THE ROLE OF FARMER FIELD SCHOOLS IN ADOPTION AND ADAPTATION OF RECOMMENDED RICE PRODUCTION PRACTICES IN MVOMERO DISTRICT IN TANZANIA

MSc (RURAL DEVELOPMENT AND EXTENSION) THESIS

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LILONGWE UNIVERSITY OF AGRICULTURE AND NATURAL RESOURCES

BUNDA COLLEGE

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BA. (Rural Development), Tanzania

A THESIS SUBMITTED TO THE FACULTY OF DEVELOPMENT STUDIES IN PARTIAL FULFILMENT OF REQUIREMENTS FOR AWARD OF THE DEGREE OF MASTER OF SCIENCE IN RURAL DEVELOPMENT AND EXTENSION

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MAY, 2016

DECLARATION

I **Nyamonge Kenya,** do hereby declare that this thesis is a result of my own original effort and work, and that to the best of my knowledge, the findings have never been previously presented to Lilongwe University of Agriculture and Natural Resources or elsewhere for the award of any academic qualification. Where assistance was sought, it has been accordingly acknowledged.

Nyamonge Kenya

Signature: ______________________________

Date: ______________________________

CERTIFICATE OF APPROVAL

We, the undersigned, certify that this thesis is the result of author's own work, and that to the best of our knowledge, it has not been submitted for any other academic qualification within Lilongwe University of Agriculture and Natural Resources or elsewhere. The thesis is acceptable in form and content, and that satisfactory knowledge of the field covered by the thesis was demonstrated through an oral examination held on ……………………….

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DEDICATION

This work is dedicated to my lovely parents Kenya Muhenga Marwa and Mariam Muhabe who laid a strong foundation for my education. It is also dedicated to my beloved brother-in- law Daniel Joram and his family for their moral and material support rendered to me throughout my study period.

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ABSTRACT

Farmer Field Schools (FFS) provide farmers with an opportunity to experiment new technologies which help them to make informed decisions that eventually lead to increased production and income. This study aimed at assessing the role of FFS in adoption and adaptation of recommended rice production practices in Mvomero district in Tanzania. To achieve the above objective a cross-sectional research design was adopted whereby 188 respondents (FFS members) were selected through a multi-stage sampling technique. Both qualitative and quantitative data were collected using various methods including household survey, interviews, Focus Group Discussions and observation. Data analysis was done using SPPS Version 22.

The results of the study show that a total of 15 recommended rice production practices were promoted using FFS in the study area and more than 75% of FFS members were found to be aware of them. The results further show that the majority of the recommended rice production practices (80%) promoted were adopted by more than 65% FFS members. However, the study results show that only 20% of the recommended rice production practices were adapted by FFS members due to financial constraints and risk averse behaviour. It was therefore concluded that FFS promoted a good number of recommended rice production practices and that the level of adoption of the recommended rice production practices was high while the level of adaptation was low. It is recommended that awareness creation among farmers on the recommended rice production practices and other agricultural technologies should be done through FFS. Additionally, the adoption of recommended rice production practices and other

agricultural related technologies should be promoted through FFS whenever resources allow.

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LIST OF ABBREVIATIONS AND ACRONYMS

AC	Abstract Conceptualization
AE	Active Experimentation
AESA	Agro-ecosystem Analysis
BPH	Brown Plant Hopper
DAICO	District Agricultural Irrigation and Cooperative Officer
EZARI	Eastern Zone Agriculture Training Institute
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
FFS	Farmer Field Schools
FSR	Farming System Research
GDP	Gross Domestic Product
IITA	International Institute of Tropical Agriculture
IPM	Integrated Pest Management
IRRI	International Rice Research Institute
MAFSC	Ministry of Agriculture Food Security and Cooperatives
MATI	Ministry of Agriculture Training Institute
MOA	Ministry of Agriculture
PADEP	Participatory Agriculture Development Program
PTD	Participatory Technology Development
RLDC	Rural Livelihood and Development Company
RO	Reflective Observation

SPSS	Statistical Package for Social Sciences
SRI	System of Rice Intensification
T&V	Training and Visit
TNS	Tanzania National Statistics
TT	Technology Transfer
URT	United Republic of Tanzania
USDA	United States Department of Agriculture

CHAPTER 1

INTRODUCTION

1.1 Introduction

This section provides information about the background, problem statement, research justification, research objectives, research questions, operational definitions and limitation of the study.

1.2 Background

Agricultural extension plays a very important role in economic development in any agrarian country like Tanzania. In an effort to improve agriculture in Tanzania, several extension approaches were introduced after independence. These were, however, not very effective due to a number of weaknesses embedded in them like being limited to demonstration of technologies, top-down in nature, donor dependent, limited use of farmers' knowledge, and using the already packaged information (Mwaseba *et al.*, 2008). Examples of these approaches included improvement and transformation approaches (Lugeye, 1995), training and visit system (Mwaseba *et al.*, 2008), farming systems research and extension approach. In responding to the failure of the previous approaches, the Government of Tanzania, through the Ministry of Agriculture Food Security and Cooperatives introduced Farmer Field Schools (FFS) as an alternative approach in transforming agriculture in 1996.

Farmer Field School (FFS) is a season long training of farmers involving participatory activities, hands-on analysis and decision making (Rola *et al.*, 2002). It is a participatory agricultural extension approach based on experiential learning or learning by discovery (FAO, 2003).The first FFS were established in 1989 in Central Java - Indonesia during a pilot season by 50 United Nations Food and Agriculture Organization plant protection officers to test and develop field training methods as part of their Integrated Pest Management (IPM) training of trainers' course (Mwaseba *et al.*, 2008). The FFS approach represents a paradigm shift in agricultural extension from top down to bottom up. The training programme utilizes participatory methods "to help farmers develop their analytical skills, critical thinking, and creativity, and help them learn to make better decisions" (Kenmore, 2002).

FFS were introduced in Western Africa in 1995 as a means of spreading agricultural practices such as soil fertility, cassava cultivation, animal health and other issues such as human health. The first example of FFS in East Africa was in Uganda in 1996, which was introduced by FAO-IPM project in the Eastern part of the country. Since then, FFS have developed and dealt with different issues such as diseases and pests control, harvest preservation techniques, management of pesticides, soil fertility, etc. Since 2008, various organizations have been implementing agro-pastoralist FFS in Karamoja region in Uganda (Sones and Duveskog, 2003).

In Tanzania, the FFS approach is not a new phenomenon as it was introduced in 1996 whereby Mkindo Farmers' Agricultural and Rural Training Centre was established in Morogoro region by the Indonesian Farmers' Fund as part of a cooperation agreement between Tanzania and Indonesia. The centre acts as the national centre for training farmers and trainers on irrigated rice. Moreover, in 2002, the Ministry of Agriculture

Training Institute (MATI) Uyole, Mbeya introduced FFS in Namtumbo district in Ruvuma region and in some areas in Mbeya region which played a very important role in enhancing participatory skills in agriculture and livestock production to farmers (Mwaseba *et al.*, 2008).

1.3 Problem Statement

Following the failure of the previous extension approaches which were introduced after independence, the Government of the United Republic of Tanzania, through its Ministry of Agriculture Food Security and Cooperatives introduced Farmer Field School (FFS) in 1996 as an alternative approach to facilitate the adoption of agricultural related technologies in order to promote agricultural transformation and economic development. It is an undeniable fact that FFS play a very important role in agriculture transformation in terms of knowledge, productivity and income. Several studies have reported the contributions of FFS in knowledge dissemination, increasing household income, and increasing production and productivity (Godtland *et al.*, 2003; Davis *et al.*, 2012). According to Rogers (2003), adoption is a decision to make full use of an innovation as the best course of action available.

Factors affecting adoption include age, education, sex, household size, landholding size, (Kusmiat *et al.*, 2007; Kasie *et al.*, 2012), awareness, income (Asfawl *et al.*, 2011), experience, risk and uncertainties (Drechsel, 2005), innovation attributes like compatibility, trialability, relative advantage (Rogers, 1962; van den Ban and Howkins, 1996), membership in FFS (Kabir, 2006). Adaptation is influenced by various factors, some of them include awareness or access to information, income/wealth and access to credit (Nhemachena and Hassan 2007; Obayelu *et al*., 2014). However, not much is known on the role of FFS in the adoption and adaptation of recommended rice production practices among FFS farmers. Therefore, it was the aim of this study to address this gap.

1.4 Research Justification

Farmers' awareness on the recommended rice production practices is very important in the adoption of the same. Subedi, *et al*., (2009) reported that farmers' awareness was the first key stage to adoption of new technology. Similarly, Rogers, (1995) reported that awareness and knowledge of a new technology was the first step in the process of adoption.

This study has therefore identified the recommended rice production practices promoted using FFS in Mvomero district Tanzania; examined the level of adoption of the recommended rice production practices among FFS members and the level of adaptation of the recommended rice production practices among FFS members. These results will inform various stakeholders including farmers, policy makers, researchers and extension workers on the role of FFS in the adoption and adaptation of recommended rice production practices including increasing farmers' awareness, knowledge and understanding of the recommended rice production practices which facilitated their adoption and adaptation. These will play a vital role in forming a foundation on recommending measures to be put in place in order to facilitate farmers' adoption and adaptation of recommended rice production practices and eventually leading to increased rice yields, household income and achieve food security in Mvomero district.

Additionally, the information will help the Government of the United Republic of Tanzania to achieve the Sustainable Development Goals including ending poverty in all its forms, ending hunger, achieving food security, improved nutrition and promoting sustainable agriculture by 2030 (ICS, 2015).

1.5 Research Objectives

The overall objective of the study was to investigate the roles of FFS in adoption and adaptation of recommended rice production practices in Mvomero district in Tanzania. The specific objectives were as follows:

i) To identify the recommended rice production practices promoted using FFS in the study area.

ii) To examine the level of adoption of recommended rice production practices among FFS members.

iii) To examine the level of adaptation of recommended rice production practices among FFS members.

1.6 Research Questions

i) Which recommended rice production practices are being promoted using FFS in the study area?

ii) What is the level of adoption of recommended rice production practices among FFS members?

iii) What is the level of adaptation of recommended rice production practices among FFS members?

1.7 Operational definitions

- Adoption was operationalized as an act whereby FFS graduates/alumni accept and use the recommended rice production practices in their own fields. This was measured by looking at the proportion of FFS members who were using the recommended rice production practices in their own fields.

- Adaptation was operationalized as an act whereby FFS graduates/ alumni made some changes on the recommended rice production practices to fit their local condition. This was measured by looking at the proportion of FFS members who made some changes on the recommended rice production practices to fit their local conditions.

- Adopters were operationalized as FFS graduates or alumni who used the recommended rice production practices in their own fields.

- Non-adopters were operationalized as FFS graduates or alumni who did not use the recommended rice production practices in their own fields.

- Non-FFS members were operationalized as members of the farming community who did not participate in the FFS season long training**.**

1.8 Limitation of the study

The scope of this study was limited to identifying the recommend rice production practices promoted using FFS in the study area and examining the adoption and adaptation levels of the recommended rice production practices among of FFS members.

1.9 Ethical issues

Research ethics refers to the application of moral rules and professional codes of conduct to the collection, analysis, reporting, and publication of information about research subjects, in particular active acceptance of subjects' right to privacy, confidentiality, and informed consent (Marshall, 1998). According to Escobedo *et al.* (2007), the Belmont Report identified three basic principles which are to be followed by all researchers. Among these is the ethical principle of respect for persons. This is the most important principle with regards to the consent process. This principle establishes that all human participants are to "be treated as autonomous agents capable of self-determination." This implies that all participants must give informed consent to be involved in a research project, they must be given adequate information about the project, they must understand the research protocol, and they must be able to withdraw from the project at any point.

To ensure adherence to the research ethics, the research protocol was approved and certified by Sokoine University of Agriculture. The University then issued clearance/introductory letter which was submitted to Mvomero district office where the study was conducted. Furthermore, Mvomero District office cleared the research protocol and subsequently issued a clearance/introductory letter which was submitted to Ward Executive Officers (WEOs) and Village Executive Officers (VEOs). The VEOs introduced the researcher to the study's respondents prior to the commencement of data collection exercise.

To ensure that the Belmont Report principles are adhered to, the respondents were adequately informed of the purpose, objectives, and benefits of the study prior to commencement of the interviews. Honesty was maintained in explaining the benefits of the study and any information about the study. Besides this, respondents were not forced to participate in the study, and interviews only proceeded with their verbal consent. Moreover, the data collected from the respondents were treated as confidential and unique identification numbers were used to conceal the identities of respondents. Additionally, all authors cited in this study were duly acknowledged.

