitful crop production system. The conventional extension or the Transfer of Technology (ToT) approach addresses these management practices by prescribing recommended practices like improved varieties, fertilizers, weeding, spacing and pesticides; and farmers remain as receivers of these already developed technological packages. In this approach the integration of farmers, researchers and extension received inadequate attention.

In order to improve agricultural technology transfer systems, other approaches such as Farming Systems Research (FSR) and Training and Visit (T&V) extension systems emerged. Despite the funding and promotion by the World Bank, These traditional approaches had been found to be ineffective, inefficient and unsustainable (Anandajayasekeram *et al.*, 2001).

These approaches have tended to be largely based on a vertical one-way communication model with information flowing from research to extension and the role of extension is to transfer the information to the farmers. In many of these linear models, problem definition tended skewed toward research interests than to farmer perceived problems. Due to the identified shortfalls, different participatory extension approaches were initiated, like Participatory Rural Appraisals (PRA), Opportunity and Obstacle to Development (O&OD), Participatory Technology Development (PDT), and Farmer Field Schools (FFS). Participatory extension methodologies are intended to assist actors in the research-extension-farmer continuum work together in a learning process where each group learns from each other.

Participatory extension approaches such as the Farmer Field Schools (FFS) are emerging methodologies for technology validation and dissemination in Africa (Dina, 2008). The Farmers Field Schools (FFS) approach was initially developed in Asia in 1989 under the assistance provided by Food and Agriculture Organization (FAO) of the United Nations, to address a major threat to food security resulting from dramatic yield losses caused by the brown plant hopper (Pontius *et al.*, 2002).

The FFS approach is a learner-centered approach, whereby farmers through understanding, observation, experimentation and evaluation are equipped to address challenges and make appropriate changes in their farm management practices. Over the years the FFS approach has been extended to other technical issues in agriculture and rural development such as natural resource management, animal husbandry, conservation agriculture just to mention few (Minjauw *et al.*, 2002). More recently the FFS is considered to be an appropriate vehicle for general empowerment of rural areas in which life-long learning processes, strengthening of local institutions and networks, stimulating social processes and collective actions may lead to improvement in rural livelihoods. Farmer Field School (FFS) is a typical example of participatory extension method that represents a paradigm shift in agricultural extension. This is due to the fact that the extension training programmes utilizes participatory methods to help farmers develop their analytical skills, critical thinking and creativity and help them to learn and make better decision. According to Potinus *et al.* (2002), in this approach, farmers are no longer positioned as receivers of already developed technological packages, but as field experts, who collaborate with the extension staff to find solutions relevant to the local realities. Farmer Field School (FFS) participants make regular field observations and use their findings, combined with their own knowledge and experience, to judge for themselves, what, if any, action needs to be taken . This is the advantage of Farmer field Schools (FFS) over other extension approaches like Transfer of Technology (ToT), Training and Visit (T&V) and Farming Systems Research (FSR) which concentrated on the transfer of predetermined agricultural knowledge and technology from research institutions to farmers as reported by Benor (1984).

In recent years a number of development agencies have promoted Farmer Field Schools as potential more effective approach to extend knowledge to farmers in developing countries. In Africa the approach was introduced by FAO since the mid-1990s in various countries like Kenya, Uganda, Tanzania, Zimbabwe, Zambia, Malawi, Ethiopia, Ghana, Nigeria, Gambia, Egypt, Lesotho, Swaziland and Mozambique (Mutinda, 2004). In Tanzania FFS is one of approaches that have been used in different regions to influence farmer's adoption of recommended agricultural practices. The Kilombero District in Morogoro Region is one of the districts that use FFS approach to enhance adoption of recommended rice production practices. Although the Kilombero District is among the major rice producing areas in

Tanzania, over the years people in this district have been using different rice growing systems which are characterized by traditional farming practices that lead to low yield (Futosh, 2007). The introduced FFS are expected to promote adoption of appropriate rice farming practices such as use of improved seed varieties, spacing, fertilizer application, weeding, pests control and lead to increase in rice production. However, it is not well known to what extent the FFS approach has achieved this goal.

1.2 Problem Statement

In Tanzania where rice is grown as cash and food crop, majority of the small holder's livelihood depend on rice cultivation. In spite of its importance the rice production is characterized by traditional method of production and the low level of technology use. As a result, despite its importance, role in the national economy and the wealth of genetic diversity and climatic suitability, the national average yield is low, 1 to 1.5 tons of paddy per ha instead of 8.0 tons per ha (40 bags of 80kg per acre) (Dismas, 2005). The recommended rice management practices are not seriously adopted at the grass root level. In addition, lack of effective extension approach in the farmers' condition also contributes to low productivity of rice.

Many efforts for improving rice production have been undertaken by the government for some years. In 1983 the Tanzanian government created the National Agricultural Policy, aimed at raising the self-sufficiency rate of major staple foods through market improvement, introduction of new agricultural technologies and creation of new fields. In addition, different approaches for improving rice production for example, Ministry-Based General Extension, The Integrated (Project) Approach, Farming

System Research and Extension (FSR&E) and Training and Visit (T&V) have been adopted and implemented. The failure for some approaches like T&V and FSR&E has been due to non participatory, one way communication and hierarchical in nature. Farmer Field School (FFS) is considered as an appropriate participatory approach in which farmers are able to decide what the best alternative for adoption is, in their particular circumstance.

Research on the contribution of Farmer Field Schools on agricultural production has been contacted (Niyegela, 2007; ICIPE, 2007; Feder *et al.*, 2003; Van de Fliert *et al.*, 1993; Van den Berg *et al.*, 2007). Among these little is known on the contribution of FFS on rice production in Kilombero District. It is on this ground that the study on assessment of the contribution of Farmer Field School in rice production in Kilombero District is worthwhile to be undertaken. In order to increase the living standard of rice farmers, FFS is regarded as one of the fundamental channel. This is due to the fact that it establishes greater local involvement in knowledge generation, sharing and enhance adoption of recommended practices. Besides the current state-run extension system, the FFS approach is assumed capable of being highly responsive to local needs over a wide range of conditions, and with wide range of crops. This study aims at assessing the contribution of FFS in promoting rice production. Understanding the contribution of FFS will be of paramount importance for Ministry of Agriculture, Food Security and Cooperatives (MAFC), Research centers, State farms, Cooperatives, and policy makers when they are designing extension systems which are responsible for the rice sector in the country. It will also be of benefit especially in countries like Tanzania, which do not have much money to spend on extension services. Farmers can be trained to be facilitators of extension and they can do the job with minimum costs. This can also save the problem of extension agents not being able to reach some farmers because of lack of human and financial resources. Researchers can also benefit from this research by learning that farmers can also perform their own creativity that can bring about meaningful change to their lives. Farmers also can benefit from this piece of research as it will give them the confidence that they can make a positive change in their lives, and they themselves are the ones who can determine what kind of technologies they want that can bring change. It is on the basis of this research that FFS can be spread to other rice growing areas and can be applied in different situations.

1.3 Research Objectives

1.3.1 General objective

The general objective of this study was to assess the contribution of Farmer Field School in rice production in Kilombero District.

1.3.2 Specific objectives

The specific objectives of the study were:

(i) To determine the level of adoption of recommended rice production practices in the Kilombero District

(ii) To find out the contribution of FFS in rice yield in the Kilombero District.

(iii) To find out the contribution of FFS in adoption of recommended rice production practices in Kilombero District.

1.3.3 Research questions

(i) What is the level of adoption of recommended rice production practices in Kilombero District?

(ii) What is the contribution of FFS in rice yield

(iii) What is the contribution of FFS in adoption of recommended rice production practices?

1.4 Conceptual Framework

The conceptual framework for this study was based on the assumption that participation in FFS increases farmer's knowledge and skills on recommended rice production practices like use of improved rice varieties, application of recommended fertilizers, use of proper spacing, weeding and pest management. This will facilitate their adoption and consequently lead to increase in rice yield.

