

**EFFECTIVENESS OF FARMER FIELD SCHOOLS IN IMPROVING
AGRICULTURAL PRODUCTIVITY IN TANZANIA: A CASE STUDY OF
SMALLHOLDER RICE FARMERS IN MVOMERO DISTRICT,
MOROGORO REGION**

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

2017

ABSTRACT

Farmers field schools (FFSs) provide farmers with an opportunity to experiment new technologies which help them to make informed decisions that eventually lead to increased agricultural production and productivity. This study was conducted to assess the effectiveness of Farmer Field Schools (FFS) in terms of improving agricultural productivity in selected villages of Mvomero District, Morogoro region. Effectiveness was conceptualized as the performance of FFS graduates meeting the goal in terms of acquisition and utilization of improved rice production technologies, knowledge and/or practices resulting in increased production and productivity of rice. The specific objectives were to describe the socio-economic characteristics of smallholder FFS and non-FFS graduates on improved rice technologies; to describe the extent of utilization of acquired improved rice technologies, knowledge and/or practices between FFS and non-FFS graduates; to compare the levels of rice yields per hectare between FFS and non-FFS graduates; and to assess the perceptions of smallholder rice farmers on the effectiveness of FFS in terms of acquisition and utilization of improved rice technologies; and improved rice productivity. A cross-sectional research survey method was used and involved interviewing 120 respondents (FFS and NFFS graduate) selected through a multi-stage sampling technique. A sample of 60 FFS and 60 NFFS graduates was proportionately selected for the study. Structured questionnaires were used to collect primary data; and secondary data were collected from relevant reports and documents. Frequencies were run using The Statistical Package for Social Sciences (SPSS) version 20 to determine socio-economic characteristics of smallholder farmers. Additionally, independent t-test was used to test the mean difference of the two groups (FFS graduates and NFFS farmers) on crop yields. The significance level of $\alpha = 0.05$ was employed in deciding whether there was significant difference among the variables. The findings of the study showed that for

all the rice technologies, knowledge and or practices, FFS graduates did significantly well in terms of **all the** utilization of all the technologies. The results further show that the differences between the two groups (FFS and NFFS graduates) were statistically significant ($p < 0.000$) in rice yield for the three years 2014 to 2016. The findings suggest that FFS as an extension approach is effective in improving agricultural productivity among smallholder rice farmers. However, challenges revolving around financial and labour constraints affected FFS graduates in making effective use of certain improved rice technologies/knowledge and or practices. It is therefore evident that FFS provide an effective and a good opportunity for the dissemination of improved rice production practices and others agricultural technologies and their use.

DECLARATION

I, PETER DERICK GBAWOQUIYA, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is the result of my own original work done within the period of registration and that it has neither been submitted nor being concurrently submitted for degree award in any other institution.

.....
Peter Derick Gbawoquiya
(MSc Candidate)

.....
Date

The above declaration is confirmed by;

.....
Prof. D. F. Rutatora
(Supervisor)

.....
Date

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ACKNOWLEDGEMENTS

Firstly, I am grateful to the Almighty God for lighting the path of my educational sojourn for allowing me to successfully complete this study in good health, peace and harmony.

My heartfelt thanks and appreciation go to the Smallholder Agricultural Productivity and Enhancement Project (SAPEC, MOA Liberia) for offering me a scholarship and endless financial support during my study.

I wish to acknowledge with deep appreciation the tireless, constant and consistent guidance and encouragement of my supervisor, Professor D.F. Rutatora for his patience, constructive criticism and moral support from the initial stage of writing my proposal up to the time of production of this dissertation. I'm indebted to the academic staff and fellow students of the Department of Agricultural Extension and Community Development for their interest and support at all stages of this study.

My sincere thanks go to the entire staff of Mvomero District Council for their cordial cooperation provided during my data collection, especially Mrs Yusta J. Kidawa and Mrs Daina M. Muywanga.

Lastly, the author's heartfelt thanks are due to his fiancée Judith Freeman and children Peachis and Francess for their moral support and patience during his long period of absence from home, and to his family for their continuous prayers and encouragements in pursuing his study.

DEDICATION

This dissertation is dedicated to the memories of my late father David W. Gbawoquiya and my late lovely daughter little Dericklyn E. Gbawoquiya. I say a big thank you to Papa who made a lot of effort in laying down the foundation for my education. And to little Dericklyn, who did not feel the love of her father until her death while I was away for study, **may** the Almighty God rest your souls in eternal peace Amen.