CHAPTER 2

LITERATURE REVIEW

2.1 The Role of Agriculture in Tanzania

Agriculture forms the basis of Tanzania economy. It accounts for about 50% of the national income (GDP), 85% of exports. It is a source of food and employs about 80% of the Tanzanians (MAFSC, 2012). Agriculture in Tanzania is dominated by smallholder farmers cultivating farm sizes ranging from 0.9 hectares to 3.0 hectares. About 70% of Tanzania's crop area is cultivated by hand hoe, 20% by ox plough and 10 % by tractor (MAFSC, 2012).

2.2 Rice in Tanzania's Agriculture

Rice is the second most important food and commercial crop in Tanzania after maize (RLDC, 2009). Tanzania is the second largest producer of rice in southern Africa after Madagascar with production level of 818, 000 tones (Matchmaker, 2010). About 71% and 29% of rice in Tanzania is grown under rain fed condition and irrigation respectively (RLDC, 2009).

2.3 Extension approaches and farming systems used after independence

Extension approach refers to a series of procedures for planning, organizing and managing the extension institution as well as for implementing practical extension work by staff with technical and methodical qualification and using the necessary and appropriately adapted means (Bollinger, 1994). Examples of farming systems and extension approaches include Training and Visit, Farming System Research, Mass media approach, Farmer Field Schools, etc. Most of the extension approaches and farming systems which were introduced in Tanzania after independence based on Technology Transfer model (TT), which was top-down in nature. Extension projects and programmes in Tanzania have been criticised for being top-down or lacking genuine farmers' participation (Douglah and Sicilima, 1997). In their study, Douglah and Sicilima (1997) reported that, "neither T& V nor SG 2000 employed genuinely balanced participatory approach in their extension programming efforts. There was more emphasis on getting farmers to implement programs than on making provisions to involve them in planning what was to be implemented or evaluating the processes or outcomes of programs." Some of the post- independence extension approaches in Tanzania are discussed below.

2.3.1 Improvement and Transformation Approaches

Improvement and transformation approaches were introduced shortly after independence (1961-1966) as a result of the World Bank recommendations which aimed at increasing production and improving the living standards of more than 95% of the population. Basically, the improvement approach consisted of efforts to gradually raise output within existing rural households through extension services. On the other hand, transformation approach sought to radically transform agriculture through the resettlement in special schemes of pre-selected villagers who would then engage in 'modern' farming under the supervision and directives of officials (extension agents). Since much emphasis was given to cash crop production, this led to Tanzania becoming a food importing country whereby by grain imports increased yearly. Besides, both approaches paid more attention to progressive farmers. By 1966, it became very clear that these approaches were not producing substantial results since output fluctuated yearly with increased production cost. Therefore, both improvement and transformation approaches failed to achieve the intended objectives.

2.3.2 Training and Visit System (T&V)

Training and visit was an extension system that focused on training extension officers on technical skills to be passed on to contact farmers who had to pass the learned technical skills to their fellow farmers (MoA, 2010). The training and visit system aimed at having competent and well trained extension workers who would visit farmers regularly with relevant technical messages and bring farmers' problems to research thus leading to increased production as well as income. It was launched in 1986 as part of the National Agricultural and Extension Rehabilitation Program funded by the World Bank (Douglah and Sicilima, 1997). The features of T &V included professionalism, concentration of effort, single line of command, time bound work, field and farmer orientation, regular and continuous training and linkage with research. Success was measured basing on yield increase of the crop covered by the program. The failure and disappearance of T&V among other things was attributed to its rigidity, top-down nature, incompatibility of its high recurrent costs with the limited budgets available domestically, leading to fiscal unsustainability, (Feder *et al.*, 2006).

2.3.3 Farming System Research (FSR)

FSR can be defined as a collaborative arrangement which involves farmers, technical and social scientists in the identification, development and evaluation of relevant improved technologies. Farmers with similar biophysical and socio-economic conditions were grouped into identifiable recommendation domains in order to come with relevant solutions (technologies) for each domain instead of blanket solutions (Francis *et al*., 1989). It was introduced in the mid-1970s with the aim of helping poor resource farmers who operated in less favourable heterogeneous farming environment and it was mainly donor dependant. It became very famous in the mid-1980s and it was associated with the introduction of projects which supported the establishment of separate farming research units which often were poorly integrated to mainstream technology development activities. Its weaknesses included donor dependency and unintegrated farming research units. Most of these projects did not succeed in producing technologies which were widely adopted by farmers (Norman, 2002).

Generally, post-independence extension approaches were not successful due a number of weaknesses embedded in them like being limited to demonstration of technologies, donor dependent, rigid, top-down in nature, limited use of farmer's knowledge (Indigenous technical knowledge), and using the already packaged information (mostly blanket recommendations) (Mwaseba *et al.*, 2008). Additionally, any deviation from researchers' recommendations by farmers was regarded to be bad, a mistake, backwardness, non-progressive etc. In other words, these approaches did not give room for modifications to meet farmers' local conditions (Kambewa, 2013, "Per Com").

Therefore, in responding to the failure of the post-independence extension approaches, the government of Tanzania through the Ministry of Agriculture Food Security and Cooperatives introduced Farmer Field School (FFS) as an alternative approach in transforming agriculture. Raghuvanshi *et al.* (2012) reported that FFS have been developed as an alternative to the conventional top-down test and verification of old extension approaches. Besides, farmers can develop solutions to their own problems.

2.4 Farmer Field Schools (FFS)

A Farmer Field School (FFS) is a season long training of farmers involving participatory activities, hands-on analysis and decision making (Rola *et al.*, 2002). It is a participatory agricultural extension approach based on experiential learning or learning by discovery (FAO, 2003). FFS is a modern, participatory learning and community empowering approach based on season-long practical demonstration of improved farming practices (Rajpal, 2008). FFS is a school without walls where by a group of farmers get together in one of their own fields to learn about their crops and things that affect the system. They learn how to farm better by observing, analysing and trying out new ideas on their own fields (Raghuvanshi *et al.*, 2012).

FFS provide farmers with the basics they need so that with their inherent diverse experience and with the newly acquired scientific knowledge they can make better decisions and ultimately become expert decision-makers to improve production and incomes significantly and in a sustainable manner. The basics being provided cover among others things agro-ecology, agronomy, soil science, plant protection, water management, economics, social science, etc. (Kabir, 2006).

The term FFS originated from the Indonesian expression *Sekolah Lapangan* meaning just field school (Gallagher, 1999). The first farmer field schools were established in 1989 in Central Java during a pilot season by 50 plant protection officers to test and develop field training methods as part of their Integrated Pest Management (IPM) training of trainers' course. The name *Sekolah Lapangan* was adopted to reflect the educational goals; the course took place in the field, and the field conditions defined most of the curriculum, and real field problems were observed and analysed from planting of the crop to harvest (Mvena *et al*, 2013). In other words, with FFS, the field is regarded as a class, farmers as students and a trained extension officer /lead farmer as a facilitator.

Green revolution promoted the use of chemical pesticides in controlling pests in order to increase productivity, among other things. Therefore, excessive use of chemical pesticides on rice fields led to the development of resistant strains of Brown Plant Hopper (BPH) which damaged almost the entire rice crop in central Java of Indonesia besides damaging soils and endangering farmers' health. It was realised that the problem was not with the farmers rather with the methods which were used to provide training to farming communities (Kabir, 2006). This called for FFS as a more appropriate approach. Due to appropriate training methods in FFS, farmers do not only master the technical knowledge needed to improve their fields, but also they become experts capable of using the knowledge gained to develop new initiatives to tackle local problems and take advantage of new opportunities as they arise (Kabir, 2006).

2.4.1 Objectives of FFS approach

The FFS approach aims at achieving the following: increasing production/productivity of crops and livestock; reducing production costs by using less inputs like pesticides and inorganic fertilizers; reducing unnecessary human exposure to agrochemicals; empowering farmers to make decisions on farming activities even in the absence of extension officers; timely field operations and emphasizing participatory and democratic learning approaches (FAO, 1999). The ultimate aim of FFS is to improve farmers' knowledge and decision making abilities so that they can cope with pest and crop management problems on their own (Rola *et al.*, 2002).

2.4.2 Basic concepts that define FFS

The basic concepts that define FFS according to Mwaseba *et al.,* (2008) include the following;

i) Adult non-formal education: FFS assume that farmers already have a wealth of knowledge and experience.

ii) FFS require technically strong facilitator. The extension officer must have skills and confidence and be able to tell trainees, "I don't know, let us find out together" when confronted with an unknown situation in the field.

iii) FFS and season long training for trainers are based on the crop phenology; seedling issues are studied during the seedling stage, fertilizer issues are discussed during high nutrient demand stages, etc. This method allows to use the crop as a teacher, and to ensure that farmers can immediately use the practice soon after learning it.

iv) Most FFS are organized for groups of about 25-30 farmers with common interests, who can support each other, both with their individual experiences and strengths, and to create the required critical mass. This situation enhances the learning capabilities of participating farmers.

v) The FFS are always held in the community where farmers live so that they can easily attend weekly and maintain the field school studies.

vi) Farmers observe and discuss dynamics of the crop's ecosystem or animal lifecycle. It was observed that farmers can learn optimally from field observation and experimentation. Simple experimentation helps farmers understand functional relationships, among pest population, crop damage and yield. In this cyclical learning process, farmers develop the expertise that enables them to make their own crop management decisions.

2.4.3 Principles of FFS

FFS are guided by certain principles which are used by facilitators as guidelines in helping farmers in the learning process. These principles according to Kabir (2006) include the following;

i) *Regard farmers as experts*: This principle reinforces the fact that farmers need to eliminate their dependency on others to solve their problems. This could only be possible when they become, and consider themselves, experts in their own fields.

ii) *Growing a healthy crop*: A healthy crop that is free from diseases and other infestations. A crop that can recover quickly from injuries and damages associated with insect attack and disease infestations. This can be achieved through good quality seeds and seedlings; good and resistant varieties; balanced nutrients and appropriate management practices.

iii) *Observe the crop regularly***:** Managing a crop effectively requires close and regular observations of the field, particularly the conditions of plants, soil, water, weeds, and climate such as temperature, sunlight, humidity, etc. Crop development is primarily determined by the combined effect of all of these.

iv) *Conserve natural enemies*: Insects are, oftentimes misunderstood as all harmful. No insects are effectively harmful unless their population reach damaging numbers. Moreover, many insects such as parasites, predators and pathogens have long been recognized as beneficial by nature because they eliminate or keep in check the pests and disease vectors that lead to crop damage.

2.4.4 Roles of FFS

Farmer Field Schools have demonstrated to play a substantial number of roles among the members of the farming community. These roles include but not limited to;

- Empowering farmers with knowledge to make them experts in their own fields (Braun *et al*., 2000; Godtland *et al*., 2003; Khatam *et al*., 2014; Khisa, 2014; Kabir, 2006;)
- Sharpening farmers' capacity to make critical and informed decisions that render their farming profitable and sustainable (Braun *et al*., 2000; Khisa, 2014)

- Improving farmers' skills and experience (Khatam *et al*., 2014).
- Sensitizing farmers on new ways of thinking and problem solving (Khisa, 2014).
- Building self- confidence among the farming community (Khatam *et al*., 2014).
- Helping farmers learn how to organize themselves and their communities (Khisa, 2014)

2.4.5 Impact of FFS

FFS have demonstrated to have impact on knowledge, adoption and productivity in different parts of the world. To a large extent, this has been attributed to its valuable principle i.e. experiential learning / learning by doing principle among other things which give farmers an opportunity to integrate their indigenous knowledge with new concepts of science and thus make a collective and informed decision(s). This process builds self-confidence among the farming community; improve their skills and knowledge that ultimately lead farmers towards empowerment (Khatam *et al.*, 2014).

In terms of knowledge, farmers who participated in FFS were seen to make significant improvements in their knowledge base and understanding about farming and in their overall decision-making. They have been able to reduce pesticides use to zero or near zero. Reduced pesticides use and better fertilizer management enhanced rice yields significantly, as a result farmers' profit margin increased as well (Kabir, 2006).

In India*,* Raghuvanshi *et al.* (2012) found a significant difference on knowledge between FFS beneficiaries and non-FFS beneficiaries where by FFS beneficiaries had a total mean score of 2.08 while non-FFS beneficiaries had a total mean score of 1.91. In other words, FFS beneficiaries' knowledge was higher by 8.90% than non-FFS beneficiaries.