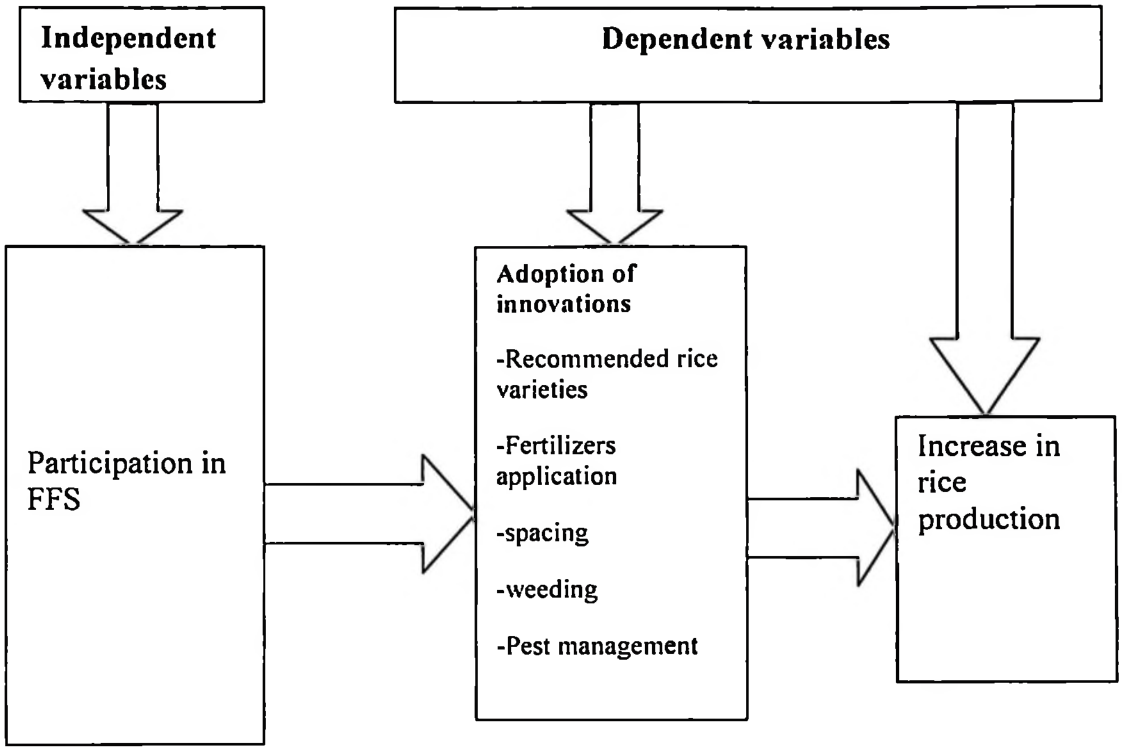

Figure 1: Conceptual Framework

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

2.1.1 Overview of Farmer Field School

The first Farmer Field Schools (FFS) were designed and managed by the United Nations Food and Agriculture Organization (FAO) in Asia (Indonesia) in 1989, where there were rice farmers. Food security was endangered and political stability threatened in several countries as a result of severe losses in rice production caused by the brown plant hopper (Winarto, 1995). Since then more than two million farmers across Asia have participated in this type of learning.

Farmer Field Schools provides opportunities for learning-by-doing. Extension workers, subject matter specialists or trained farmers facilitate the learning process, encouraging farmers to discover key agro ecological concepts practiced in the field hence increase the adoption of recommended agricultural practices and subsequently improve agricultural production (Babur, 2009).

The Farmer Field School is basically a school without walls. It is a school where participatory training techniques are used to achieve learning objectives, which are not limited to those of the work domain alone, but also include interactive and empowerment domains. The approach is integrated and organized so that participants are not the objects of training but are able to use their experience as the subject of training and therefore participants share in the control of decision making.

This standard model of the school with its emphasis on learner-centred and experiential learning initially tried for rice system Integrated Pest Management (IPM) is now being adopted for improvement in production of a range of food crops (Van de Pool, 2003).

2.1.2 Difference between FFS and traditional extension systems

As mentioned earlier, FFS differ from other traditional extension methods like Training and Visit (T&V) and Farming System Research (FSR). The following are some comparison between FFS and conventional T&V as cited by (Alida, 2009) (Table 2).

Table 1: Comparison between FFS and Conventional T&V approach

PARAMETER	FARMER FIELD SCHOOL	CONVENTIONAL T & V
1. Learning method	By doing, experimenting, participating, discovering Bottom-up	By listening and observing (demo plots). Package of recommendation Top-down
2. Training venue	Subject to learning environment (field, crop, animal etc). Fixed location	Training shed or tree Different meetings in different locations
3. Duration	Complete study (Season long cycle)	One or two sessions
4.Group composition	Fixed membership	Variable members
5. Extension Agent and their role	Trained expert. Spends most of her/his time assisting the participants to convince themselves about a given technology by experiments and experiences exchange	Jack of all trades. Spends most of her/his time trying to convince participants. Experiences of extension worker important
6. Participant and her/his role	Participator, Contributor, Decision maker. Assumption- participant is a cup of tea full of knowledge but needs steering.	Listener. Management decisions usually Prescribed. Assumption- participant is an empty cup of tea that needs to be filled.
7. Relationship extension agent - participants	Interaction Increased confidence between facilitator and farmers	One-way The relation between the extension worker and farmers is not very close
8. Qualification to participate	Everybody can participate (literate/illiterate, young/old, women/men)	Need to be able to write (esp. with intensive programmes
9. Programme Planning	Done and agreed upon by/with Participants. Extension agent commits themselves	Office work Extension agents' commitment not guaranteed
10. Evaluation and adoption	Together with participants. Adoption is the choice of the Participant.	Office. Usually persuasion/force for implementing the recommendations

Source: (Gallagher, 1999).

2.1.3 Salient Features of FFS

According to FAO (2005) FFS is a group-based learning process that includes hands-on training methods in which farmers test management methods/production technologies for themselves and learn concepts directly. Training also includes communication skills, skills in identification and problem solving, in leadership, in interaction and discussion methods. Training in the field school follows the season long cycle and the field is the primary learning venue. Farmers learn by carrying out themselves the various activities related to the particular farming practice they want to learn/evaluate (Davis, 2006). The field school offers farmers an opportunity to learn by doing, by being involved in experimentation, discussion and decision-making. This strengthens the role of farmers in the research-extension-farmer chain. It also improves the sense of ownership of technological packages and new knowledge and skills. Other features of the FFS are:

- It is flexible, non-lecture based field study using a field that allows the "field to be the teacher".

- It has strong emphasis on observation, analysis, discussion and debate, which allows new ecological concepts to be combined with local knowledge;

- Technically competent facilitator leads group activities, but is not seen as the "all knowing source" of the "right information" and a focus on farmers becoming "experts" and "farmer facilitators" in their own communities (Babur, 2009).

2.1.4 FFS curriculum

The FFS curriculum follows the natural cycle of its subject, be it crop or animal. The approach allows all aspects of the subject to be covered, in parallel with what is happening in the FFS fields (Sones and Duveskog, 2003).

The FFS curriculum also describes what has to be done (topics), why it has to be done (objectives) and how it has to be implemented (methods). The FFS curriculum is designed around achieving the following objectives: To empower participants with knowledge and skills to make them experts in their own fields, to sharpen the participants' ability to make critical and informed decisions that renders their enterprise/activities profitable and sustainable, to sensitize participants in new ways of thinking and problem solving and to help participants learn how to organize themselves and their communities. Emphasis is put on agro-ecosystem analysis that helps farmers gain ecological insight and integrated management principles with wider alternatives to choose (Gallagher, 2003).

2.1.5 Expected outputs of FFS approach

According to Alida (2009) the following are the expected outputs of FFS approach

i. Increased farmers' capacity for research and innovation.
ii. Development of farmers' capacity to define their own research agenda and follow-up activities.
iii. Stimulation of farmers to become facilitators of their own research and learning processes.
iv. Increased responsiveness to farmer-clients demands and needs by organizations in national research and extension and development systems.

2.1.6 Agro - ecological system analysis as a corner stone of FFS

In general the corner stone of the FFS approach is the Agro Ecological System Analysis (AESA), which is a field, based analysis of the interactions observed between crop and other biotic and a biotic factors co-existing in the crop field. The analysis allows a cycle of observation, analysis and action (Gallagher, 2003). Using the framework of agro ecosystem analysis, improved farmers decision-making emerges from an iterative process of analyzing problems and situations from multiple viewpoints, synthesizing the analyses, making decisions and implementing them accordingly. It also involves observing the outcomes of the implemented decisions and evaluating their overall impact. Learning in the field school is experiential and discovery based and agro ecosystem analysis is done in small groups of 4 - 5 farmers on the activities being carried out in the central plot. Special topics are included in farmer field schools to cover unknown agro ecosystem relationships. The topics also develop farmer's research capacity by stimulating comparison of treated plots and non-treated plots and by providing regular opportunities for data gathering and analysis through the testing, validation and evaluation of technologies (Babur, 2009).

2.1.7 Contribution of FFS in agriculture

According to literatures (Feder, *et al.*, 2003; Van de Fliert *et al.*, 1993; Van den Berg *et al.*, 2007) FFS participants tend to have higher agriculture knowledge than those who did not participate in FFS. As reported earlier, the first FFS was used in Indonesia on integrated pest management (IPM), to reduce pesticide use, increase farmer knowledge, increasing the crop yield and provide additional income to farmers. A remarkable impact in terms of pesticide reduction and increase in

productivity was experienced by FFS participants than those who did not participated in FFS (Pontius, 2002). Moreover FFS has shown positive impacts in different crop yields, livestock production and soil conservation projects.
A research done by INMASP (2006) reports that there was high level of production and financial return among FFS participants as a result of new soil fertility management practices introduced through FFS. Environmental Alert (2010) also found that farmers who used the recommended soil fertility management practices promoted by FFS, their Crop yields, especially for beans, maize and vegetables were increased by over 50% compared to yield of farmers who did not participate in FFS.

Other Studies conducted by SAWAC (2003) and Humayun (2006) reports that the average rice yield was high among FFS participants; an increase of between 20% and 100% of rice yield was noted, While Babur (2009) found that farmers' rice yields after FFS experience were found to be consistently higher, averaging more than 200% increase from their baseline conditions. This large yield increase came from the use of the various different rice practices promoted by the FFS.