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LIST OF ABBREVIATIONS AND ACRONYMS

ASDP	Agricultural Sector Development Programme
ASDS	Agricultural Sector Development Strategy
CAADP	Comprehensive African Agriculture Development Programme
CRDB	Commercial Rural Development Bank
FAO	Food Agricultural and Organization
FFS	Farmers Field School
FGDs	Focus Group Discussions
FTC	Farmers' Training centre
GDP	Gross Domestic Product
ICPM	Integrated Crop and Pest Management
IFAD	International Fund for Agricultural Development
IPM	Integrated Pest Management
MDC	Mvomero District Council
NFFS	Non Farmer Field School
NMB	National Microfinance Bank
PPS	Probability Proportional to Size
SAGCOT	Southern Agriculture Growth Corridor of Tanzania
SHERFS	Southern Highlands Extension and Rural Financial Services Project
SPSS	Statistical Package for Social Sciences
SRI	System Rice Intensification
SSA	Sub-Sahara Africa
T&V	Training and Visits
TADB	Tanzania Agricultural Development Bank
TAFSIP	Tanzania Agriculture and Food Security Investment Plan

TDV	Tanzania Development Vision
TOT	Training of Trainer
URT	United Republic of Tanzania

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

The United Republic of Tanzania is an East African country with a population of approximately 52.3 million, of which about 1.3 million (2.9%) inhabits the islands of Zanzibar (URT, 2015). Agriculture is one of the mainstays of the economy contributing about 24.1% of the country's GDP and 30% of export earnings. The agricultural sector employs about 70% of the country's workforce (URT, 2015). About 80% of agricultural production comes from subsistence farming which is characterized by the use of primitive tools such as hand hoe, oxen plough, cutlass and axes with limited areas under medium and large-scale farming (URT, 2015).

According to the Agricultural Sector Development Programme (ASDP) Phase II (URT, 2015), the agricultural sector in Tanzania has a number of strengths which present significant potential for future growth with comparative advantage in the production of both traditional and non-traditional export crops such as coffee, cocoa, rice and wheat, an advantage that can be improved through enhanced productivity and market efficiency (URT, 2015). Despite the above mentioned potential, the sector has over the years registered a slower growth rate of about 3.4 percent far less than the 6 percent required by the Comprehensive African Agriculture Development Programme (CAADP) which is considered necessary for increased economic growth (URT, 2015).

Tanzania's agricultural sector has over the years faced key constraints to achieving its growth targets, including: high transaction costs due to the poor state or lack of infrastructure; under-investment in productivity enhancing technologies; limited access to

technologies; limited access to financing for the uptake of technologies; un-managed risks with significant exposure to variability in weather patterns with more periodic flooding and droughts (URT, 2015). Based on the above, there is a general need to address the constraints in order to achieve the CAADP growth rate with the aim of addressing the growing food security needs; adoption of improved agricultural techniques and farming methods. According to Abdullah *et al.* (2014), increased agricultural productivity by smallholder farmers is essential if the increasing population's food needs are to be met.

In order to revitalize the agricultural sector and make sure it lives up to the Tanzania Development Vision (TDV) 2025, and the Tanzania Five Year Development Plan (2016/2017-2020/2021), efforts have been made by the Government in collaboration with Development Partners (DPs) (e.g. the World Bank and the International Fund for Agricultural Development-IFAD) with the aim to improve the living standard of typical medium-income country through ensuring food security, improving incomes and increasing export earnings. In an effort to invigorate the agricultural sector, the Government has come up with a number of initiatives including the Agricultural Sector Development Strategy (ASDS 1-2001 and ASDS II-2015) operationalized through the Agricultural Sector Development Programme (ASDP 1—2006 and ASDP II-2015); the Tanzania Agriculture and Food Security Investment Plan (TAFSIP) operationalizing the Comprehensive Africa Agriculture Development Programme (CAADP), the Southern Agriculture Growth Corridor of Tanzania (SAGCOT) operationalizing *Kilimo Kwanza* National Resolve (Agriculture First - 2009) and the Big Results Now (BRN-2013) with agriculture being one of its priority sectors (URT, 2012). In the same vein, working in partnership with other stakeholders, such as the Africa Rice project, the Government of Tanzania deemed it mandatory to invigorate rice production in order to promote food

security and to effectively increase the productivity of smallholder rice farmers in the country (Lugongo, 2010).