Khatam *et al.* (2014) reported that FFS approach had made significant developments in providing the opportunity for farmers to acquire an understanding of important 'systems' concepts and relationships. Besides, FFS graduates had proven to be willing and able to communicate viable, new plant protection and production technologies to others in their immediate localities and beyond, and in some cases have made significant contributions to local social development. In addition to that, results indicated that, out of 19 strengths of FFS, improving farmers' knowledge was ranked number one with the mean value of 3.60.

In terms of productivity, FFS have played a very important role in increasing farmers' productivity. For example, Kabir (2006) reported a stable improvement in rice productivity among FFS members for three consecutive years since the inception of the project. The mean yield increased from about 2t/ha (before FFS) to more than 4t/ha (after FFS). Kajigili (2012) reported that, "the introduction of FFS lead to increase in productivity from 1.63 t/ha to 4.75 t/ha, 0.32 t/ha to 1.21 t/ha and 1.88 t/ha to 3.5 t/ha for maize, beans and coffee respectively." Similarly, maize grain yields rose from an average of 1 t/ha to 4.5 t/ha among FFS members (FAO, 2008).

In terms of adoption, FFS has played a very important role in increasing the adoption of technologies. For example, Kabir (2006) reported a substantial increase in the number of non- FFS participants who were using SRI technology in the study area besides FFS participants. On average, the number increased from 24 farmers in 2002 to 43 farmers in 2004. To a large extent the adoption was influenced by field-day activities, sharing of experience by FFS farmers, yields on FFS farmers' fields, and yields on FFS study-fields. Also, in another study by FAO (2008) it was found that both FFS and non FFS- members in Bukoba district widely adopted technologies to replenish soil nutrients, conserve water, control soil erosion, and improve soil biodiversity. In the course of trying new ideas in FFS study fields, FFS members get an opportunity to make some changes on the recommended practices to meet their local condition.

2.4.6 FFS operations in Tanzania

Farmer Field Schools were first introduced in Tanzania in 1996. The FFS in Tanzania operate on the basic principles of FFS as described in section 2.4.3. According to Khisa (2014), the processes of conducting FFS follow the following key classical steps;

i) Conducting ground working activities like identification of focus enterprises, priority problems, solutions to identified problems, establishment of farmers' practices, identification of field school participants and sites, etc.
ii) Training of facilitators on different issues like crop/ livestock production and protection technologies, participatory technology development, group dynamics, etc.

iii) Establishment and running of FFS including carrying experiments and field trials, conducting AESA, data collection , group dynamics, special topics, etc.
iv) Evaluation of Participatory Technology Development including analysis of the collected data, interpretation and presentation.
v) Conducting field days activities once or twice per season where by the rest of the community is invited to share what the group has learned in the FFS.
vi) Organizing graduations whereby farmers are awarded certificates which mark the end of the season long training.
vii) FFS graduates running FFS using the knowledge and confidence gained in the season long training.
viii) Follow-up by core facilitators on the schools that have graduated for backstopping.

The length of membership among FFS members in Mvomero district varied from one FFS to another. Some members had longer time while others had shorter time. The average length of membership in an FFS was three (3) years while the minimum and maximum lengths were six (6) months and nineteen (19) years respectively.

2.4.7 System of Rice Intensification (SRI) in Tanzania

The System of Rice Intensification (SRI) is a methodology for increasing the productivity of irrigated rice cultivation by changing the management of plants, soil, water, and nutrients, while reducing external inputs (Sinha and Talati, 2007). SRI has been raising yields by 32% to 100%, and sometimes more, with reduced requirements for water, seed, fertilizer, and crop protection (*ibid*).

SRI involves intermittent wetting and drying of water bunds and it is based on six principles which include: i) Transplanting a single seedling, ii) Transplanting younger seedlings aged 8-12 days old, iii) Wide plant spacing of 25cm x 25 cm, planted in lines, iv) Minimum water applications during vegetative growth period keeping soils moist, but well-drained and aerated, v) Frequent weeding with a simple mechanical handweeder, and vi) Application of organic matter in preference to chemical fertilizer (Katambara *et al*., 2013)

Despite its advantages, SRI has some challenges including; to transplant young seedlings within 20 minutes after uprooting; seeds are vulnerable to rodent and other creatures and therefore pest management is necessary during the rice growing period; controlling alternate wetting and drying is hard when surrounded by non-SRI participating farms, and additional weeding since alternate wetting and drying facilitates weed growth (Katambara *et al*., 2013).

2.5 Theoretical Framework

Theoretical framework under this study focused on adoption theory. This theory is described below.

2.5.1 Adoption theory

Adoption of an innovation refers to a process by which an individual is exposed, considers and makes a decision to permanently use / practise a particular innovation (Win and Chumjai, 2009). According to Beal and Bohlen, (1957) the process by which people accepts new ideas is not a unit act, but rather a series of complex unit acts - a mental process. The research seems to indicate that this mental process consists of at least five stages. These stages include awareness stage, interest stage, evaluation stage, trial stage, and adoption stage.

i) The Awareness Stage

At this stage an individual becomes aware of some new ideas, such as hybrid seed corn. He knows about the existence of the idea, but he lacks details concerning it. He may know, for instance, only the name and may not know what the idea or the product is, what it will do, or how it will work.

ii) The Interest Stage

At the interest stage an individual wants more information about the idea or product. He wants to know what it is, how it works, and what its potentialities are. He may say to himself that the idea or product might help him increase his income, or help him control insects or diseases, or improve farming or home life in some other way.

iii) The Evaluation Stage

The third stage in this mental process is the evaluation stage. The individual makes a mental trial of the idea. He applies the information obtained in the previous stages to his own situation. He asks himself, "Can I do it; and if I do it, will it be better than what I am doing now - will it increase my income, or will it help maximize any other values which I hold important?”

iv) The Trial Stage

If a person decides that the idea has possibilities for him, he will try it. The trial stage is characterized by small-scale experimental use, and by the need for specific information which deals with: "How do I do it; how much do I use; when do I do it; how can I make it work best for me?" Apparently, individuals need to test a new idea even though they have thought about it for a long time and have gathered information concerning it.

v) The Adoption Stage

The final stage in this mental process is the adoption stage. This stage is characterized by large-scale, continued use of the idea, and most of all, by satisfaction with the idea. This does not mean that a person who has accepted an idea must use it constantly. It simply means that he has accepted the idea as good and that he intends to include it in his on-going program.

Through FFS, the participating farmers get informed of the available innovation which creates awareness among them. As the season-long training progresses, participants develop interest and evaluate the innovation in question. Trials of the innovation are done on FFS study fields. Basing on the results from the trials, participants may decide to permanently use/practise the innovation or otherwise.

2.6 Conceptual framework

The conceptual framework for this study is based on the assumption that the adoption and adaptation of recommended rice production practices such as improved rice variety (SARO 5), seed bed preparation, water bunds construction, leveling, transplanting, timely weeding, seed selection , fertilizer application (both top dressing phase one and two), spraying to control insect-pests, spraying to control weeds, spraying to control diseases, spacing 20 x 20 (3 weeks), spacing 20 x 10 x 40 (3 weeks) and spacing 25 x 25(8-15 days) is influenced by a number of independent variables which emanate from membership in FFS like agro-ecosystem analysis, problem identification, solution testing, testing and validating new technologies, information sharing, yields on FFS study fields, yields on FFS members' fields, and the intervening variables such as awareness, knowledge, experience and perception. The intervening variables are assumed to have direct influence on the adoption and adaptation of recommended rice production practices. On the other hand, the independent variables are assumed to influence the adoption and adaptation behavior through the intervening variables. Figure 3 illustrates the conceptual framework of the study.

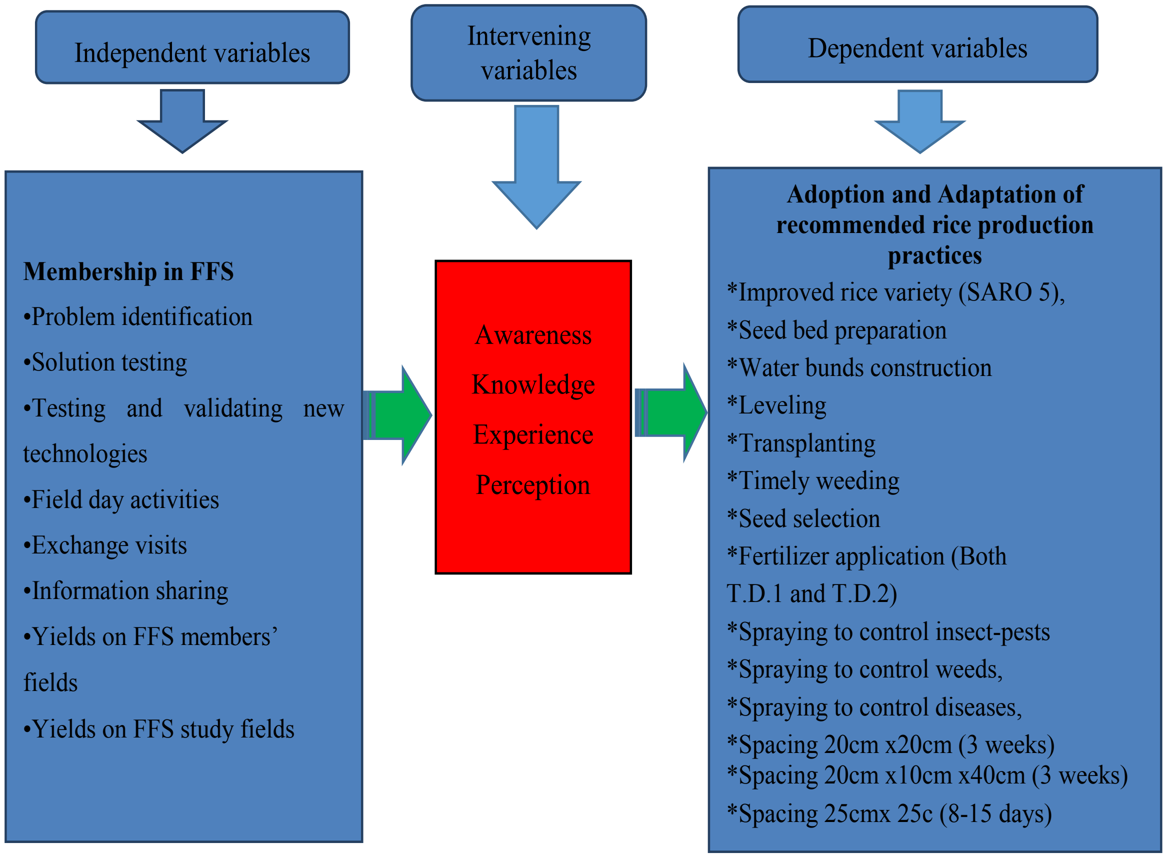

Figure 2.1 Conceptual Framework

Source: Adapted from Duvel (1991) model.

CHAPTER 3

METHODOLOGY

3.1 Description and choice of the study area

The study was carried out in Mvomero district. The reason for selecting Mvomero district was due to the presence of numerous functional and viable farmer field schools (FFS). The other reason was the fact that it was an area where FFS were first introduced in the region and the country at large.

3.1.1 Geographical location and population

The study area, Mvomero district, is located in Morogoro region. The region has Tanga, Pwani, Morogoro Rural, Morogoro Urban, and Kilosa on its North, North East, East, South East and West boarders respectively. Mvomero district lies between 8^0 00" and 10^0 00" latitudes South of the Equator and 37^0 00" and 28^0 22" longitudes East of the Greenwich Meridian (MOVEK, 2008).

The population of Mvomero district, according to the 2012 Tanzania National Census, was 312,109 people. Its average household size was 4.3 (URT, 2013). Mvomero ward where this study took place had a total population 37,321 people with an average household size of 4.3 (*ibid*.).