An increase of income is also an important aspect of FFS. A study by Ortiz *et al.* (2004) which was conducted in Tanzania noted that there was an increase in terms of Agricultural income among FFS participants whereby FFS members in Tanzania their agricultural income doubled while in Kenya, agricultural income increased by 21% due to participation in a field school. In Ghana Cocoa farmers also increased their income through participating in FFS. According to Soniia (2006), farmers who applied the recommended cocoa production practices promoted by FFS were able to increase their annual income by 23%. The research done in citrus production management indicates that FFS was used to teach farmers on citrus production practices such as reduced pesticide use, better soil management with increased use of organic material and better canopy management as a result of these citrus production practices of a majority of farmers claimed to improve health of the citrus trees and increase net profits.

The contribution of FFS was also noted in non crop enterprises, URT (2009) indicated that Farmers who used FFS as an approach on local chicken production have succeeded in reducing mortality rate from 90% to almost zero percent through the use of thermo stable New Castle Disease (NCD) vaccine and semi intensive system of management. Through FFS, the introduced Cross-breeding between local chicken and improved cockerels increased egg production from 40 to 60 eggs per hen per year.

2.1.8 Constraints of FFS approach

James (2002) reported that, many of agricultural approaches have some constraints. The FFS approach is somehow new in East Africa and there are still some serious constraints. The necessary attitudinal change takes time and many facilitators still have limited participatory skills. Process documentation necessary to improve the Field School methodology is time consuming and often is not given enough attention. According to Thijssen (2002) another limitation is the inadequate inclusion of local knowledge and practices because of time limitation, relative narrow focus and general approach of FFS only superficial, more easily recognized local information is accessible. Another major limitation to sustainability of FFS is the financial commitment entailed in the continued operation of such initiatives particularly on national scale if the government is to carry out a significant training program over a long period of time relying on trainers, a fiscal obligation is implied, which may not be financially sustainable (Leeuwis *et al.*, 1998; Quizon *et al.*, 2001).

2.2 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 (TARP II – SUA Project, 2002). 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).

2.3 Rice Production Practices

2.3.1 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 varies 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 stature 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.

2.3.2 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.

2.3.3 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 *et al.*, 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.

2.3.4 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.

CHAPTER THREE

3.0 METHODOLOGY

This section describes the method that was used in this study, it includes, description of study area, research design, data collection methods, and data analysis.

3.1 Description of Study Area

Kilombero District is one of the six districts in Morogoro Region, located in Southwest of the Morogoro region. The District lies between Latitude 8^0 and 9^0 South of Equator and Longitude 30^0 and 36^0 East of Greenwich. The District extends from the middle of south-west of Morogoro Region. To the East and North borders with Morogoro rural and Kilosa Districts, respectively. To the North West borders Mufindi and Njombe Districts of Iringa region, while at its south and South-East extremes it shares borders with Songea Rural (Ruvuma Region) and Ulanga Districts, respectively.

The main economic activity of the District is agriculture and the major food crops grown are rice and maize while sugarcane is the major cash crop. The district comprises of 19 wards with a population of 321 611 (2002 census). In this study four wards were purposively selected namely Kidatu, Mang'ula, Mlimba and Mchombe. Seven villages were involved in this study, whereby Kidatu and Miwangani were from Kidatu ward, Mang'ula B and Kisawasawa were from Mang'ula ward, Kamwene and Viwanja sitini were from Mlimba and one village (Njage) was from Mchombe ward.

3.2 Research Design

A cross-sectional research design was applied in this study, whereby data were collected at single point in time from a sample selected to represent some large population (Babbie, 1990; Creswell, 1994). The design is suitable for purpose of description and as well as for determination of relations between variables (Margaret. 2009).

3.3 Sampling Methods

The purposive sampling method was employed to obtain four (4) wards that are mostly involved in rice production and that contained villages in which FFS have been operating for more than three years and wards that contained villages which have never participated in FFS. These are Mangu'ula and Mngeta (with villages participated in FFS) and Kidatu and Mlimba (with villages that did not participate in FFS). Simple random sampling method was used to obtain two (2) villages from each three wards namely Mang'ula, Mlimba, Kidatu and one (1) village from Mchombe ward, making a total of seven (7) villages. A Simple random sampling was also used to obtain the required respondents from each village. Table 3.1 summaries the distribution of respondents according to their villages.

Table 2: Distribution of respondents according to their villages

Ward	Village	Out of FFS	In FFS	Total
Kidatu	Kidatu	12		
	Miwangani	14		
Mang'ula	Manula B		21	
	Kisawasawa		15	
Mlimba	Kamwene	17		
	Viwanja sitini	17		
Mchombe	Njage		15	
Total		60	51	111

3.4 Sample Size

A sample size for this study consisted of fifty one (51) respondents from villages which have been participating in rice FFS for more than three years and sixty (60) respondents who have never participated in rice FFS, therefore a total of 111 respondent farmers were interviewed in this study. Three (3) agricultural extension workers were also interviewed to solicit information on the contribution of FFS in rice production. A sample of 111 is regarded desirable in this study due to limited time, financial and is enough for statistical analysis such as descriptive, correlation and chi-test (Mandenhall, 1982).

3.5 Data Collection Methods

Primary data were collected to answer the research questions and achieve the objectives of this study. In this regard, primary data were collected through personal and face-to-face interview using structured interview schedule that were filled up by an interviewer.

3.6 Data Analysis

Gathered Data were analyzed by using Statistical Package for Social Sciences (SPSS) whereby descriptive statistics such as frequency and percentage were used to obtain the general picture of respondent's characteristics such as age, level of education, marital status, and adoption of recommended rice production practices and rice yield. Chi-square and correlation were used to investigate the contribution of FFS in rice production in terms of adoption of recommended rice production practices and rice yield. Chi-square test was specifically used to test whether there were significant differences between the study variables under investigation while Karl Pearson's Coefficient of Correlation (r) was used to determine whether there was any linear relationship between the study variables.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Respondent's personal characteristics

This section present the personal characteristics of the respondent farmers participated in this study. They include farmers who have been participating in Rice Farmer Field School for more than three years. and farmers who have never participated in Rice FFS. The basic personal characteristics described under this section are age, sex, level of education, marital status, household income and farm size under rice production. These basic characteristics were considered important because they have a certain influence on development initiatives introduced in a given social setting (Howllet and Nagu, 1997). They also give the general information about the selected sample and the population from which they represent.

4.1.1 Age

The respondent age is often considered to be an indicator of willingness to adopt new agricultural practices with assumption that younger people are more likely to adopt new technology than old people. Lemchi *et al.* (2003) found that younger farmers are likely to adopt new technology than old farmers because they are more willing to take risks. Table 3 shows the distribution of respondents according to their age.

The lowest category is 20–30 years and the highest category is with respondents of above50 years. The results show that, 7 (11.7%) of respondents who have never participated in FFS were in 20-30 years category, 21 (35%) were in 30-40 years category, 19 (31.7%) were in 40-50 years category 13 (21.6%) were above 50 years.

Table 3: Distribution of respondents according to their ages

Category	n	Percentage
Age of respondents (out of FFS)		
20-30 years	7	11.7
30-40 years	21	35.0
40-50 years	19	31.7
50 < years	13	21.6
Total	60	100.0
Age of respondents (in FFS)		
20-30 years	4	7.8
30-40 years	23	45.1
40-50 years	18	35.3
50 < years	6	11.8
Total	51	100.0

Respondents who participated in FFS for more than three years fall in the following categories, 4 (7.8%) were in 20-30 years category, 23 (45.1%) were in 30-40 years category, 18 (35.3%) were in 40-50 years category and 6 (11.8%) were above 50 years. This shows that more respondents 45 (88.2%) who participate in rice FFS fall in the age category of 20-50 years compared to 47 (78.4%) of non -FFS participants who fall under the same category. This indicates that the majority of respondent farmers fall under age category that can enable them to perform farming activities.

4.1.2 Sex

Sex denomination is an important parameter in social analysis (Overholt, 1991). The results show that 33 (55%) were male and 27 (45%) were female from respondents who have never participated in Rice Farmer Field Schools (Table 4). On the other hand 24 (47.1%) were males and 27 (52.9%) were female respondents who have been in Rice Farmer Field Schools for more than three years. This shows that in this study more females participated in FFS were interviewed, which also indicate active involvement of women in rice farming in the study area.

Table 4: Distribution of respondents according to their sex

Category	n	Percentage
Sex of respondents (out of FFS)		
Male	33	55.0
Female	27	45.0
Total	60	100.0
Sex of respondents (in FFS)		
Male	24	47.1
Female	27	52.9
Total	51	100.0

4.1.3 Level of education

It is assumed that formal education level is directly correlated with willingness to adopt new technology. Finlay (2004) found that the likelihood of participating in new agricultural practices is associated with educational level. Literacy among farmers has effect on improvement of farmer's productivity. This is because educated farmers may take the initiative in the adoption of innovation (Weir and Knight, 2000). Moreover education facilitates easy communication and follows instruction during interaction of farmers in interpersonal meeting and training (Djalou, 2005). The study reveals that majority of respondents from both groups had attained primary education as their highest level of education. This is represented by 45 (88.2%) of respondents who have been participating in FFS and 52 (86.7%) of the respondents who have never participated in FFS. Very few respondents from both groups attained secondary education as their highest level of formal education as indicated in Table 5.