In Tanzania, rice is one of the major food and commercial crops grown in a wide range of climatic zones and is the second widely cultivated cereal food crop in Tanzania after maize (Mghase *et al.*, 2010). Rice is grown in three agro-ecosystems which comprise 74% rain-fed lowland, 20% upland and 6% irrigated rice ecosystem (Mghase *et al.*, 2010). The three leading rice producing regions in the Central Corridor with larger areas under cultivation include: Morogoro, 537 000 ha, Shinyanga, 119 000 and Tabora, 66 000 ha, representing 19.5, 18.5 and 10.5% respectively. As stated by Kagitiriri *et al.* (2003), Tanzania ranks second within Eastern, Central and Southern Africa in terms of rice production and consumption after Madagascar. In Tanzania, the cultivated area for rice in 2012 was 720 000 hectares; while the average yield for the period between 2003- 2012 was considered low, 1.8 tons per ha compared to Madagascar whose yields stood at 2.2 tons per hectare (FAO, 2014).

Improvement in rice productivity and yield requires adequate investment in increasing farmer's knowledge and skills as provided through the Farmer field School (FFS) approach (FAO, 2014). The Farmer Field School approach was established in 1989 in Indonesia central Java during the pilot phase of the Food and Agriculture Organization (FAO) assisted National Integrated Pest Management (IPM) programme. It is an alternative extension approach, whereby farmers are given opportunity to make a choice in the methods of production through a discovery learning approach. The (FFS) programme aimed at increasing farmers' knowledge about new technology through participatory learning for the enhancement of crop productivity and sustainable use of agricultural resources (FAO, 2014).

According to Kenmore (2002) and Godtland *et al.* (2004), FFS represents a paradigm shift in agricultural extension with emphasis on utilization of participatory methods to help farmers develop their analytical skills, critical thinking, creativity, and help them learn to make better decisions. Participants are encouraged to share their knowledge with other farmers, and are sometimes trained to teach the courses themselves, thus reducing the need for external support (Godtland *et al.*, 2004). In addition, FAO (2015) argues that FFS is a participatory approach for capacity building, efficient, sustainable and inclusive food production systems. To effectively promote the approach, FAO and its partners have opted for a "produce more with less" approach for several years by promoting sustainable intensification of agriculture production model which aims at boosting income with emphasis on enhancing the environment and improving the health of farmers and rural communities. FFS equip millions of small farmers with the knowledge and skills necessary to implement this approach and improve living conditions. As mentioned by Davis (2006), the FFS approach has had significant impact on increasing farmers' knowledge and skills over the years since its introduction.

Based on this significant impact of FFS in increasing farmers' knowledge and skills through training and experimentation, the Government of Tanzania in partnership with the Indonesian Government established the Farmers' Agricultural and Rural Centre in Mkindo, Mvomero District, Morogoro Region in 2001 as part of a cooperation agreement between Tanzania and Indonesia to provide farmers with new technologies to increase their productivity (FAO, 2008). The Centre acts as the national centre for training farmers and trainers on irrigated rice practices and provide an improve method for farmers by way of increasing productivity. Moreover, the centre trains farmers on use of improved rice varieties such as TXD 306 (Tanzania cross Dakawa 306) or SARO 5, TXD 85, TXD 88, IR 54, as well as resistant varieties such as Mwangaza and Kalalu. The centre also

introduced the System of Rice Intensification (SRI) to farmers focusing on selection and utilization of improved seeds, farm layout, seeds soaking, fertilizer application and incubation among others (MDC, 2016).

The FFS programme in Mvomero has made a remarkable improvement in the livelihoods of the Centre's targeted community through helping farmers to have easy access to utilization of agricultural information and knowledge pertaining to modern way of farming. Farmer groups namely "Mwanzo Mgumu and "Nguvukazi" were formed with a total of 51 members who were trained on improved practices in irrigated rice production and later FFS was scaled-up to include Mlali, Hembeti and Wami-Dakawa wards (MDC, 2012). In 2003-2013, about 65 farmers groups graduated in irrigated rice technology from the FFS Mkindo's Farmers Training Centre with the total numbers ranging from 15-25 farmers per group (MDC, 2016). A total of 875 farmers have participated in the training whereby 507 received training directly from the Mkindo Farmers' Training centre in Mvomero District while 360 farmers were trained in Kanga and Mzila Wards by extension workers. Likewise, in 2014-2016, a total of 165 farmers graduated from similar training in the district (MDC, 2016). As the result of the training and putting into practice the acquired improved skills and technologies provided by the FFS, rice yield increased from about 3-4.3 t/h to an average of 7-9 t/h (MDC, 2016).