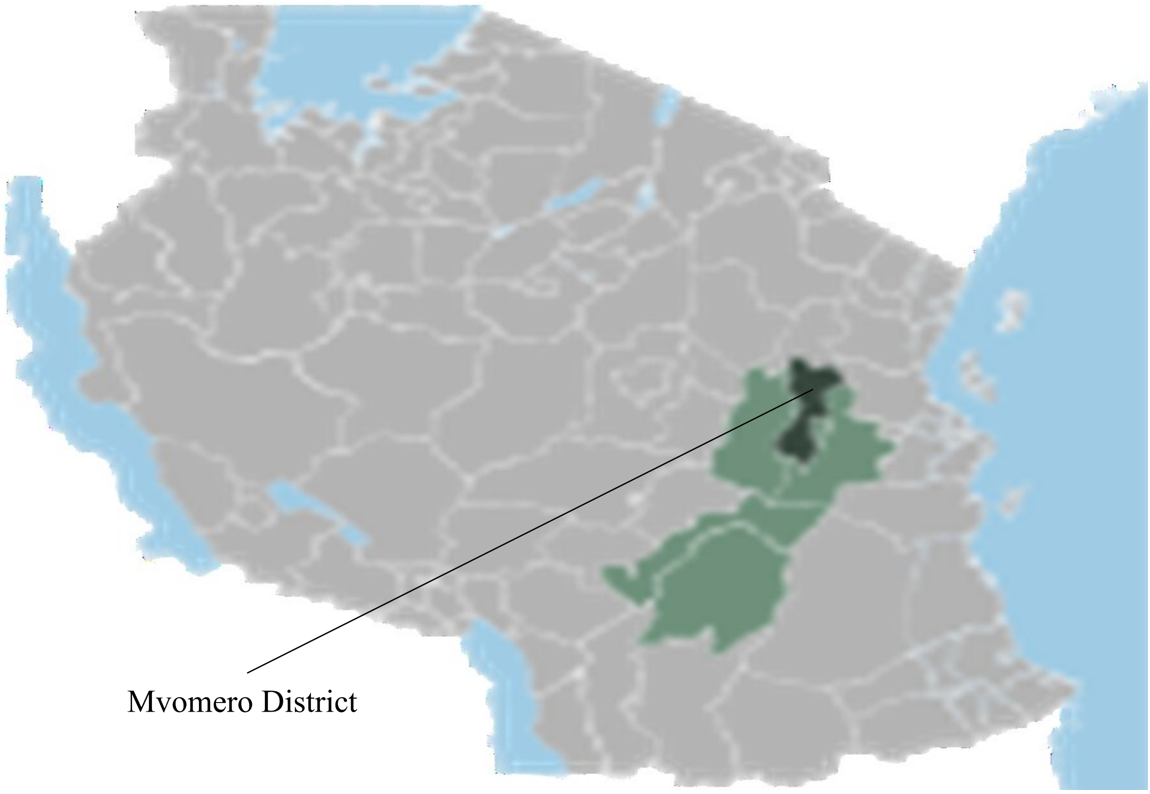

Figure3. 2. Map of Tanzania showing the study area (Mvomero District)

3.1.2 Economic activities

The economy of Mvomero district depends on agriculture, mainly from crop production. The main crops grown are cassava, rice, maize, and bananas. Other crops include beans, millet, peas, potatoes, coffee, groundnuts, citrus fruits, mangoes, jackfruits, sugarcane, coconut, tomato and eggplant. The cultivation is carried out mainly by the use of hand hoes using primarily family labour and hired labour when the situation demands. A few individuals especially the well-off farmers use tractors. Livestock keeping is also practised by few households (MOVEK, 2008).

3.2 Research Design

The study adopted a cross-sectional research design whereby data were collected at a single point in time. The reason for adopting a cross-sectional research design was because it was simple, economical and time saving Kothari (2004). Additionally, it gave an opportunity to report FFS members' experiences and opinions and comparing differing characteristics of their experiences and outcomes (Mathews and Ross, 2010).

3.2.1 Population of study

The population of study included all members of FFS where the recommended rice production practices have been promoted in Mvomero district. By the time this research was conducted there were about 1000 rice farmers within the FFS groups (Kidawa, 2014, "Per com").

3.2.1.1 Sampling frame

The sampling frame for this study involved all rice FFS in Mvomero district from which the sample was drawn. It was developed from a list of all existing rice FFS in Mvomero district, which was obtained from Mvomero district office.

3.2.1.2 Sampling unit

The sampling unit for this study constituted an individual respondent in a household who was a member of rice FFS. According to URT (1993), a household refers to a single person or a group of people who live together and share common living arrangements. On the other hand, a household refers to a person or group of people who reside in the same homestead/compound but not necessarily in the same dwelling unit, eating from the same pot, and are under the same household head (URT,2013).

3.2.1.3 Sampling procedure and sample size

A multistage sampling technique was employed in order to come up with the study sample. According to Kajigili (2012), a multistage sampling technique is convenient for studying large and diverse populations.

In the first stage, 4 wards out of 18 wards were purposely selected with the aim of getting wards with functional and viable FFS in the district. The wards selected were Mvomero, Mtibwa, Dakawa and Hembeti. They were selected from a list of all wards with rice FFS in the district under the guidance of FFS coordinator in the district. In the second stage, 6 out of 23 villages were selected purposely in order to get the right villages with functional and viable FFS. These villages included Mvomero, Misufini, Mkindo, Hembeti, Lukenge and Wami-Dakawa. The villages were selected from a list of villages with FFS under the guidance of FFS coordinator in the district. In the third stage, fifty two (52) active FFS were selected whereby all FFS members were given an opportunity to be included in the sample. Finally, a total of 188 FFS members were obtained. The sample size of the study was calculated basing on Boyd *et al.* (1981) who recommended that, for a random sample to be representative of the population from which it is drawn, it should constitute at least 5% of the total population. So, in this case it included at least 5% of all FFS members in Mvomero district. By the time this study was conducted, there were approximately 1000 FFS members (Kidawa, 2014, “Per com”).

Additionally, a total of seven key informants were interviewed including the District Agricultural Irrigation and Cooperative Officer (DAICO) and six Village Extension Officers (VEOs), one from each village. The key informants were involved because they had detailed and useful information related to farmer field schools.

3.3 Methods of data collection

The study used various data collection methods, namely household survey, key informant interviews, focus group discussions and observations. A questionnaire with both open and closed ended questions was used to collect quantitative data from rice FFS members. The questionnaire allowed a large amount of data to be collected quickly. Focus group discussions involved rice FFS members in order to get detailed information on the role of FFS in adoption and adaptation of recommended rice production practices promoted in the study area.

Data were collected in two stages as described below:

1. 1st stage: Reconnaissance survey to identify the recommended rice production practices promoted using FFS in the study area.
2. 2nd stage: Sample survey to get information about the adoption and adaptation levels among rice FFS members. The methods of data collection are presented in the research design table below.

Table 3.1 Research design table

Specific objective	Type of data	Source of data	Data collection methods &tools	Data analysis
i) To identify recommended rice production practices promoted by FFS in the study area.	➢ Recommended rice production practices promoted by FFS	District FFS coordinator	Key informant interviews using a checklist	Narratives
ii) To examine the level of adoption of recommended rice production practices among FFS members	➢ The proportion of FFS members who use the recommended rice production practices in their own fields	Rice FFS members. Key informants	HH survey using a questionnaire; Observation; Key informant interviews using an interview guide/checklist; FGD using a checklist	Frequencies, percentages, narratives,
iii) To examine the level of adaptation of recommended rice production practices among FFS members	➢ Types of changes made by FFS members on the recommended rice production practices and reasons behind the changes	Rice FFS members. Key informants	HH survey using a questionnaire; Observation; Key informant interviews using an interview guide/checklist; FGD using a checklist	Frequencies, percentages, narratives,

3.4 Validity of instruments

According to Kimberlin and Winterstein (2008), validity is often defined as the extent to which an instrument measures what it purports to measure. In this study, the measurement instruments were validated through discussions with supervisors from Sokoine University of Agriculture and Lilongwe University of Agriculture and Natural Resources who were experts in the field of technology adoption, rice production and FFS approach.

3.5 Reliability

Reliability of an instrument refers to the degree of consistency with which an instrument measures whatever it is measuring (Ary, 2010). In order to ensure reliability of research instruments under this study, a pilot study was carried out in Mlali and Vikenge villages which are about 77 km away from the actual study area. This eliminated the contamination of the respondents in the actual study area. A sample of twenty (20) rice FFS members both males and females was randomly selected from the list of active FFS members in the above mentioned villages who were involved in a face to face interview. The collected data was coded and subjected to split-half analysis technique. The calculated correlation coefficient of the split-half analysis was 0.73. According to Dennick and Tavakol (2011), a reliable test should have a correlation coefficient (Cronbach's alpha) ranging from 0.70 to 0.95. Hence the calculated correlation coefficient of the split-half analysis was within the recommended range.

3.6 Methods of data analysis

The collected data were coded and analysed using the Statistical Package for Social Sciences (SPSS) version 22.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

This section provides results and discussions of the findings according to the objectives of the study. These objectives included: to identify recommended rice production practices promoted using FFS in the study area; to examine the level of adoption of recommended rice production practices among FFS members, and to examine the level of adaptation of recommended rice production practices among FFS members. The section is preceded by the descriptions of the sample characteristics.

4.2 Sample characteristics

In order to identify demographic and socio-economic characteristics of the sample, FFS members were interviewed on the following demographic and socio-economic variables, and the results were as presented in Table 4.1 below.

Table 4.1 Demographic and socio-economic characteristics of the respondents (n=188)

Respondent's characteristics	Mean	Minimum	Maximum
Household size (persons)	5.20	1.00	12.00
Age (years)	42.70	18.00	77.00
Formal education (years)	7.03	0.00	13.00
Land holding size (hectares)	3.42	0.50	30.00

The sample was composed of 94 male and 94 female respondents. This shows that the sample had a good representation of both male and female respondents. The mean household size was 5.2 members (Table 4.1), which was slightly above the district's average household size that was 4.0 members (URT, 2014). The smallest household had 1 member, and the largest household had 12 members. These results imply that larger households supplied more labour force which facilitated the adoption of some of labour demanding rice recommended practices like transplanting, weeding and fertilizer application. The results are in line with Kassie *et al*. (2012), who argued that large household sizes facilitated the adoption of sustainable agricultural practices.

The table further shows that the sample had an average age of 42.7 years. This implies that FFS members were within the economically active age; hence they were more likely to adopt the recommended rice production practices which were promoted through FFS. According to Kusmiat *et al*. (2007), people who were in productive age were more eager to learn about new knowledge which facilitated the process of transferring and adoption of technology. The average number of years spent in school by the sampled respondents was 7.03 years which was slightly below the national average which was 9.0 years (Indexmundi, 2012). The majority of the respondents (71.3%) had attended primary education while very few respondents (8.5%) had not gone to school. Literacy rate was high among respondents whereby 52.3% male respondents were literate while 47.7% of female respondents were literate. Education and high literacy rate among respondents put them at an advantage of reading and understanding the recommended rice production practices better. Kusmiat *et al*. (2007) reported that educated people were usually more open and able to analyse the advantages and disadvantages of an innovation which facilitated the adoption process. According to Mikwamba (2011), literacy empowered individuals to read and understand messages in written form. Additionally, the sample had an average land size of 3.4 acres which was slightly above the national average which was 2.6 hectares (Survey, 2008). The smallest land size was 0.5 hectares, and the maximum land size was 30 hectares. Having enough land size made it possible for farmers to set aside a portion of land for trying the recommended rice production practices prior to adoption.

4.2.1 Marital status of respondents

In order to identify marital status of respondents, FFS members were interviewed, and the results were as presented in Table 4.2 below.

Table 4.2 Marital status of respondents

Marital status	**Frequency**	**Percent (%)**
Married	145	77.1
Single	24	12.8
Divorced	10	5.3
Separated	6	3.2
Widowed	3	1.6
Total	188	100

The results presented in Table 4.2 above show that the majority of the respondents (77.1%) were married. The results further show that respondents who were single represented 12.8% of the respondents, and those who were divorced represented 5.3% of the respondents. Those who were separated represented 3.2%, and widows represented 1.6% of the respondents. This implies that the adoption of the recommended rice production practices (of which some were labour demanding) was made easier due to the fact that marriage created a room for sharing of responsibilities. The results agree with Mikwamba (2011), who reported that the adoption of technologies was easier to married people than to single headed households since the work output produced by each person in marriage was much more than when each person worked independently.

4.2.2 Income sources of respondents

In order to identify sources of income of the respondents, FFS members were interviewed, and the results are presented in Table 4.3 below.