Table 5: Distribution of respondents according to their level of education

Category	n	Percentage
Education level (out of FFS)		
Non- formal Education	5	8.3
Primary Education	52	86.7
Secondary Education	3	5.0
Total	60	100.0
Education level (in FFS)		
Non formal Education	3	5.9
Primary Education	45	88.2
Secondary Education	3	5.9
Total	51	100.0

4.1.4 Marital status of respondents

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. The results in Table 6 show that all 60 (100%) respondents who have never participated in Farmer Field School were married, while the percent of married who have been participating in FFS for more than three years is 46 (90%).

Table 6: Distribution of respondents according to their marital status

Category	n	Percentage
Marital status (out of FFS)		
Married	60	100.0
Single	0	0
Total	60	100.0
Marital status (in FFS)		
Married	46	90.2
Single	5	9.8
Total	51	100.0

4.1.5 Household size

Table 7 shows that most families from both groups had a family size ranging from 4-6 members. About 31 (51.7%) were from farmers who have never participated in FFS and 35 (68.6%) were from farmers who have been participating in FFS for more than three years. The next category with many respondents is that with 1-3 members which comprises 16 (26.7%) of non - FFS participants and 13 (25.5%) of FFS participants. It was also noted that there was a family 1 (1.7%) with more than ten members among those who have never participated in FFS.

Table 7: Distribution of respondents according to their household size

Category	n	Percentage
household size (out of FFS)		
1-3 members	16	26.7
4-6 members	31	51.7
7-10 members	12	20.0
Above 10 members	1	1.7
Total	60	100.0
Household size (in FFS)		
1-3 members	13	25.5
4-6 members	35	68.6
7-10 members	3	5.9
Above 10 members	0	0
Total	51	100.0

4.1.6 Farm size

Empirical studies show that land is one of the factors that affect adoption of improved technologies among farmers. Those farmers who have land are likely to adopt improved technologies than the landless farmers (Samson, 2007). Table 8 shows that majority of the interviewed respondents had small farms ranging from 1-3 acres.

As indicated in the Table 8 about 43 (71%) and 49 (96%) of non-FFS participants and FFS participants, respectively were in the category of 1-3 acres. Only 2 (3.9%) of farmers who have been participating in FFS had 3- 6 acres. In addition not a single respondent from FFS participants had more than 6 acres while 13 (21.7%) of farmers who have never participated in FFS had 3- 6 acres.

Table 8: Distribution of farmers according to their farm size

Category	n	Percentage
Size of rice farm (out of FFS)		
1- 3acre	43	71.67
3-6 acre	13	21.67
Above 6 acre	4	6.66
Total	60	100.00
Size of rice farm (in FFS)		
1- 3 acre	49	96.1
3-6 acre	2	3.9
Above 6 acre	0	0
Total	51	100.0

This implies that the majority of FFS participants had small farms as compared to those who have never participated in FFS.

4.1.7 Annual income

Income has a direct correlation with adoption of technologies. Farmers who are well off can afford the prices of new improved technology than low income farmers (Roger, 2003). During the survey it was noted that most of respondents didn't properly keep their income records and therefore the provided figures in Table 9 are just estimated income.

Table 9 shows that all FFS participants 51 (100%) their annual income was above 200 000Tsh. while 57 (95%) of non- FFS participants their annual income was above

200 000Tsh. Only 3 (5%) of non-FFS participants their annual income ranged from 50 000 to 200 000Tsh.

Table 9: Distribution of respondents according to their annual income

Category	n	Percentage
Income out of FFS		
50 000-100 000 Tsh.	1	1.7
100 001-200 000 Tsh.	2	3.3
Above 200 000 Tsh.	57	95.0
Total	60	100.0
Income in FFS		
Above 200 000 Tsh.	51	100.0
Total	51	100.0

4.2 Level of Adoption of Recommended Rice Production Practices

This section presents the findings of the level of adoption of recommended rice production practices in the study area. These include the recommended rice variety, fertilizer application, spacing, weeding, and pesticide application.

4.2.1 Recommended rice variety

In Kilombero District farmers grow different rice varieties, but the recommended rice variety is TXD 306. During data collection respondents were requested to indicate rice varieties they grew in 2009/2010 cropping season. Table 10 show the distribution of respondents according to type of rice varieties planted.

Table 10: Distribution of respondents according to rice varieties planted in 2009/10

Variety	n	Percentage
Local	59	53.2
Kilombero and Kihoko	1	0.9
Super India	17	15.3
TXD 306	34	30.6
Total	111	100.0

Out of 111 respondents only 34 (30.6%) planted TXD 306 rice variety. Others, 17 (15.3%) planted super India rice variety and only 1 (0.9%) respondent planted Kilombero and Kihoko rice varieties. The remaining 59 (53.2%) respondents planted local rice varieties. Data were further analyzed to assess the level of adoption among the two different groups that were involved in the interview namely, FFS participants and non FFS participants and Table 11 summarizes the study results.

Table 11: Distribution of respondents according to rice varieties used

	Variety	n	Percentage
Out of FFS	Local	44	73.3
	Kilombero, Kihoko	1	1.7
	Super India	14	23.3
	TXD 306	1	1.7
	Total	60	100.0
In FFS	Local	15	29.4
	Super India	3	5.9
	TXD 306	33	64.7
	Total	51	100.0

The results in Table 11 shows that only one respondent out of 34 who used the recommended rice variety was from non FFS participants and the remaining 33 (64%) were from FFS participants. The results also reveal that, 44 (73.3%) of non FFS participants used local rice variety and the rest, 14 (23.3%) and 1 (1.7%) used super India, Kilombero and Kihoko rice varieties, respectively. On the other hand 15 (29.4%) of FFS participants used local rice variety; whereby 3 (5.9%) used super India rice variety. The results show that, big number of FFS participants 33 (64.7%) used the recommended rice variety than non- FFS participants 1 (1.7%). This reveals that there is high level of adoption of recommended rice variety among FFS participants than among non- FFS participants. Probably in their participation in FFS they got an opportunity to see the advantages of the recommended rice variety that enable them to adopt.

4.2.2 Fertilizer application

According to Haefele *et al.* (2003) using fertilizer nutrients in the proper amount and applying them correctly both economically and environmentally is important to the long term profitability and sustainability of crop production. Therefore the recommended type and amount of nutrients (fertilizers) should go hand in hand with the result of soil analysis of a respective area (Haefele *et al.,* 2003).

In order to obtain reasonable rice yield in Kilombero District, farmers are recommended to use phosphate fertilizers during planting and Nitrogen fertilizers during topdressing. The recommended phosphate fertilizers in the Kilombero District are DAP or Minjingu or NPK or TSP, at the rate of 50 kg per acre for DAP, NPK, TSP and 100 kg per acre for Minjingu. The recommended nitrogen fertilizers in

Kilombero District are Urea or CAN or NPK, and they are recommended to be applied at a rate of 50 kg per acre.

4.2.2.1 Phosphate fertilizers

According to Chatterjee (1983) Phosphate fertilizers stimulate root development, promote early flowering and ripening, it also provide more grains and more active tillers. In 2009/2010 cropping season the majority of farmers who used fertilizers in Kilombero District applied DAP at planting as a source of Phosphate fertilizer and Urea as topdressing fertilizer. Out of 111 respondents interviewed only 6 (14.4%) applied phosphate fertilizers in their rice fields at different rates. Out of these only 1 (2%) respondent from non FFS participants applied phosphate fertilizer at a rate of 30 to 39 kg per acre and 5 (10%) respondents from FFS participants applied phosphate fertilizer at a rate of 20 to 29 kg per acre (Table 12).

Table 12: Distribution of respondents according to their application of phosphate fertilizers

	Scale point	P fertilizer (kg/acre)	n	Percentage
	0	No fertilizer	59	98
Out of FFS	1	< 20	0	0
	2	20 - 29	0	0
	3	30 - 39	1	2
	4	40 - 49	0	0
	5	≥50	0	0
Total			60	100
In FFS	0	No fertilizer	46	90
	1	< 20	0	0
	2	20 - 29	5	10
	3	30 - 39	0	0
	4	40 - 49	0	0
	5	≥50	0	0
Total			51	100

As indicated earlier the recommended rate of phosphate fertilizers in Kilombero District is 50 kg per acre (DAP or NPK or TSP) and 100 kg per acre (Minjingu) but not a single respondent from both groups applied it at recommended rate. However there is an indication that a big number of FFS participants applied phosphate fertilizers in their rice fields compared to non-FFS participants. When respondents were probed to know the reasons of low adoption of phosphate fertilizers, the majority of them claimed that their soil is fertile and it does not need a phosphate fertilizer which was not the case. This calls a need to further train farmers on the necessity of phosphate fertilizer application in their rice fields.

4.2.2.2 Nitrogen fertilizers

According to Chatterjee (1983) the function of Nitrogen fertilizers in rice farming are; to imparts dark green color to rice plant parts, promote rapid growth and increase the quality and quantity of grains. As indicated earlier, the recommended nitrogen fertilizers in Kilombero District are Urea or CAN or NPK, at a rate of 50 kg per acre. But the majority of farmers who applied fertilizers in the study area used Urea in 2009/2010 growing season (Table 13).