Table 4.3 Sources of income of the respondents

Source of income	**Frequency**	**Percent**
Farming	113	60.1
Farming and small business	72	38.3
Employment and farming	2	1.1
Remittance	1	0.5
Total	188	100

The study results presented in Table 4.3 above indicate that respondents were involved in a number of activities as sources of income to earn living. The main source of income for the majority of the respondents (60.1%) was farming. Apart from farming, the respondents had non-farm income sources which included small business, salaried employment and remittance. Farming and small business were done by 38.3% of the respondents while employment and farming activities were done by 1.1% of the respondents. Receiving remittances was applicable to 0.5% of the respondents. None of the respondents was relying solely on employment or small business. This implies that the adoption of recommended rice production practices which were promoted through FFS was not hampered by limited income generated from off-farm activities. The results were not astonishing, considering the fact that the study was conducted in rural areas where opportunities for salaried employment were limited. Additionally, the majority of the respondents (71.3%) had primary education which put them at a disadvantage of accessing paid employment opportunities. However, off-farm income has been reported to facilitate the adoption of technologies like buying inputs related to such technologies (Tura *et al*., 2010).

4.3 Recommended rice production practices promoted using FFS in the study area

This section provides information on the recommended rice production practices which were promoted using FFS in the study area. The section also provides information on the number of respondents who were aware of such practices. The information was obtained through a reconnaissance study which was conducted prior to the actual survey. It should be noted that by the time this study was conducted, some of the recommended rice production practices were yet to be taught in some of the farmer field schools. Table 4.4 below presents the results.

Table 4.4 Awareness of recommended rice production practices (n=188)

Recommended practices	**FFS members aware**		**FFS members not aware**	
	Frequency	Percent	Frequency	Percent
Improved rice variety (SARO 5)	188	100.00	0	0.00
Seed bed preparation	188	100.00	0	0.00
Water bunds construction	188	100.00	0	0.00
Levelling	188	100.00	0	0.00
Transplanting	188	100.00	0	0.00
Timely weeding- twice	188	100.00	0	0.00
Seed selection	187	99.50	1	0.50
Fertilizer application (T.D.1)	187	99.50	1	0.50
Fertilizer application (T.D.2)	187	99.50	1	0.50
Spraying to control insects-pests	187	99.50	1	0.50
Spraying to control weeds	187	99.50	1	0.50
Spraying to control diseases	187	99.50	1	0.50
Spacing -20 x 20 (3weeks)	173	92.02	15	7.98
Spacing - 25 x 25 (8-15days)	154	81.90	34	18.1
Spacing - 20 x 10 x 40 (3 weeks)	143	76.10	45	23.9

The results presented in Table 4.4 above show that FFS promoted a total of fifteen recommended rice production practices. The promotion of these practices was done using various methods including training, demonstration, field visits, meetings and agro-ecosystem analysis. The results also show that the awareness of FFS members on recommended rice production practices promoted was very high (above 75%). For example, FFS members' awareness on the use of improved rice variety (SARO 5), seed bed preparation, water bunds, levelling, transplanting and weeding was 100%. This implies that FFS members were well informed of those practices as a result of being members of FFS and active participants in FFS related activities. High degree of awareness of the recommended rice production practices promoted signifies the role FFS in awareness creation. FFS created a room for sharing of information among members. These results agree with Anandajayasekeram *et al.* (2007) who reported that FFS enhanced farmer to farmer extension information.

However, awareness of 25 cm x 25 cm spacing and 20 cm x 10 cm x 40m spacing was low as compared to the rest of the recommended rice production practices promoted using FFS in the study area. Some of the respondents clearly pointed out that they were not well informed of the 25 cm x 25 cm spacing and 20 cm x 10 cm x 40 cm spacing because they joined their respective FFS a bit late. They decided to join after having seen that their fellow farmers who were FFS members were getting higher yields as compared to them. It was found that FFS members who had shorter periods with respect to their membership in FFS were less informed of the recommended rice production practices as compared to those who had longer periods. This implies that it is very important for FFS members to attend all activities from the commencement of the season-long training to the end. It is for this reason that FFS trainings should always be held in the community where farmers live so that they can easily attend weekly and maintain the field school studies as pointed out by Mwaseba et al. (2008) and Gallagher (1999). Additionally, some of the FFS members clearly pointed out that they were not well informed of 25 cm x 25 cm spacing and 20 cm x 10 cm x 40 cm spacing because these two practices were yet to be taught in their respective FFS by the time this study was conducted. It should be noted that a farmer (FFS member) was considered to be aware of the recommended rice production practices if he /she was able to give some details of the same.

4.4 Level of adoption of recommended rice production practices

In this section the researcher aimed at assessing the level of adoption of recommended rice production practices which were promoted using FFS in the study area. The adoption was measured by looking at the proportion of FFS members who were using the recommended rice production practices in their own fields. To accomplish this objective, interviews, FGDs and observations were conducted, and table 4.5 presents the results.

Table 4.5 Level of adoption of recommended rice production practices (n=188)

Recommended practices	FFS members practicing		FFS members not practicing	
	Frequency	Percent	Frequency	Percent
Timely weeding- twice	188	100.00	0	0.00
Water bunds construction	188	100.00	0	0.00
Seed bed preparation	186	98.9	2	1.1
Levelling	186	98.9	2	1.1
Transplanting	186	98.9	2	1.1
Seed selection	184	97.9	4	2.1
Improved rice variety (SARO5)	183	97.3	5	2.7
Spraying to control insects-pests	177	94.1	11	5.9
Spraying to control diseases	177	94.1	11	5.9
Fertilizer application (T.D.2)	163	86.7	25	13.3
Spraying to control weeds	161	85.6	27	14.4
Fertilizer application (T.D.1)	151	80.3	37	19.7
Spacing -20cmx 20cm (3weeks)	123	65.4	65	34.6
Spacing – 25cmx 25cm (8-15days)	92	48.9	96	51.1
Spacing - 20 x 10 x 40 (3 weeks)	26	13.8	162	86.2

The results in Table 4.5 show that the majority (80%) of recommended rice production practices which were promoted through FFS were adopted by FFS members. Weeding and construction of water bunds were adopted by all respondents. Seed bed preparation, levelling, transplanting and seed selection were adopted by 98.9% of the respondents (FFS members). The study revealed that the level of adoption was very high (above 65%). This was attributed to high yields which FFS members obtained in both FFS study fields and FFS members' own fields which surpassed yields obtained with traditional practices which were locally known as "*Kilimo cha mazoea.* Additionally, it was attributed to high degree of awareness among FFS members on the recommended rice production practices promoted and their advantages. The results are in line with Asfawl *et al*. (2011) who reported that farmers who were aware of the advantages of new technologies were more likely to adopt such technologies and allocate more land in the subsequent year. On the same note, Drechsel *et al.* (2005) reported that, to start an adoption process, at least some farmers had to experience the advantages of an innovation to be adopted.

However, there was high rate of non-adoption in 20 cm x 10 cm x 40 cm and 25 cm x 25 cm spacing practices. The results show that 20 cm x 10 cm x 40 cm and 25 cm x 25 cm spacing practices were adopted by less than 49% of the respondents. This was attributed to the fact that these practices were found to be more labour demanding. It was reported that 25 cm x 25 cm spacing had a component of additional weeding since it required alternate wetting and drying which created a favourable environment for the growth of weeds (Katambara *et al.,* 2013). Therefore, this implies that less labour demanding rice production practices were more likely to be adopted as compared to more labour demanding practices.

4.4.1 Improved rice variety (SARO 5)

Improved varieties have always been promoted due to the fact that they have more advantages as compared to local varieties. These advantages included high output, resistance to pest and diseases, just to mention a few. Evenson and Gollin (2003) reported that rice yield could be increased through adoption of high-yielding modern varieties. Improved rice variety (SARO 5) was one of the recommended rice production practices promoted through FFS. To assess the adoption of SARO 5, observations, interviews and FGDs were conducted, and the results are discussed below.

The results presented in Table 4.5 show that the majority of FFS members (97.3%) had adopted improved rice variety (SARO 5) in their own fields. This implies that the majority of FFS members were using improved rice variety (SARO 5) in their own fields. This was attributed to high yields observed by FFS members in both FFS study fields and FFS members' own fields as compared to local varieties like *Mbawambili, Kula na bwana, Domo la fisi* and Super. These findings concur with what farmers said during FGDs whereby they reported that SARO 5 had higher yields than local varieties. Additionally, the findings concur with what was said during key informant interviews that local varieties had good aroma but had low yields**.** According to Tulole *et al*. (2011), local rice varieties are relatively low yielding, averaging 1.5– 2.1 tons per acre. Similarly, Saka *et al*. (2005) reported that improved rice varieties had significantly higher mean yield than local varieties with a yield advantage of 38.7%. Tenge *et al*. (2013) reported that the improved variety was preferred due to its high yielding potential. Additionally, SARO 5 matured earlier than local varieties. It was reported that SARO 5 was semi-aromatic and matured earlier (120 days) than local varieties (180 days) (URT, 2011). According to Rogers (2003), an innovation that is perceived to be superior over others and having visible results will be rapidly adopted.

4.4.2 Seed selection

Seed selection can be defined as the process of separating better quality seeds from poor quality seeds. This can be done by using salt + water, water only, or by winnowing. The use of water is done by mixing water and rice seeds until they are well soaked whereby better quality seeds (heavy) tend to sink while poor ones (light) float which are then removed and discarded. The method of using water + salt and water only were mostly used by FFS members since they had higher assurance of getting better quality seeds than winnowing. To assess the adoption of seed selection, interviews and FGDs were conducted, and the results are discussed below.

The results presented in table 4.5 show that the majority of FFS members (97.9%) had adopted seed selection practice. This was attributed to the fact that this practice helped FFS members to get better quality seeds which led to the increase in rice yields. These findings concur with what was reported by key informants that selecting seeds using water + salt was better than winnowing since it had higher assurance of getting better quality seeds**.** Better seeds (well filled / heavy grains) ensured high germination percentage, produced seedlings with high growth vigour (URT, 2011) and healthier plants with resistance to drought, pests and diseases (IITA, 1972).

4.4.3 Seed bed preparation.

Rice seed bed can be defined as a small plot where rice seedlings are grown before being transplanted to water bunds. Seed bed preparation was among the recommended rice production practices promoted using FFS in the study area. Seed beds provided a conducive environment for growing healthy seedlings which in one way or another contributed to high yields. To assess the adoption of seed bed preparation, interviews and FGDs were conducted, and the results are discussed below.

The results presented in Table 4.5 show that almost all (98.9%) of FFS members had adopted the seed bed preparation practice in their own fields. This implies that the majority of FFS members were growing their rice seedlings in seed beds prior to transplanting them into water bunds. This was attributed to the fact that seed beds provided a conducive environment for the growth of healthy seedlings which in one way or another contributed to increased rice yields as compared to the broadcasting practice. Seed beds produced healthy and vigorous seedlings with good tillering potential (URT, 2011).

4.4.4 Levelling

Levelling can be defined as the process of changing the ground level of the rice field into a smooth horizontal surface. This is usually done after ploughing and paddling of the field. It can be done manually using pulled-levellers, hand-hoes, and spade. It can as well be done mechanically using ox-pulled rectangular shaped logs of wood or powered levellers. Perfect levelling of rice fields is very important as it facilitates even spread of water across the field, better crop stand, uniform crop stand and maturity (URT, 2011). To assess the adoption of levelling, interviews and FGDs were conducted, and the results are discussed below.

The results in Table 4.5 show that levelling was adopted by the majority of FFS members (98.9%). This gives an impression that FFS members levelled their rice fields (water bunds) prior to transplanting of rice seedlings. This was attributed to the fact that levelling allowed equal supply of water throughout the rice field, hence smooth growth of rice seedlings. One of the members said "*Unlevelled rice filed can lead to some rice plants get little water than others*" (Farmers from Mkindo village). These results are in line with information in a report by URT (2011) that perfect levelling facilitates even spread of water across the field, better crop stand, uniform crop stand and maturity.

4.4.5 Plant spacing

Plant spacing is an important practice in crop production. Proper spacing resulted in optimum plant population and yield increase. Additionally, proper plant spacing facilitated weeding, fertilizer application and harvesting (URT, 2011). There are three categories of spacing being recommended; they include 20 cm x 20 cm, 20 cm x 10 cm x 40 cm, and 25cm x 25cm (SRI). The 20 cm x 20 cm spacing is recommended for the rain-fed lowlands (inland valleys and flood plains) especially during dry months when solar radiation is higher, than during wet season (Nuhu and Martin, 2016). The 20 cm x 10 cm x 40 cm spacing is recommended because it has highest plant density (Kidawa, 2014, "Per Com"). The 25 x 25 spacing (SRI) is recommended because it rises rice yields by 32% to 100% (Sinha and Talati, 2007) and it uses less water due to alternate wetting and drying. Water for agriculture is becoming increasingly scarce, and climate change-induced higher temperatures will increase crops' water requirements, making the water shortages even more serious (Kahimba *et al*., 2014). By 2025, it is estimated that 15–20 million of the world's 79 million hectares of irrigated rice lowlands, which provide three-quarters of the world's rice supply, are expected to suffer some degree of water scarcity (IWMI, 2007). To assess the adoption of the above mentioned spacing categories, interviews, observations and FGDs were conducted, and the results are discussed below.