According to Table 13 the majority of respondents (74 out of 111) did not apply Nitrogen fertilizers in their rice fields and the majority of them 49 (81.67%) were non FFS participants. On the other hand the study results show that 37 out of 111 respondents indicated that they applied Urea as a source of nitrogen at different rates. The majority of them 22 (43%) applied nitrogen fertilizers at recommended rate and these were from FFS participants while only 7 (11.67%) were non FFS participants (Table 13).This shows that more respondents who participated in FFS applied the recommended nitrogen fertilizer than non-FFS participants. This might be attributed by the fact that FFS participants through their FFS sessions learned the importance of nitrogen fertilizer in rice production, while non FFS participant did not get that opportunity.

4.2.3 Total fertilizer package application

Total fertilizers package indicates the amount of phosphate and nitrogen fertilizers recommended in the study area for rice production. Total fertilizer package applied.

Table 13: Distribution of respondents according to application of nitrogen fertilizers

	Scale point	Nitrogen fertilizer (Urea)kg/acre	n	Percentage
	0	No fertilizer	49	81.67
Out of FFS	1	< 20	3	5
	2	20 - 29	1	1.67
	3	30 - 39	0	0
	4	40 - 49	0	0
	5	≥ 50	7	11.67
Total			60	100
In FFS	0	No fertilizer	25	49
	1	< 20	0	0
	2	20 - 29	4	8
	3	30 - 39	0	0
	4	40 - 49	0	0
	5	≥ 50	22	43
Total			51	100

was obtained by adding the scale points of P and N fertilizers indicated in the Table 12 and 13 above. For example a respondent who applied the recommended amount of phosphate and nitrogen fertilizer scored 10 points, obtained from adding 5 scale point from Table 12 and 5 scale point from Table 13. Those who didn't apply fertilizer at all scored 0 scale point obtained by adding 0 scale point from Table 12 and 0 scale point from Table 13. The same procedure was used to the rest of respondents. The scale points were then categorized into four categories, 0 for those who didn't apply fertilizers at all, 1- 4 for low fertilizer adoption, 5 - 8 for medium fertilizer adoption and ≥ 9 for high fertilizer adoption (Table 14).

Table 14: Distribution of respondents according to total fertilizer package applied

	Scale point	Adoption level	n	Percentage
Out of FFS	0	Nil	49	81
	1-4	Low	4	7
	5-8	Medium	7	12
	≥ 9	High	0	0.0
Total			60	100
In FFS	0	Nil	25	49
	1-4	Low	4	8
	5-8	Medium	15	29
	≥ 9	High	7	14
Total			51	100

Table 14 shows that 49 (81%) respondents from non FFS participants didn't use fertilizer package in their rice fields while 4 (7%) and 7 (12%) respondents from non FFS participants their level of adoption was low and medium, respectively. No single respondent from non FFS participants whose level of adoption was high. On the other hand 25 (49%) respondents from FFS participants did not use fertilizer package, 4

(8%) and 15 (29%) from FFS participants their level of adoption was low and medium, respectively. All 7 (14%) respondents whose level of adoption was high were from FFS participants. The results reveal that the adoption of recommended fertilizer package is high among the FFS participants than among non-FFS participants where there is no respondent with high level of adoption.

4.2.4 Spacing

Proper spacing includes maintaining recommended spacing between and within row, to avoid nutrient competition. Sufficient spacing between plants and rows is vital to get maximum yield in a given plot of land. Appropriate spacing enables the farmer to keep appropriate plant population in his/her field. Hence, a farmer can avoid over or less population in a given plot of land which has negative effect on yield. A recommended spacing for rice production in Kilombero District is 20 cm x 20 cm (single row spacing) or 10 cm x 20 cm x 40 cm (double rows spacing) where 10cm is spacing between plants, 20 cm between rows and 40 cm is the spacing between double rows. During the interview, the respondent farmers were asked to indicate the spacing used in their rice farms in 2009/2011 growing season. Table 15 shows the distribution of respondents according to the spacing used.

According to Table 15 only 6 (10%) of the respondents who didn't participate in FFS used a recommended spacing of 20cm x 20cm. Others 11 (18.3%) used a spacing of 10cm x 10cm and majority of them 43 (71.7%) used broadcasting. On the other hand the majority 39 (77.4%) of the respondents from FFS participants used a spacing of 20 cm x 20 cm or 10 cm x 20 cm x 40 cm which is a recommended spacing.

Table 15: Distribution of respondents according to the spacing used

	Spacing	n	Percentage
Out of FFS	Broadcasting	43	71.7
	10x10	11	18.3
	20x20 or 10x20x40	6	10.0
	Total	60	100.0
In FFS	Broadcasting	11	21.6
	10x10	1	2.0
	20x20 or 10x20x40	39	77.4
	Total	51	100.0

Only 1(2%) respondent used a spacing of 10 cm x 10 cm and 11 (21.6%) respondents used broadcasting. The results reveal that the adoption level of recommended spacing is high among the FFS participants than among non- FFS participants.

4.2.5 Weeding

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). At Kilombero District the number of weeding depends on the location of the farm, those farms on the flooding plans experiences low weed prolific than farms which are out of the flooding plans. Most of interviewed respondents their rice fields fall under flood plain and therefore, the recommended weeding frequency under this condition are twice per growing season. The respondents were interviewed to see if they weeded their rice farms. The results in Table 16 show that all respondents from both groups i.e. non FFS and FFS participants weeded their rice fields but they differed in weeding frequency.

The results in Table 16 show that 23 (38.3%), 31 (51.7%) and 6 (10%) respondents from non FFS participants weeded their rice farms once, twice and thrice, respectively. On the other hand 7 (13.7%), 42 (82.4%) and 2 (3.9%) from FFS participants weeded their rice farms once, twice and thrice, respectively. This implies that the majority of FFS participants 44 (86.3%) weeded their rice farms more than once as compared to non FFS participants.

Table 16: Distribution of the respondents according to weeding frequency

	Number of weeding	n	Percentage
Out of FFS	Once	23	38.3
	Twice	31	51.7
	Thrice	6	10.0
	Total	60	100.0
In FFS	Once	7	13.7
	Twice	42	82.4
	Thrice	2	3.9
	Total	51	100.0

4.2.6 Pesticide application

According to Youdeowei (1985) Pests are major threats to increased agricultural production and to the health and well being of human being. The need to reduce and if possible eliminate altogether the ravages of these pests is very important.

When respondents were interviewed to see if they applied pesticides in their rice farms, it was found that a total of 64 respondents from both groups applied pesticides in their farms. The results in Table 17 show that, 40 (66.7%) of those who applied pesticides were from non FFS participants and 24 (47.1%) were respondents from

FFS participants. The results reveal that a big number of respondents from non FFS participants applied pesticide in their rice farms, due to the fact that their farms were infested by white flies in 2009/2010 cropping season.

Table 17: Distribution of respondents according to the use of pesticide

	Used pesticide	n	Percentage
Out of FFS	No	20	33.3
	Yes	40	66.7
	Total	60	100.0
In FFS	No	27	52.9
	Yes	24	47.1
	Total	51	100.0

4.3 Rice Yield for 2009/2010 Cropping Season

Improved production and productivity in some crops has been noticed due to application of recommended agricultural practices. According to Dismas (2005) farmers who apply recommended rice production practices like rice variety, fertilizer, spacing, weeding, and pesticide can harvest 30- 40 bags (of 80kg) per acre. In this study farmers were asked to indicate their average rice yield obtained in 2009/2010 cropping season and the results are summarized in Table 18.

The results in Table 18 show that 25 (41.7%) respondents from non FFS participants their average rice yield was between 1 and 9 bags, while 32 (53.3%) and 2 (3.3%) their average rice yield was between 10-19 bags and 20-29 bags, respectively. Only 1 (1.7%) respondent from non FFS participants had an average rice yield of above 30 bags per acre.

Table 18: Distribution of respondents according to average rice yield

	Average rice yield	n	Percentage
Out of FFS	1-9	25	41.7
	10 - 19	32	53.3
	20 - 29	2	3.3
	30 ≤	1	1.7
	Total	60	100.0
In FFS	1-9	3	5.9
	10 - 19	25	49.0
	20 - 29	17	33.3
	30 ≤	6	11.8
	Total	51	100.0

On the other hand 3 (5.9%), 25 (49%) and 17 (33.3%) respondents from FFS participants their average rice yield was in category of 1-9, 10-19, and 20-29 bags per acre, respectively. About 23 (45.1%) respondents from FFS participants their average rice yield was above 20 bags per acre. Generally, the results reveal that the majority of non FFS participants (25) than FFS participant (3) their average rice yield was less than 10 bags per acre while many FFS participants (23) than non FFS participant (3) their average rice yield was above 20 bags per acre.

4.4 Contribution of FFS in the Study Area

FFS sessions provide participants an opportunity to learn important agricultural practices and hence apply them in their field. Babur (2009) reported that, the knowledge acquired during the learning process can enable farmers to adapt agricultural technologies and hence become more productive and profitable. This part describes the contribution of FFS in the study area. It finds out if there is any significant different or relationship between yield and participation in FFS.

Also it examines if there is any significant contribution of FFS in terms of farmers adoption of recommended rice production practices like recommended rice variety, fertilizer application, spacing and weeding.