The results presented in Table 6 show that about two-thirds (65.4%) of FFS members had adopted 20cm x 20cm spacing. This implies that a good number of FFS members were using 20cm x 20cm spacing practice in their rice fields. This was attributed to the fact that FFS members were well informed of the importance of spacing (Table 5) as it was reported by one of the members who said "*Good spacing reduces chances of plants to compete for water, space, air and nutrients*" (A farmer from Wami-Dakawa village). Good spacing allowed the plant roots to grow profusely both vertically and horizontally, cover a larger area and tap more nutrients which resulted in the development of larger plants with larger numbers of tillers and grains (Furahisha, 2013).

The results further show that 20cm x 10cm x 40cm spacing was adopted by a small proportion of FFS members (26.0 members) that accounted for only 13.8%. This implies that the majority of FFS members (86.2%) did not adopt the 20cm x 10cm x 40cm spacing. This was attributed to the fact that this type of spacing occupied more land space hence necessitated larger land size while the majority of FFS members (85.1%) had smaller land holding sizes (<=5ha) as discussed previously (Table 2).

The results further show that less than half of FFS members (48.9%) had adopted 25cm x 25cm spacing. This means that the majority (51.1%) of FFS members did not adopt this type of spacing. This was attributed to the fact that this type of spacing occupied more land space. In other words, this type of spacing had lower plant density as compared to 20cm x 20cm spacing. Additionally, this type of spacing was considered to be more risky since it involved transplanting only one seedling per planting station. One of the members said *"This type of spacing occupies more land space and it is very risky to transplant one seedling per planting station"* (A farmer from Mkindo village). Drechsel *et al*. (2005) reported that risks and uncertainties affected farmers' attitude towards innovations and adoption behaviour. Plate 1 shows 20 cm x 20 cm spacing and 20 cm x 10 cm x 40 cm spacing.

	
20cm x20cm spacing	20cm x 10cm 40cm spacing

Plate 4.1. Plant spacing (20 cm x 20 cm, and 20 cm x 10 cm 40 cm)

4.4.6 Fertilizer application (Top dressing phase 1 and 2)

Fertilizer refers to any organic or inorganic of natural or synthetic compound that is applied to the soil to supply plant nutrients that are essential for growth and development of a plant (NRCS, 2011). Fertilizer application is considered to be crucial in plant growth due to continual decrease in soil fertility caused by both man-made and natural factors. For example, some of Mvomero farmers rotated rice with vegetables and maize which had no ability to improve soil fertility after rice but increased nutrient depletion (Tenge *et al*., 2013). Fertilizer application under these conditions is necessary in order to replenish the depleted nutrients. Fertilizer application under this discussion included basal and top dressing fertilizer.

Basal fertilizer application is done just prior to transplanting in order to facilitate the plant's rapid recovery from the shocks of transplanting. On the other hand, top dressing is applied after transplanting and is done in two phases. The first phase top dressing is applied 2 weeks after transplanting in order to promote rapid vegetative growth, tillering and to strengthen plants against disease attacks. The second phase top dressing is applied 7 weeks after transplanting to ensure increase in weight, grain size and complete grain filling (Matembo, 2014, "Per. com"). To assess the adoption of fertilizer application (Top dressing phases 1 and 2) interviews and FGDs were conducted, and the results are discussed below.

The results presented in table 4.5 show that more than half of the FFS members had adopted fertilizer application (both top dressing phases 1 and 2). It was found that 80.3% of FFS members had adopted top dressing phase 1, while 86.7% of FFS members had adopted top dressing phase 2. This gives an impression that the majority of FFS members were applying fertilizer in rice production. This was attributed to high degree of awareness on the importance of fertilizer and high rice yields which they observed in both FFS study fields and members' own fields. These findings agree with what was reported during key informant interviews that fertilizer application increased rice yields. Similarly, these findings concur with what was reported by Evenson and Gollin (2003) that increase in rice yield could be achieved through the increase in chemical fertilizer application. It should be noted that it was for the similar reason that Drechsel *et al*. (2005) argued that, for adoption process to start at least farmers had to experience the advantages of an innovation.

4.4.7 Timely weeding- twice

Weeding refers to practical removal of unwanted plants in the field that negatively affect crop production by competing with crops for resources such as light, nutrients, and water, harbouring pest and also reducing the quality of crop product (Finney *et al*., 2008). It is advised that weeding should be done early enough, preferably two (2) weeks after transplanting and three (3) weeks after the first weeding to avoid yield loss (URT, 2011). This is an important practice in rice production just like in any other crop for the growth of healthy rice plants as it eliminates competition for water, space, air, light and nutrients between weeds and rice plants. To assess the adoption of weeding practice observations, interviews and FGDs were conducted, and the results are discussed below.

The results presented in Table 4.5 show that the adoption of weeding among FFS members in the study area was 100%. This means that all FFS members (188) had adopted weeding practice in their own rice fields, implying that FFS was very successful in promoting the adoption of weeding practice. This was attributed to high degree of awareness on the importance of weeding for the growth of healthy rice plants. Awareness of the farmers is the first key stage to adoption of new technology (Subedi, *et al*., 2009). The findings from key informant interviews revealed that late weeding decreased rice yields. Unsuccessful weed control can result in the almost total loss of rice yield (Furahisha, 2013).

4.4.8 Spraying to control insects, weeds and diseases

Spraying can be defined as the process of applying chemicals like herbicides, fungicides, insecticides etc. on growing crops. This process aims at ensuring healthy plant growth which leads to high yields. Mtengeti *et al*. (2012) reported that the use of pesticides among Mvomero households was low (≤ 50%). It was further reported that the herbicides used for controlling weeds in rice production in Mvomero district were 2.4D and Round up (*ibid*). To assess the adoption of spraying practice, interviews and FGDs were conducted, and the results are discussed below.

The results presented in Table 4.5 show that a good proportion of FFS members in the study area had adopted spraying practice. The adoption of spraying to control diseases represented 94.1% of respondents mean while spraying to control insects represented 94% of respondents. Additionally, the adoption of spraying to control weeds represented 85.6% of respondents. This implies that FFS were very successful in promoting the adoption of spraying practice. This was attributed to the fact that the majority (98.5%) of FFS members were well informed of the importance of spraying on the growth rice plants as Table 4.4 shows. This implies that FFS increased the use of spraying from ≤ 50% in 2012 as reported by Mtengeti *et al*. (2012) to > 85% in 2014.

4.4.9 Transplanting

Transplanting can be defined as an act of uprooting and transferring rice seedlings from the seed bed to rice water bunds. The age of seedling at transplanting was reported to be an important criterion in rice production as it primarily contributed to the number of tillers per hill (Ginigaddara *et al*., 2011). For example, young seedlings below 10 days of age produced higher number of tillers that contributed to higher grain yields (Stoop *et al*., 2002). It was further reported that late transplanting led to production of few number of tillers during vegetative growth hence poor yield (Mobasser *et al.*, 2007). To assess the adoption of transplanting practice, interviews, observations and FGDs were conducted, and the results are discussed below.

The results presented in Table 4.5 show that 98.9% of FFS members had adopted transplanting practice in their own rice fields. This implies that the majority of FFS members were using the transplanting practice in rice production instead of broadcasting. This was attributed to the fact that transplanting led to higher rice yields. Additionally, transplanting used less quantity of seeds as compared to broadcasting. These findings agree with what was said by farmers during FGDs whereby they reported that broadcasting method led to unhealthy plants and low yields due to competition for air and nutrients**.** Additionally, these results are supported by Evenson and Gollin, (2003) who reported that transplanting in rice production contributed in increasing rice yields.

4.4.10 Water bunds construction

Water bund refers to an enclosure made of soil in which paddy seedlings are transplanted (NRCS, 2011). Water bunds are recommended because they increase efficient utilization of water (Tenge *et al.*, 2013). To assess the adoption of water bunds, interviews, FGDs and observations were conducted, and the results are discussed below.

The results presented in Table 6 show that 100% of the FFS members had adopted water bunds in their own fields. This implies that FFS succeeded very well in promoting the adoption of water bunds such that all members had adopted the practice. This was attributed to the fact that rice production required good water management which was made possible by the construction of water bunds besides other things like levelling etc. Additionally, water bunds facilitated water harvesting in rain fed systems and prevented fertilizer loses (URT, 2011).

4.5 Level of adaptation of recommended rice production practices

In this section the researcher aimed at assessing the level of adaptation of the recommended rice production practices among FFS members. According to Rogers (1983), adopting an innovation was not necessarily a passive role of just implementing a standard template of the new idea. This implies that, in the course of implementing a technology, the receiver can make some changes on it in order to fit his/ her local conditions. In this study adaptation was measured by looking at the proportion of FFS members who made some changes on the recommended rice production practices in their own fields. To accomplish this objective, interviews, FGDs and observations were conducted, and Table 4.6 below presents the results.

Table 4.6 Level of adaptation of recommended rice production practices (n=188)

Recommended practices	No. of FFS members practiced as per recommendations	No. of FFS members who made some changes
Water bunds	188	0
Seed bed preparation	186	0
Levelling	186	0
Seed selection	184	0
Use of improved paddy variety (SARO 5)	183	0
Spraying to control insects-pests	177	0
Spraying to control diseases	177	0
Transplanting	173	13
Spraying to control weeds	161	0
Fertilizer app (Top dressing 2)	147	16
Fertilizer app (Top dressing 1)	141	10
Spacing -20cmx 2cm0 (3weeks)	123	0
Timely weeding- twice	100	0
Spacing – 25cmx 25cm (8-15days)	92	0
Spacing – 20cmx 10cmx 40cm (3 weeks)	26	0

The results presented in Table 4.6 above show that the majority of the recommended rice production practices promoted (80%) were not changed by FFS members in their own paddy fields. This means that they were adopted as prescribed in the recommendations

(Section 4.4). However, the results show that less than one third (20%) of the recommended rice production practices promoted were changed by FFS members. The changed practices included transplanting and fertilizer application. The changes made are described in the next section.

4.5.1 Adaptation of transplanting

Adaptation of an innovation can be defined as an act of making some changes on an innovation to suit farmers' local conditions. Transplanting in rows was reported to be among the practices that could help to achieve increase in rice yield (Evenson and Gollin, 2003). In rice production, transplanting can be grouped into two major categories namely normal/common system of rice transplanting and system of rice intensification (SRI). These two categories are described in the subsections below.

4.5.1.1 Adaptation of common system of rice transplanting.

This type of transplanting involves transplanting an average of 2-3 seedlings per planting station. To assess the adaptation of common system of rice transplanting interviews, FGDs and observations were conducted, and table 4.7 below presents the results.

Table 4.7 Adaptation of common system of rice transplanting (n=123)

Recommended number of seedlings per planting station	Number of seedlings per planting station as per farmers' practices	Number of farmers practicing	Percent (%)
2-3	2-3	121	98.4
	4	2	1.6
	Total	123	100.0

The study results presented in table 4.7 above show that, under normal system of rice transplanting, only 1.6% of FFS members had made some changes on transplanting. In this case the respondents transplanted 4 seedlings per planting station which had exceeded the recommended number of seedlings by 100%.The changes made were attributed to risk averse behaviour among FFS members. For example, one of the members said that "*I transplanted four seedlings per planting station so that in case one or two die at least some should remain."*(A farmer from Mvomero village). Therefore, this gives an impression that fear against loses influenced farmers' decisions on the number of seedlings to be transplanted per planting station. It should be noted that it was for a similar reason that Drechsel *et al*. (2005) argued that risks and uncertainties affected farmers' attitude towards technologies and adoption behaviour.

4.5.1.2 Adaptation of system of rice intensification (SRI)

Unlike the common system of rice transplanting which involves transplanting an average of 2-3 seedlings per planting station, SRI involves transplanting one seedling per planting station. To assess the adaptation of system of rice intensification interviews, FGDs and observations were conducted, and Table 4.8 presents the results.

Table 4.8 Adaptation of system of rice intensification (SRI) (n=92)

Recommended number of seedlings per planting station	Number of seedlings per planting station as per farmers' practices	Number of farmers practicing	Percent (%)
1	1	81	88.0
	2-3	11	12.0
	Total	92	100.0

The results presented in Table 4.8 above show that out 92 FFS members who had adopted SRI in their paddy fields, 12% had made some changes on SRI. They transplanted a range of 2-3 seedlings per planting station. The changes made exceeded the recommended number of seedlings per planting station by a range of 100% -200%. The changes made were attributed to risk averse behaviour among FFS members. They believed that it was too risky to transplant one seedling per planting station. This agrees with what was pointed out by Drechsel *et al*. (2005) that risks and uncertainties affected farmers' attitude towards innovations and adoption behaviour.

4.5.2 Adaptation of fertilizer application (Top dressing phase 1and 2)

Fertilizer application plays a crucial role in increasing rice yield. It was reported that increase in rice yield could be achieved through the diffusion of high-yielding modern varieties together with an increase in chemical fertilizer application (Evenson and Gollin, 2003). To assess the adaptation of fertilizer application interviews, FGDs and observations were conducted, and the results are discussed below.

It was found that the changes made on fertilizer application were in two categories. The first category was in terms of frequency of application. In this case study the results show that 33% of FFS members had applied either top dressing phase 1 or top dressing phase 2 instead of applying both top dressing phase 1 and phase 2. In the second category the changes made were in terms of quantity of fertilizer to be applied. In this case some of the FFS members had applied less than the recommended quantity. In both cases the changes were attributed to financial constraints among FFS members such that they were unable to procure enough fertilizer to be applied in two phases as per recommendations. Additionally, the subsidized fertilizer was not enough such that it could not be applied in both phases. The findings were not astonishing due to the fact that farmer field schools provided members with an opportunity to make some changes on the practices to fit their local conditions. Changes made on the quantity of fertilizer to be applied are described in details in the next section.

4.5.2.1 Adaptation of top dressing phase 1

Fertilizer application plays a very important role in increasing rice yield. Due to the nature of the soil of Mvomero district, which is relatively fertile, it was recommended that 50kg of urea/ha should be applied two weeks after transplanting as top dressing phase one. This promoted rapid vegetative growth, tillering and strengthened plants against disease attacks (Matembo, 2014, “Per.com”). To assess the level of adaptation of top dressing phase 1 interviews and FGDs were conducted and table 4.9 presents the results.

Table 4.9 Adaptation of top dressing phase 1 (n=151)

Recommended quantity of urea (kg/ha)	Quantity of urea applied (kg/ha)	Level of adaptation (%)	No. of FFS members adapted
50	3	6	1
	5	10	2
	12	24	1
	15	30	1
	20	40	1
	25	50	3
	40	80	1
		Total	10

The results show that only 4.9 FFS members (6.7%) had made some changes on top dressing phase 1 whereby they applied less than the recommended quantity. The rate of application ranged from 3kg of urea per hector (6%) to 40 kg/ha (80%). This was attributed to financial constraints among FFS members such that they were unable to procure the right quantity of fertilizer as per recommendations. One of the members said *"I applied less fertilizer because I did not have money to buy enough fertilizer"* (A farmer from Wami-Dakawa village).This implies that farmers' financial ability influenced their decisions on the use of fertilizer. According to Roger, (2003), well off farmers can afford the prices of new improved technology than low income farmers. Additionally, other FFS members reported that their fields were still fertile such that just a little supplement of fertilizer was needed. For example one member said that, "*My field is still fertile such that I did not need to apply 50kg of urea per hectare*" (A farmer from Mkindo village). This implies that the nature of soil fertility of the field influenced farmers' decisions on fertilizer usage. These results are reflected in a study by Mtengeti *et al*. (2012) who found that Mvomero rice producers were not applying basal dressing fertilizer; they were rather applying top dressing fertilizer whereby urea of varying rates was applied ranging from 16-50kg/ ha.

4.5.2.2 Adaptation of top dressing phase 2

With regard to top dressing phase 2, it was recommended that 50kg of urea/ha should be applied immediately after panicle initiation (7 weeks after transplanting) as top dressing phase 2. This ensured complete grain filling, increased grain size and weight (Matembo, 2014, "Per.com").To assess the adaptation of top dressing phase 2, interviews and FGDs were conducted and table 4.10 presents the results.

Table 4.10 Adaptation of top dressing phase 2 (n=163)

Recommended quantity of urea (kg/ha)	Quantity of urea applied (kg/ha)	Level of adaptation (%)	No of FFS members adapted
50	3	6%	1
	5	10%	2
	12	24%	1
	15	30%	2
	20	40%	1
	25	50%	7
	32	64%	1
	40	80%	1
		Total	16

The results in table 4.10 show that only 16 FFS members (9.8%) had made some changes on top dressing phase 2 practice whereby they applied less than the recommended quantity. The rate of application ranged from 3kg of urea per hectare (6%) to 40 kg/ha (80%). This implies that 9.8% of FFS members did not comply with recommendations on the quantity of fertilizer application in their rice fields. This was attributed to similar reasons as discussed in section 4.5.2.1. Despite the fact that some of the FFS members applied less than the recommended quantity of fertilizer, they harvested higher yields than in the previous seasons when they did not apply fertilizer. This implies that fertilizer application played a very important role increasing rice yields among FFS members.

Summarily, it was found that farmer field schools played a very important role in the adoption and adaptation of recommended rice production practices among FFS members in Mvomero district in Tanzania. Specifically, farmer field schools played a very important role in awareness creation whereby a good number (15) of recommended rice production practices were promoted among FFS members. In this case more than 75% of FFS members were found to be aware of recommended rice production practices which were promoted using FFS. Farmers' awareness on the availability of technologies was an important factor for adoption to take place (Asfawl *et al*., 2011). These results agree with those of a study by Gotland *et al*. (2003) on the impact of FFS on knowledge and productivity.

Additionally, farmer field schools contributed much in increasing the adoption of recommended rice production practices. In this case the majority of recommended rice production practices (80%) which were promoted using FFS were adopted by more than 65% of FFS members. This was attributed to high degree of awareness among FFS members on the recommended rice production practices promoted and high yields which FFS members observed in both FFS study fields and their own fields. Asfawl *et al*. (2011) reported that farmers who were aware of the advantages of new technologies were more likely to adopt such technologies and allocate more land in the subsequent year. Therefore, FFS created a conducive environment for members to learn and understand the recommended rice production practices which facilitated their adoption. These results agree with the study by Raghuvanshi *et al*., (2012) on the impact of FFS on knowledge and adoption level of wheat; and Kabir (2006) on the adoption SRI technology where FFS facilitated the adoption of wheat and SRI technology respectively.

However, it was found that FFS had little role in the adaptation of recommended rice production practices in Mvomero district. In this case only 20% of recommended rice production practices which were promoted using FFS were adapted by FFS members. Low adaptation rate could have been attributed to the fact the recommended practices suited the local conditions of the majority of FFS members. On the other hand, the little changes made were attributed to financial constraint which limited their ability to procure the right quantity of fertilizer as per recommendations and risk averse behaviour among FFS members. Therefore, financial constraint and risk averse behaviour subjected some of the recommended rice production practices to changes among FFS members. Risks and uncertainties affected farmers' attitude towards innovations and adoption behaviour (Drechsel *et al*., 2005). It was further reported that, if farmers had good income in one year, they were more likely to increase their fertilizer use in the following year. On the other hand, if their income was low, they would reduce their expenditures on fertilizer (Tisdale, 1985). According to Rogers (1983) adopting an innovation was not necessarily a passive role of just implementing a standard template of the new idea. This implies that, in the course of implementing a technology, the receiver of technology can make some changes on it in order to fit his/ her local conditions

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This section begins with presentation of the conclusions drawn from the study followed by recommendations based on the findings of the study. Generally, the researcher aimed at investigating the role of FFS in adoption and adaptation of recommended rice production practices in Mvomero district in Tanzania. Specifically, the researcher aimed at identifying the recommended rice production practices promoted using FFS in the study area, examining the level of adoption of recommended rice production practices among FFS members, and examining the level of adaptation of recommended rice production practices among FFS members.

5.2 Conclusions

Conclusions of the study are presented in terms of recommended rice production practices promoted using FFS in the study area, the level of adoption of recommended rice production practices among FFS members, and the level of adaptation of recommended rice production practices among FFS members.

Having conducted the study, analysed the data and discussed the results, the following conclusions can be made:

- Farmer field schools played a very important role in awareness creation among FFS members whereby a total of 15 recommended rice production practices were promoted. FFS members' awareness on the recommended rice production practices was very high (above 75%).

- Farmer field schools improved FFS members' knowledge and experience which facilitated the increased adoption of recommended rice production practices among FFS members since the adoption level was very high (above 65%).

- Farmer field schools had little role in the adaptation of recommended rice production practices in Mvomero district. In this case only 20% of recommended rice production practices which were promoted using FFS were adapted by FFS member.

5.3 Recommendations

Since farmer field schools demonstrated to have influence in creating awareness and promoting the adoption of recommended rice production practices, the researcher makes the following recommendations:

- Awareness creation among farmers on the available recommended rice production practices and other agricultural technologies should continue being done through farmer field school approach.
- It is further recommended that the adoption of recommended rice production practices and other agricultural related technologies should continue being promoted through FFS approach whenever resources allow.

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APPENDICES

Appendix 1. Questionnaire for FFS members

THE ROLE OF FARMER FIELD SCHOOLS ADOPTION AND ADAPTATION OF RECOMMENDED RICE PRODUCTION PRACTICES IN MVOMERO DISTRICT IN TANZANIA

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A. IDENTIFICATION

Name of Enumerator ………………………………………………

Name of Respondent ………………………………………………

Name of FFS……………………………………………………………

Name of Village ……………………………Ward……………………

Date of Interview….…………………………………………………….

B. SOCIO-ECONOMIC CHARACTERISTICS OF HOUSEHOLD

B1. Household Characteristics

H/h Size	H/h Age (yrs)	H/H Marital Status	Education Level. i)*What is your highest grade of education?* *ii) What is your highest qualification?*	H/h Literacy	Source of Income	H/h Total Land size (Hector)	H/h land planted with paddy (Hector)
			i)……………..				

…….	……..	…………	ii) ………………	…………	……………		………..
		01=single (never married) 02=married 03=separated 04=widowed 05=divorced 06=other (specify)		01=Cannot read & write 02=Can read 03=Can read & write	01=farming 02=employment 03=small business 04=remittance 05=others (specify)		

C. ABOUT RECOMMENDED PRACTICES

1. For how long have been in rice FFS? .... Years
2. How did you know about FFS?
    1) Through WEO/ VEO
    2) Through fellow farmers
    3) Through TV
    4) Through Radio
    5) Through Friends
    6) Others (specify)………………………………………………………

3. How did you become a member of the FFS?

    1) Voluntarily 2) Being forced 3) Being advised

4. How many members are there in the current FFS? ……………. farmers

5. Which recommended rice production practices are being promoted by the current FFS? (Tick the appropriate)

No	***Recommended practices***	***Tick***
1	Agro Ecosystem analysis (AESA)	
2	Use of improved seed	
3	Seed selection	
4	Seed bed preparation	
5	Water bunds construction	
6	Ploughing, paddling an levelling	
7	Transplanting a) 20 by 20cm (3-4wks) b) 20 by 10 by 40cm c) 25 by 25cm (8-15dys)	
8	Manure/inorganic fertilizer application a) First time b) Second time	
9	Weeding	
10	Spraying to control a) Insect-pests b)Weeds	

	c)Diseases	
11	Bird scaring	
12	Others (Specify) i)……………………………… ii)……………………………… iii)………………………………	

6. Were you aware of any of the recommended rice production practices before joining the FFS?

   1) YES 2) NO

7. If answered YES in question 6 above, who gave you the information? (Tick the appropriate one)

S/No	***Source of information***	***Tick***
1	WEO/VEO	
2	Fellow farmers	
3	Friends	
4	Relatives	
5	Television	
6	Radio	
7	Others (specify i)…………………………………… ii)………………………………….. iii)………………………………….	