4.4.1 Contribution of FFS in farmers' adoption of recommended rice production practices

In an attempt to promote rice production in the study area, Farmers who participated in FFS were trained in the use of recommended rice seeds (TXD 306), fertilizer package that is P-fertilizers during planting and N- fertilizers as top dressing, use of spacing, weeding and pesticide application. This section investigate whether there is any significant different and/ or significant relationship between farmers who participated in FFS and farmers who have never participated in FFS in terms of the adoption of recommended rice production practices.

4.4.1.1 Rice varieties and FFS participation

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). As stated earlier farmers in Kilombero District used different varieties like TXD 306, Kilombero, Kihoko, Local variety and Super India. The correlation was used to test whether there is any significant relationship between participation in FFS and rice variety used. The results in Table 19 indicate a highly significant relationship ($r = 0.605$; $p = 0.000$) between participation in FFS and rice varieties used.

Table 19: Distribution of respondents according to rice varieties used and FFS participation

Variety used	FFS participation					
	Did not participate in FFS		Participated in FFS		Total	
	n	Percentage	n	Percentage	n	Percentage
Local variety	44	73.3	15	29.4	59	53.2
Kilombero, kihoko	1	1.7	0	0	1	0.9
Supa India	14	23.3	3	5.9	17	15.3
TXD 306	1	1.7	33	64.7	34	30.6
Total	60	54.1	51	45.9	111	100

χ^2 = 52.102; df =3; p = 0.000 r = 0.605; p = 0.000

This implies that the adoption of TXD 306 rice variety is high among farmers who participated in FFS than those who did not participated in FFS. Chi square was also used to test whether there is any significant different between farmers who participated in FFS and those who did not participate in term of rice variety used.

The results in Table 19 indicate that the difference is highly statistically significant (χ^2 = 52.102; df =3; p = 0.000). This implies that the two groups differ significantly in terms of rice variety used. This finding is in agreement with the findings of Tsion (2008) who reported that training in FFS kept the trained farmers more informed and updated on recommended packages like varieties, fertilizers, spacing, weeding and pesticides application.

4.4.1.2 Fertilizer application and FFS participation

Fertilizers are materials used to provide plant nutrients which are deficient in soils. According to Terrence (2002) and Basak (2010) nutrients in soil are the major determinant of the success or failure of a crop production. During survey farmers were requested to indicate the type and rate of phosphate and nitrogen fertilizer used in their rice fields. As far as phosphate fertilizer application is concerned correlation test was used to test whether there is any relationship between participation in FFS and phosphate fertilizer application. Correlation findings summarized in Table 20 show that there was no significant relationship (r = 0.146; p = 0.125) between FFS participation and phosphate fertilizers application.

Table 20: Distribution of respondents according to P fertilizers application and FFS participation

Use of P fertilizers	FFS participation					
	Did not participate in FFS		Participated in FFS		Total	
	n	Percentage	n	Percentage	n	Percentage
No fertilizer	59	98.3	46	90.2	105	83.8
20-29kg	0	0.0	5	9.8	5	13.5
30-39kg	1	1.7	0	0.0	1	1.7
> 50kg	0	0	0	0	0	0
Total	60	54.1	51	45.9	111	100.0

$\chi^2 = 9.625$ df =2; p = 0.031 r = 0.146; p = 0.125

This implies that application of phosphate fertilizer is not determined by participation in FFS in the study area. Chi- square was also used to test whether there is significant difference between participation/non participation in FFS and phosphate fertilizer application.

The results show that there is no statistical significant difference ($\chi^2 = 4.574$; df = 2; p = 0.102) between the two groups. This implies that application of phosphate fertilizer do not differ among FFS and non FFS participants. This might be attributed by the fact that the majority of participants from both groups i.e. 59 (98.3%) from non- FFS participants and 46 (90.2%) from FFS participants did not use phosphate fertilizer due to the belief that their farms were fertile and therefore there is no need to apply phosphate fertilizer.

4.4.1.3 Nitrogen fertilizer and FFS participation

Nitrogen fertilizers were among the package which farmers at Kilombero District were recommended to apply in order to increase their rice production. Many respondents who applied Nitrogen fertilizers from both groups that are FFS and non FFS participants applied it at different rates as indicated in Table 21.

The relationship between FFS participation and Nitrogen fertilizer application was tested by correlation, and the results show that there is a highly significant relationship (r=0.378 p= 0.000) between FFS participation and application of nitrogen fertilizer. This implies that participating in FFS improves respondent's awareness on the importance of Nitrogen fertilizers in rice production and therefore FFS participation facilitated the adoption of N fertilizer. The chi square results also indicate that there is a significant difference ($\chi^2 = 19.742$; df =3; p = 0.000) between FFS participation and N fertilizer application, which implies that the two groups differ in terms of N fertilizer application.

Table 21: Distribution of respondents according to FFS participation and N fertilizer application

Use of N Fertilizers	FFS participation					
	Did not participate in FFS		Participated in FFS		Total	
	n	Percentage	n	Percentage	n	Percentage
No fertilizer	49	81.7	25	49	74	66.7
>20kg	3	5	0	0	3	2.7
20-29kg	1	1.7	4	7.8	5	4.5
50kg<	7	11.7	22	43.1	29	26.1
Total	60	54.1	51	45.9	111	100.0

χ^2 = 19.742; df =3; p = 0.000 r=; 0.378 p= 0.000

4.4.1.4 Total fertilizer package application and FFS participation

As stated earlier total fertilizers package application indicates the amount of phosphate and nitrogen fertilizers applied by respondents. Table 22 summarizes the test results on the influence of FFS participation and total fertilizer package application. Correlation results indicated in Table 4.20 show that there is a significant relationship (r = 0.389 p = 0.000) between FFS participation and total fertilizer package application. This indicates that the adoption of total fertilizer package is higher among farmers who participated in FFS than those who did not participate in FFS and vise versa. This implies that in the study area total fertilizer package adoption is influenced by participation in FFS.

Table 22: Distribution of respondents according to FFS participation and total fertilizer package application

Total fertilizer package	FFS participation					
Score	Did not participate in FFS		Participated in FFS		Total	
	n	Percentage	n	Percentage	n	Percentage
0	50	83.3	25	49	75	67.6
1-3	3	5.0	4	7.8	7	6.3
4-6	7	11.7	17	33.3	24	21.6
7≤	0	0.0	5	9.8	5	4.5
Total	60	54.9	51	45.1	111	100.0

χ^2 = 17.025; df =3; p = 0.001 r = 0.389 p = 0.000

Chi square test results also show a highly significant difference (χ^2 = 17.025; df = 3; p = 0.001) between the two groups implying that the two groups differ in terms of total fertilizer package application.

4.4.1.5 Plant Spacing and FFS participation

To avoid nutrient competition sufficient spacing between plants and rows is vital to get maximum yield in a given plot of land. Appropriate spacing enables the farmer to keep appropriate plant population in his/her field (Tadesse, 2008). As stated earlier, the recommended spacing in Kilombero District is 10 cm x 20 cm x 40 cm for double row and 20 cm x 20 cm for single row. The relationship between FFS participation and spacing was tested by using correlation and the results show that there is highly statistical significant relationship (r = 0.634; p = 0.000) between FFS participation and spacing used (Table 23). This implies that majority of farmers who participated in FFS used recommended spacing than those who did not participate in FFS, which indicate that level of adoption of plant spacing increases with participation in FFS in the study area. The chi - square results also show the difference ($\chi^2 = 33.508$; df = 2; p = 0.000) between FFS participation and Plant Spacing, implying that there is significant different between FFS participants and non FFS participants in terms of using the recommended spacing.

Table 23: Distribution of respondents according to FFS participation and spacing used

The spacing used	FFS participation					
	Did not participate in FFS		Participated in FFS		Total	
	n	Percentage	n	Percentage	n	Percentage
No spacing	43	71.7	11	21.6	54	48.6
10x10	11	18.3	1	2	12	10.8
20x20 or 10x20x40	6	10	39	76.4	45	40.6
Total	60	54.1	51	45.9	111	100.0

$\chi^2 = 55.934$; df =3; p = 0.000 r = 0.634; p = 0.000

4.4.1.6 The relationship between FFS participation and weeding

It was expected in Kilombero District that training farmers in FFS would assist them to understand the importance of weeding and hence practice in their rice fields. It was of interest to test whether there is any association between participation and adherences to recommended weeding frequency. The correlation test results in Table 24 show that there is no statistical significant relationship (r = 0.168; p = 0.078) between FFS participation and weeding implying that there is no significant relationship between FFS participation and weeding frequency. But the Chi square test indicates that there is a significant different ($\chi^2 = 11.537$; df = 2; p = 0.003) between farmer who participated in FFS and those who did not participate in FFS in terms of weeding frequency.

Table 24: Distribution of respondents according to FFS participation and weeding

Number of weeding	FFS participation					
	Did not participate in FFS		Participated in FFS		Total	
	n	Percentage	n	Percentage	n	Percentage
Once	23	38.3	7	13.7	30	27.0
Twice	31	51.7	42	82.4	73	65.8
Thrice	6	10	2	3.9	8	7.2
Total	60	54.1	51	45.9	111	100

$\chi^2 = 11.537$; df =2; P = 0.003 r = 0.168; p = 0.078

4.5 Contribution of FFS on Rice Yield

It was expected that respondents who participated in FFS had an opportunity to learn the important agricultural practices, apply them in their fields and hence increase rice yield. Therefore the obtained yield was compared with participation or non participation in FFS to see whether there is significant different or relationship between the two variables. Table 25 summarizes the results on the relationship between average rice yield and participation in FFS. As indicated in Table 25 about 6 (11.8%) respondents from FFS participants their average harvest was above 30 bags per acre while only 1 (1.7%) respondent from non FFS participants his/her average harvest was above 30 bags per acre. The correlation results indicates that there is significant relationship (r = 0.522 p = 0.000) between FFS participation and rice yield. This implies that those who participated in FFS had high yields than those who did not participate in FFS.

Chi square results also show that there is a highly significant difference ($\chi^2 = 33.046$; df = 3; p = 0.000) between FFS participation and rice yield, implying that FFS and non FFS participants differ among themselves in terms of average yield. These findings are in line with SAWAC (2003) who found that farmers who participated in the FFS program, their yields were significantly greater than farmers who did not participate in FFS programme.

Table 25: Distribution of respondents according to average yield and participation in FFS

Average harvest in 2009/10	FFS Participation					
	Did not participate in FFS		Participated in FFS		Total	
	n	Percentage	n	Percentage	n	Percentage
1-9	25	41.7	3	5.9	28	25.2
10 - 19	32	53.3	25	49.0	57	51.4
20 - 29	2	3.3	17	33.3	19	17.1
30≤	1	1.7	6	11.8	7	6.3
Total	60	54.1	51	45.9	111	100

$\chi^2 = 33.046$ df = 3 p = 0.000 r = 0.522 p = 0.00

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

This study investigated the contribution of FFS in rice production. Specifically it focused on the contribution of FFS in terms of adoption of agricultural practices which were recommended by rice FFS in Kilombero District, such as improved varieties (TXD 306), fertilizers (phosphate and nitrogen), spacing, weeding, and pesticide application. The study also investigated the contribution of FFS in terms of rice yield.

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

(i) Generally the results reveal that, the level of adoption of recommended rice production practices varied across the two groups namely, FFS participants and non FFS participants. The level of adoption was high among FFS participants than in non FFS participants with the exceptional of P fertilizers and pesticide application. For example, 33 (64.7%) FFS participants used the recommended rice variety while only 1 (1.7%) from non FFS participants used the recommended rice variety that is TXD 306. For the case of plant spacing 39 (76.4%) FFS participants used the recommended spacing while 6 (10%) non FFS participants used the recommended spacing. As far as nitrogenous fertilizer application is concerned, 22 (43%) FFS participants applied recommended nitrogen fertilizer while only 7 (11.67%) non FFS participants applied recommended nitrogen fertilizer. Similar trend was observed with recommended weeding frequency whereby 42 (82.4%) FFS participants weeded their rice fields at recommended frequency while 31 (51.7%) non FFS participants did so. On the other hand phosphate fertilizer application was low in both FFS and non FFS participants, whereby only 5 (10%) and 1 (2%) of FFS participants and non FFS participants respectively, applied phosphate fertilizers below the recommended rate in their rice field.

(ii) The average rice yield was high among FFS participants than among non FFS participants; About 23 (45.1%) respondents from FFS participants their average rice yield was above 20 bags per acre while only 3 (5%) respondents from non FFS participants their average rice yield was above 20 bags per acre.

(iii) The significant contribution of FFS in terms of adoption of recommended rice production practices and rice yield was noted in the study area. Both adoption and rice yield were significantly influenced by FFS participation. For example adoption and rice yield significantly increased with participation in FFS. In addition, there was a significant different between FFS participation and non FFS participants in term of rice yield and adoption of recommended rice production practices like rice varieties, P fertilizers, N fertilizers, spacing and weeding

5.2 Recommendations

The following recommendations are based on the conclusions drawn from the findings:

(i) Due to low level of fertilizer application especially phosphate fertilizer among the two groups it is recommended that FFS facilitators should put more emphasis on the importance of applying recommended phosphate fertilizers in rice production as per recommendations from research centers.

(ii) Taking into account the fact that FFS has contributed a lot in terms of enabling farmers to adopt the recommended rice production practices and increased rice yield it is recommended that the government through the Ministry of Agriculture, Food Security and Cooperatives should facilitate the establishment of FFS in all rice growing areas and ensure their sustainability.

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APPENDICES

Appendix 1: Interview Questionnaire

TITLE: ASSESSMENT ON THE CONTRIBUTION OF FARMER FIELD SCHOOLS IN RICE PRODUCTION IN KILOMBERO DISTRICT

General Instructions to Enumerators

- Make brief introduction to each farmer 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.
- Pleas fill up the interview questionnaire according to the farmers reply (do not put your own reply/ feeling).
- Please ask each question so clearly and patiently until the farmer understands clearly (get your points).
- Please do not try to use technical terms while discussing with the farmers (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 determine the level of adoption of rice production practices recommended during Farmers Field School

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

(iii) To find out the contribution of FFS in rice production in Kilombero District

General information

Respondent's name.. ....

Respondents mobile phone number...

Questionnaire No...

Interview date..

Village... Ward...........................

Respondent's personal characteristics

1) Sex of the respondent

1. Male [ ] 2. Female [ ]

2) What is your age in years...

3) What is your highest Education level?

1. No formal education [ ]
2. Primary school education [ ]
3. Secondary education [ ]
4. Others (specify)...

4) What is your marital status?

1. Married [ ]
2. Single [ ]
3. Divorce [ ]
4. Widowed [ ]

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

1 Less than 50,000 [ ]
2 50,000- 100,000 [ ]
3 100,001-200,000 [ ]

4 Above 200,000 [ ]

6) How many people in your household.

1. 1 - 3 [ ]
2. 4 - 6 [ ]
3. 7 - 10 [ ]
4. 11 and above [ ]

7) What is your farm size? (Actual size..........................acres)

1 Less than 1 acre [ ]
2. 1 - 2 acres [ ]
3. 2 – 3 acres [ ]
4. 3 – 4 acres [ ]
5. Above 4 acres [ ]

8) What area of your farm did you use to grow rice in the 2009/2010 season? (Actual size..........................acres)

1. Less than 1 acre [ ]
2. 1 -2 acres [ ]
6. 2 - 3 acres [ ]
7. 3 - 4 acres [ ]
8. Above 4 acres [ ]

Rice production

9) What yield did you get in 2009/2010 season? (Actual total number of bags...........)

Size of bags used

1) 80kg bags (5tins) [ ]

2) 96kg bags (6tins) [ ]

3) 112kg bags (7tins) [ ]

4) 128kg bags (8tins) [ ]

NB: Adjusted yield to 100kg bags......................................

10) Were there any natural hazards that affected your yield in the 2009/2010 season?

1. No [ ] 2 Yes [ ]

11) If yes, what were the hazards?

1) Flood [ ]

2) Drought [ ]

3) Locust, Arm worms [ ]

4) Arm worms [ ]

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

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

Size of bags used

1) 80kg bags (5tins) [ ]

2) 96kg bags (6tins) [ ]

3) 112kg bags (7tins) [ ]

4) 128kg bags (8tins) [ ]

NB: Adjusted yield to 100kg/ bags…………………………………..

Total actual yield………………………………………………….kg

Average yield/acre………………………………………......…..kg

13) How do you rate your yield in the following five points scale?

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

14) How many bags of rice could one get per acre under good management practices

Total number of bags……………………………………

Size of bags used

1) 80kg bags (5tins) [ ]
2) 96kg bags (6tins) [ ]
3) 112kg bags (7tins) [ ]
4) 128kg bags (8tins) [ ]

NB: Adjusted yield to 100kg/ bags………………………

Total yield…………………………………………………kg

Average yield/acre……………………………….……..kg

Adoption of recommended rice production practices

Rice varieties

15) Which rice verities did you plant in 2009/2010 season?

	Variety	**Source of seed**	**Proportion of planted land**
1)	Local varieties (Afaa Mwanza Tule na bwana, Moshi wa sigara, Shingo ya mwali)		
2)	Kilombero,Kihoko red, sindano		
3)	Super India		
4)	TXD 88		
5)	TXD 306		

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,) [ ]
2) Kilombero, kihoko red, sindano [ ]
3) Super India [ ]
4) TXD 88 [ ]
5) TXD 306 [ ]

16) How do you rate on the 5 point scale the efficient of your variety choice?

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

17) Do you intent to change your variety choice?

1) No [ ] 2) Yes [ ]

18) If yes, to which variety?

1) Local varieties (Afaa Mwanza, Tule na bwana, Moshi wa sigara,) [ ]

2) Kilombero, kihoko red, sindano [ ]

3) Super India [ ]

4) TXD 88 [ ]

5) TXD 306 [ ]

19) What is the recommended rice variety in your area?

1) Local varieties (Afaa Mwanza, Tule na bwana, Moshi wa sigara,) [ ]

2) Kilombero, kihoko red, sindano [ ]

3) Super India [ ]

4) TXD 88 [ ]

5) TXD 306 [ ]

20) Which variety do you regard to be the best?

1) Local varieties (Afaa Mwanza, Tule na bwana, Moshi wa sigara.) [ ]

2) Kilombero, kihoko red, sindano [ ]

3) Super India [ ]

4) TXD 88 [ ]

5) TXD 306 [ ]

21) What are the advantages of recommended rice varieties?