D: UPTAKEOFRECOMMENDED RICE PRODUCTION PRACTICES

Circle the most correct answer

8. Which of the following recommended rice production practices do you practice in your own field? Tick the appropriate one and give reasons

No	***Practices***	***Tick***	
1	Agro Ecosystem analysis (AESA)		
2	Use of improved seed		
3	Seed selection		
4	Seed bed preparation		
5	Water bunds construction		
6	Ploughing, paddling an levelling		
7	Transplanting a)20 by 20cm (3-4wks) b)20 by 10 by 40cm c)25 by 25cm (8-15dys)		
8	Manure/inorganic fertilizer application a)First time b)Second time		
9	Weeding		
10	Spraying to control a) Insect-pests b)Weeds		

	c)Diseases		
11	Bird scaring		
12	Others (Specify) i)………………………………. ii)……………………………… iii)………………………………		

9. Which of the above technologies in question 1above you DO NOT practice in your own field and why?

S/No	***Practices not being practiced***	***Reasons***
1		
2		
3		
4		
5		
6		
7		

10. Which recommended rice production practices have other people learnt from you?

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

11. How many other people have learnt about the recommended rice production practices from you?............... people.

E: ADAPTATION OF RECOMMENDED RICE PRODUCTION PRACTICES. ***Circle the most correct answer***

12. Have you made any changes to any of the technologies you are using?

1) YES 2) NO

13. If answered YES in question 1 above, which kind of changes have you made and why?

No	***Technologies***	***Recommended***	***Modifications***	***Reasons***
1	AESA	At least once/week		
2	Use of improved seed	Saro , TXD 85		
3	Seed selection	i)Soaking in salt water ii) Soaking in fresh water	i)…………… ii)……………	
4	Seed preparation	i)Soaking in water for 24hrs ii)Incubating for 48hrs	i)…………… ii)…………	
5	Seed bed preparation			
6	Band construction	i) Height;20cm ii)Ploughing iii)Levelling	i) Height;… ii)………… iii)…………	
7				

8	Transplanting i)No of plants/hole ii)Spacing a) 20 by 20cm b) 20 by 10 by40 c) 25 by 25cm	 2 to 3 plants a) 20by 20cm b) 20by10by40 c) 25 by 25cm	 a)………… b)………… c)…………	
9	Inorganic fertilizer application/hectare a)First time (7th day after transplanting) b)Second time (45th day after transplanting)	 a)-Nitrogen:40kgs -Urea:87kgs b)-Nitrogen:40kgs - Urea:87kgs	 a)………… b)…………	
10	Weeding	Twice per season		
11	Pest management	a)Spraying with insect-sides b)Use of local herbs	a)………… b)…………	
12	Bird scaring			

14. Which challenges do you face in implementing the learned practices for rice production in your own fields?

S/No	*Challenges*	*Tick*
1	Limited land size	
2	High cost of inputs	
3	It is laborious	
4	Insufficient agricultural inputs	
5	Limited extension services	
6	Others (Specify) i)………………………………………. ii)………………………………………. iii)…………………………………….. iv………………………………………	

15. What should be done in order to address such challenges?

i) ---

ii) ---

iii) ---

16. Are there better approaches than FFS for promoting the recommended rice production practices?

1) YES 2) NO

17. If answered YES in question 5 above, mention them and give reasons.

S/No	***Approaches to be promoted***	***Reasons***

18. Do you have any other comments?

THANK YOU FOR YOUR COOPERATION

Appendix 2. Check list for office based extension officers

THE ROLE OF FARMER FIELD SCHOOLS IN ADOPTION AND ADAPTATION OF RECOMMENDED RICE PRODUCTION PRACTICES IN MVOMERO DISTRICT IN TANZANIA

D. IDENTIFICATION

Name of Enumerator ……………………………………………….

Village ………………………………Ward…………………………

Date of Interview….…………………………………………………

E. ABOUT FFS

1. Are there rice FFS in your area? YES/ NO
   1) YES 2) NO
2. If answered YES in question 1, how many are there? ....
3. Tick recommended rice production practices that are being promoted by those FFS?

No	*Technologies*	*Tick*
1	Agro Ecosystem Analysis (AESA)	
2	Use of improved seed	
3	Seed selection	
4	Seed bed preparation	

5	Water bunds construction	
6	Ploughing, paddling an levelling	
7	Transplanting d) 20 by 20cm (3-4wks) e) 20 by 10 by 40cm f) 25 by 25cm (8-15dys)	
8	Manure/inorganic fertilizer application c) First time d) Second time	
9	Weeding	
10	Spraying to control a) Insect-pests b)Weeds c)Diseases	
11	Bird scaring	

4. Do FFS members make any changes in practices as a result what they learned?
   1) YES 2) NO

5. If answered YES in question 4 above, mention the practices and give reasons

No	***Practices***	***Recommended***	***Modifications***	***Reasons***
	AESA	At least once/week		
1	Use of improved seed	Saro , TXD 85		
2	Seed selection	i)Soaking in salt water	i)………………	

		ii) Soaking in fresh water	ii)………………	
3	Seed preparation	i)Soaking in water for 24hrs ii)Incubating for 48hrs	i)……………… ii)……………	
4	Seed bed preparation			
5	Water bunds construction	i) Height;20cm ii)Ploughing iii)Levelling	i) Height;……. ii)……………. iii)…………….	
6	Transplanting i)No of plants/hole ii)Spacing a) 20 by 20cm b) 20 by 10 by40 c) 25 by 25cm	2 to 3 plants a) 20by 20cm b) 20by10by40cm c) 25 by 25cm	-……………… a)……………… b)……………… c)………………	
7	Inorganic fertilizer application/hectare a)First time (7th day after transplanting) b)Second time (45th day after transplanting	a)-Nitrogen:40kgs -Urea:87kgs b)-Nitrogen:40kgs - Urea:87kgs	a)……………… b)……………	

8	Weeding	Twice per season		
10	Pest management	a)Spraying with insect-sides b)Use of local herbs	a)…………… b)……………	
11	Bird scaring			
12	Others (Specify) i)………………… ii)………………… iii)…………………			

6. Which challenges do FFS members face in implementing the learned recommended rice production practices?

S/No	***Challenges***	***Tick***
1	Limited land size	
2	High cost of inputs	
3	It is laborious	
4	Insufficient agricultural inputs	
5	Limited extension services	
6	Others (Specify) i)………………………………………. ii)………………………………………. iii)…………………………………….. iv)………………………………………	

7. What should be done in order to address such challenges?

i) ---

ii) ---

iii) ---

8. Are there better approaches than FFS for promoting recommended rice production practices?

2) YES 2) NO

9. If answered YES in question 8 above, mention them and give reasons

S/No	***Approaches to be promoted***	***Reasons***
1		
2		
3		
4		

10. Do you have any other comments?

THANK YOU FOR YOUR COOPERATION

Appendix 3 Questionnaire for field- based extension officers (lead farmers)

THE ROLE OF FARMER FIELD SCHOOLS IN ADOPTION AND ADAPTATION OF RECOMMENDED RICE PRODUCTION PRACTICES IN MVOMERO DISTRICT IN TANZANIA

F. IDENTIFICATION

Name of Enumerator ………………………………………………

Name of Respondent ………………………………………………

Village……………………………..Ward……………………………..

Date of Interview….……………………………………………………….

G. ABOUT FFS

1. Have you ever been a member of rice production FFS before?

   1) YES 2) NO

2. If answered YES in question 1 above, which of the following recommended rice production practices did you learn (Tick the appropriate one)

No	***Practices***	***Tick***
1	Agro Ecosystem Analysis (AESA)	
2	Use of improved seed	
3	Seed selection	
4	Seed bed preparation	

5	Water bunds construction	
6	Ploughing, paddling an levelling	
7	Transplanting g) 20 by 20cm (3-4wks) h) 20 by 10 by 40cm i) 25 by 25cm (8-15dys)	
8	Manure/inorganic fertilizer application e) First time f) Second time	
9	Weeding	
10	Spraying to control a) Insect-pests b)Weeds c)Diseases	
11	Bird scaring	
12	Others (Specify) i)………………………………… ii)……………………………… iii)………………………………	

3. Which of the following learned practices that you practice in your own field and why?

No	***Practices***	***Tick***	***Reasons***
1	Agro Ecosystem Analysis		
2	Use of improved seed		
3	Seed selection		
4	Seed bed preparation		
5	Water bunds construction		
6	Ploughing, paddling an levelling		
7	Transplanting j) 20 by 20 k) 20 by 10 by 40 l) 25 by 25		
8	Manure/fertilizer application g) First time h) Second time		
9	Weeding		
10	Spraying		
11	Bird scaring		

4. Do you make any changes in practices as a result of what you have learned?
   1) YES 2) NO

5. If answered YES in question 5 above, which kind of changes and why?

No	*Practices*	*Recommended*	*Modifications*	*Reasons*
1	Use of improved seed	Saro5		
2	Seed selection	i)Soaking in salt water ii) Soaking in fresh water	i)………… ii)…………	
3	Seed preparation	i)Soaking in water for 24hrs ii)Incubating for 48hrs	i)………… ii)…………	
4	Seed bed preparation			
5	Water bunds construction	i) Height;20cm ii)Ploughing iii)Levelling	i) Height;…… ii)…………… iii)…………	

6	Transplanting i)No of plants/hole ii)Spacing a) 20 by 20cm b) 20 by 10 by40 c) 25 by 25cm	 2 to 3 plants a) 20by 20cm b) 20by10by40 c) 25 by 25cm	 - ……………. a)………… … b)………… … c)…………..	
7	Inorganic fertilizer application/hectare a)First time (7th day after transplanting) b)Second time (45th day after transplanting)	 a)-Nitrogen:40kgs -Urea:87kgs b)-Nitrogen:40kgs - Urea:87kgs	 a)………….. b)………… …	
8	Weeding	Twice per season		

10	Pest management	a)Spraying with insect-sides b)Use of local herbs	a)……….. b)……….. …	
11	Bird scaring			
12	Others (Specify) i)………………… ii)………………… iii)…………………			

6. Which challenges do you face in implementing the learned recommended rice production practices in your own field?

S/No	***Challenges***	***Tick***
1	Limited land size	
2	High cost of inputs	
3	It is laborious	
4	Insufficient agricultural inputs	
5	Limited extension services	

7. What have you been doing to address such challenges?

i) --

ii) --

iii) --

8. What else should be done in order to address such challenges?

i) --

ii) --

9. Are there better approaches than FFS for promoting recommended rice production practices?

3) YES 2) NO

10. If answered YES in question 10 above, mention them and give reasons

S/No	***Approaches to be promoted***	***Reasons***

11. Do you have any other comments?

THAK YOU FOR YOUR COOPERATION

Appendix 4 Check list for DAICO

A. THE ROLE OF FARMER FIELD SCHOOLS IN ADOPTION AND ADAPTATION OF RECOMMENDED RICE PRODUCTION PRACTICES IN MVOMERO DISTRICT IN TANZANIAIDENTIFICATION.

Name of Enumerator ………………………………………………

Name of Respondent ………………………………………………

Village………………………………Ward……………………………

Date of Interview…..……………………………………………………….

B. ABOUT FFS

1. What activities do FFS carry out in the district?

2. What recommended rice production practices are being promoted by FFS?

3. Which recommended rice production practices being promoted by FFS have been adopted by farmers?(FFS members)

4. How have FFS contributed to the uptake of recommended rice production practices by farmers?(FFS members)

5. How have FFS contributed to the adaptation of recommended rice production practices by farmers (FFS members)

6. Which challenges do FFS members face in implementing the learned recommended rice production practices in their own fields?

7. What should be done in order to address such challenges in Q6?

8. Are there any aspects of FFS which need to be changed in order to improve or increase their performance?

9. If answered YES in question 8 above, what are they and why?

10. Are there better approaches than FFS for promoting recommended rice production practices? YES/ NO

11. If answered YES in question 10 above, mention them and give reasons
12. Do you have any other comments?

THANK YOU FOR YOUR COOPERATION

Appendix 5 Check list for FGDs

THE ROLE OF FARMER FIELD SCHOOLS IN ADOPTION AND ADAPTATION OF RECOMMENDED RICE PRODUCTION PRACTICES IN MVOMERO DISTRICT IN TANZANIA.

IDENTIFICATION

Name of Enumerator …………………………………………………

Village …………………………………Ward ……………………......

Date of Interview….…………………………………………………….

ABOUT FFS

1. What is the name of your FFS?
2. When was it formed?
3. How was it formed?
4. Has FFS been helpful to you?
5. If the answer is YES in question 4 above, how has it been helpful to you?
6. Who are the people that seem to be benefiting from the FFS and why?
7. How do you compare this approach (FFS) with other approaches like T& V, Demonstration, etc.?
8. Do you have any other comments?

THANK YOU FOR YOUR COOPERATION