1) Insect pest resistance [ ]

2) Disease resistance [ ]

3) Quality grain [ ]

4) Early maturity [ ]

5) High productivity/yield [ ]

6) Others (specify)...

22) What are the disadvantages of recommended rice varieties?

1) Low storability [ ]

2) Low market demand [ ]

3) Poor taste [ ]

4) High seed cost [ ]

5) Low productivity (yield) [ ]

6) Others (specify)..

Fertilizer application

23) Did you use fertilizer in your rice field in 2009/2010 season?

1) No [ ] 2) Yes [ ]

24) If yes what type and amount of fertilizers did you use during planting?

Fertilizer		DAP	NPK	TSP	MINJINGU
Rate/acre	0	No fertilizer	No fertilizer	No fertilizer	No fertilizer
	1	Less than 20kg	Less than 20kg	Less than 20kg	Less than 40kg
	2	20 - 29kg	20 - 29kg	20 - 29kg	40 - 59kg
	3	30 - 39kg	30 - 39kg	30 - 39kg	60 - 79kg
	4	40 - 49kg	40 - 49kg	40 - 49kg	80 - 99kg
	5	_ > 50kg	_ > 50kg	_ > 50kg	_ >100kg

25) What type and amount of fertilizers did you use during top dressing?

Fertilizer		Urea	CAN	NPK
Rate/acre	0	No fertilizer	No fertilizer	No fertilizer
	1	Less than 20kg	Less than 20kg	Less than 20kg
	2	20 - 29kg	20 - 29kg	20 - 29kg
	3	30 - 39kg	30 - 39kg	30 - 39kg
	4	40 - 49kg	40 - 49kg	40 - 49kg
	5	> 50kg	> 50kg	> 50kg

NB: Total fertilizer application.

0) 0 [ ]

1) 1 – 3 [ ]

2) 3 – 5 [ ]

3) 5 – 7 [ ]

4) 7 – 9 [ ]

5) 10 [ ]

26) How do you rate your fertilizers application efficiency? Use the following scale to indicate your rating

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

27) Do you intend to chance your fertilization?

1) No [ ] 2) Yes [ ]

28) If yes, to which fertilization?

a) At planting

Fertilizer		DAP	NPK	TSP	MINJINGU
Rate/acre	0	No fertilizer	No fertilizer	No fertilizer	No fertilizer
	1	Less than 20kg	Less than 20kg	Less than 20kg	Less than 40kg
	2	20 - 29kg	20 - 29kg	20 - 29kg	40 - 59kg
	3	30 - 39kg	30 - 39kg	30 - 39kg	60 - 79kg
	4	40 - 49kg	40 - 49kg	40 - 49kg	80 - 99kg
	5	> 50kg	> 50kg	> 50kg	>100kg

b) As top dressing

Fertilizer		Urea	CAN	NPK
Rate/acre	0	No fertilizer	No fertilizer	No fertilizer
	1	Less than 20kg	Less than 20kg	Less than 20kg
	2	20 - 29kg	20 - 29kg	20 - 29kg
	3	30 - 39kg	30 - 39kg	30 - 39kg
	4	40 - 49kg	40 - 49kg	40 - 49kg
	5	> 50kg	> 50kg	> 50kg

c) Total fertilizer application.

0) 0 [ ]

1) 1 – 3 [ ]

2) 3 – 5 [ ]

3) 5 – 7 [ ]

4) 7 – 9 [ ]

5) 10 [ ]

28) If yes, to which fertilization?

a) At planting

Fertilizer		DAP	NPK	TSP	MINJINGU
Rate/acre	0	No fertilizer	No fertilizer	No fertilizer	No fertilizer
	1	Less than 20kg	Less than 20kg	Less than 20kg	Less than 40kg
	2	20 - 29kg	20 - 29kg	20 - 29kg	40 - 59kg
	3	30 - 39kg	30 - 39kg	30 - 39kg	60 - 79kg
	4	40 - 49kg	40 - 49kg	40 - 49kg	80 - 99kg
	5	≥ 50kg	≥ 50kg	≥ 50kg	≥100kg

b) As top dressing

Fertilizer		Urea	CAN	NPK
Rate/acre	0	No fertilizer	No fertilizer	No fertilizer
	1	Less than 20kg	Less than 20kg	Less than 20kg
	2	20 - 29kg	20 - 29kg	20 - 29kg
	3	30 - 39kg	30 - 39kg	30 - 39kg
	4	40 - 49kg	40 - 49kg	40 - 49kg
	5	> 50kg	> 50kg	> 50kg

c) Total fertilizer application.

0) 0 [ ]

1) 1 – 3 [ ]

2) 3 – 5 [ ]

3) 5 – 7 [ ]

4) 7 – 9 [ ]

5) 10 [ ]

29) What are the recommended fertilizers in your area/

a) At planting

Fertilizer		DAP	NPK	TSP	MINJINGU
Rate/acre	0	No fertilizer	No fertilizer	No fertilizer	No fertilizer
	1	Less than 20kg	Less than 20kg	Less than 20kg	Less than 40kg
	2	20 - 29kg	20 - 29kg	20 - 29kg	40 - 59kg
	3	30 - 39kg	30 - 39kg	30 - 39kg	60 - 79kg
	4	40 - 49kg	40 - 49kg	40 - 49kg	80 - 99kg
	5	_ > 50kg	_ > 50kg	_ > 50kg	_ >100kg

b) As top dressing

Fertilizer		_Urea	CAN	NPK
Rate/acre	0	No fertilizer	No fertilizer	No fertilizer
	1	Less than 20kg	Less than 20kg	Less than 20kg
	2	20 - 29kg	20 - 29kg	20 - 29kg
	3	30 - 39kg	30 - 39kg	30 - 39kg
	4	40 - 49kg	40 - 49kg	40 - 49kg
	5	> 50kg	> 50kg	> 50kg

c) Total fertilizer application.

0) 0 [ ]

1) 1 – 3 [ ]

2) 3 – 5 [ ]

3) 5 – 7 [ ]

4) 7 – 9 [ ]

5) 10 [ ]

30) What in your view is the best fertilizer?

a) At planting

Fertilizer		DAP	NPK	TSP	MINJINGU
Rate/acre	0	No fertilizer	No fertilizer	No fertilizer	No fertilizer
	1	Less than 20kg	Less than 20kg	Less than 20kg	Less than 40kg
	2	20 - 29kg	20 - 29kg	20 - 29kg	40 - 59kg
	3	30 - 39kg	30 - 39kg	30 - 39kg	60 - 79kg
	4	40 - 49kg	40 - 49kg	40 - 49kg	80 - 99kg
	5	> 50kg	> 50kg	> 50kg	>100kg

b) As top dressing

Fertilizer		Urea	CAN	NPK
Rate/acre	0	No fertilizer	No fertilizer	No fertilizer
	1	Less than 20kg	Less than 20kg	Less than 20kg
	2	20 - 29kg	20 - 29kg	20 - 29kg
	3	30 - 39kg	30 - 39kg	30 - 39kg
	4	40 - 49kg	40 - 49kg	40 - 49kg
	5	> 50kg	> 50kg	> 50kg

c) Total fertilizer application.

0) 0 [ ]

1) 1 – 3 [ ]

2) 3 – 5 [ ]

3) 5 – 7 [ ]

4) 7 – 9 [ ]

5) 10 [ ]

31) What are the advantages of using recommended type of Fertilizer?

1. Dark green looking stand [ ]

2. Facilitates maturity [ ]

3. High grain yield [ ]

4. Others (specify)..

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

1) Laborious [ ]

2) Unavailability of fertilizer [ ]

3) High cost [ ]

4) Others (specify)...

Spacing

33) Did you use spacing in rice farming in the last season (2009/2010)

1) No [ ] 2) Yes [ ]

34) If yes which spacing did you use?

1) Broadcasting [ ]

2) 10x10 [ ]

3) 20 x20 [ ]

4) 10 x 20 x 40 [ ]

35) What is the recommended spacing?

1) Broadcasting [ ]

2) 10x10 [ ]

3) 20 x20 [ ]

4) 10 x 20 x 40 [ ]

36) Which spacing do you regard the best?

1) Broadcasting [ ]

2) 10x10 [ ]

3) 20 x20 [ ]

4) 10 x 20 x 40 [ ]

Weeding

37) Did you weed your rice farm last season (2009/2010)?

1) No [ ] 2) Yes [ ]

38) If yes how many times?

1) Once [ ]

2) Twice [ ]

3) Thrice [ ]

39) What is the recommended weeding frequency?

1) Once [ ]

2) Twice [ ]

3) Thrice [ ]

40) What is the best weeding frequency?

1) Once [ ]

2) Twice [ ]

3) Thrice [ ]

Pest control

44) Did you face any pest problems in your rice farm last season (2009/2010)?

1) No [ ] 2) Yes [ ]

45) If yes, which type pesticide and amount used?

S/NO	Pest	Pesticide used	Rate of application
1	....	....	....
2	....	....	....
3	....	....	....
4	....	....	....

Factors influencing adoption of recommended rice production practices

46) Which factor hampers the adoption of recommended rice production practices?

1) Unavailability of credit, [ ]

2) Unavailability market [ ]

3) Unavailability Extension services [ ]

4) Unavailability inputs [ ]

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