1.2 Problem Statement and Justification

1.2.1 Problem statement

Since the introduction of FFS in Mvomero District in 2001, smallholder rice farmers under the FFS programme are reported to have improved their rice yields per unit area as a result of acquiring relevant knowledge and technologies revolving around improved rice production and effectively making use of that knowledge. As much as it is reported that

FFSs have had significant impact on rice productivity amongst FFS graduates, consultations with concerned officials and relevant literature, there is no specific study that has been conducted in the District to assess the effectiveness of FFS in terms of improved rice productivity amongst beneficiary smallholder farmers. This study therefore is intended to assess the effectiveness of FFS in improving rice productivity amongst the target women and men smallholder farmers as a result of acquisition and effective utilization of improved rice production technologies, knowledge and related agronomic practices.

1.2.2 Justification of the study

The findings of this study shed light on the effectiveness of FFS in terms of improved rice productivity and mechanisms for enhancing knowledge acquisition, dissemination and utilization of improved rice technologies and accompanied/complementary practices by smallholder farmers. The study highlights on the best practices of FFS approaches that are enhancing rice productivity among smallholder farmers in the District and provides essential measures for improving the implementation of FFS as a participatory extension methodology. Additionally, this study highlights on the perceptions of smallholder rice farmers toward the effectiveness of FFS and provide mechanisms through which agricultural extension services through FFS at district level can be scaled-up (Rutatora and Mattee, 2001). Similarly, information obtained from the this study does inform policy makers and various stakeholders (government, development partners, civil society, farmers and private sector) to consider new ways of designing effective agricultural extension programmes on the basis of FFS, with the intent of improving access and utilization of extension messages and technologies or practices and hence contributing to the increase in production and productivity of rice.

1.3 Objectives of the study

1.3.1 Overall objective

The overall objective of this study was to assess the effectiveness of farmer field school in improving agricultural productivity among smallholder rice farmers in selected villages of Mvomero District, Morogoro.

1.3.2 Specific objectives

- i) To describe the socio-economic characteristics of smallholder FFS and non-FFS graduates on improved rice technologies in selected villages of Mvomero District;
- ii) To describe the extent of utilization of acquired improved rice technologies, knowledge and/or practices between FFS and non-FFS graduates.
- iii) To compare the levels of rice yields per hectare between FFS and non- FFS graduates; and
- iv) To assess the perceptions of smallholder rice farmers on the effectiveness of FFS in terms of acquisition and utilization of improved rice technologies; and improved rice productivity.

1.4 Research Questions

- i) What are the socio-economic characteristics of smallholder rice farmers that enhance knowledge acquisition and utilization of improved rice technologies in the selected villages of Mvomero District?
- ii) To what extent are FFS graduates making use of improved acquired rice technologies, knowledge and or practices that were disseminated and utilized through the FFS approach?
- iii) What are the levels of yields of rice per hectare between FFS and non- FFS?

- iv) What is the perception of women and men smallholder rice farmers on the effectiveness of FFS in as far as improved rice productivity is concerned?

1.5 Conceptual Framework

The conceptual framework (Figure 1) of this study aims at assessing the effectiveness of FFS in terms of improved rice productivity as a result of acquisition and utilization of improved rice technology/knowledge and practices (Anderson and Feder, 2004). According to Feder *et al.* (2004) knowledge can be broadly defined as the possession of analytical skills, critical thinking, ability to make better decisions, familiarity with specific agricultural practices, and understanding of interactions within the agro-ecological system.

Overall, FFSs seek to improve farmers' problem solving abilities by sharpening their observational skills and decision-making ability, thereby relying on the diffusion/sharing of information or knowledge within farming communities (Ebewore, 2013). In addition, effectiveness of FFS is accomplished through innovation and the adoption of new technologies to increase the productivity of smallholder farmers. Based on the conceptual framework, it is assumed that effective FFS will lead to increase rice productivity by smallholder farmers.

However, effectiveness of FFS is dependent on the appropriate training/competence of extension officers labeled as facilitators; effective participation of farmers in FFS and the extent to which new or improved technologies/knowledge/practices influence farmers' attitudes and overall-behavioral change; as well as access to required inputs. The factors are based on Tanzanian socio-economic, political, cultural and environmental characteristics which include farmer's socio-economic characteristics and technological

factors as access to required inputs which are the independent variables that influence the dependent variable (the effectiveness of FFS on smallholder rice farmers' agricultural productivity (Mugenda, 2009).

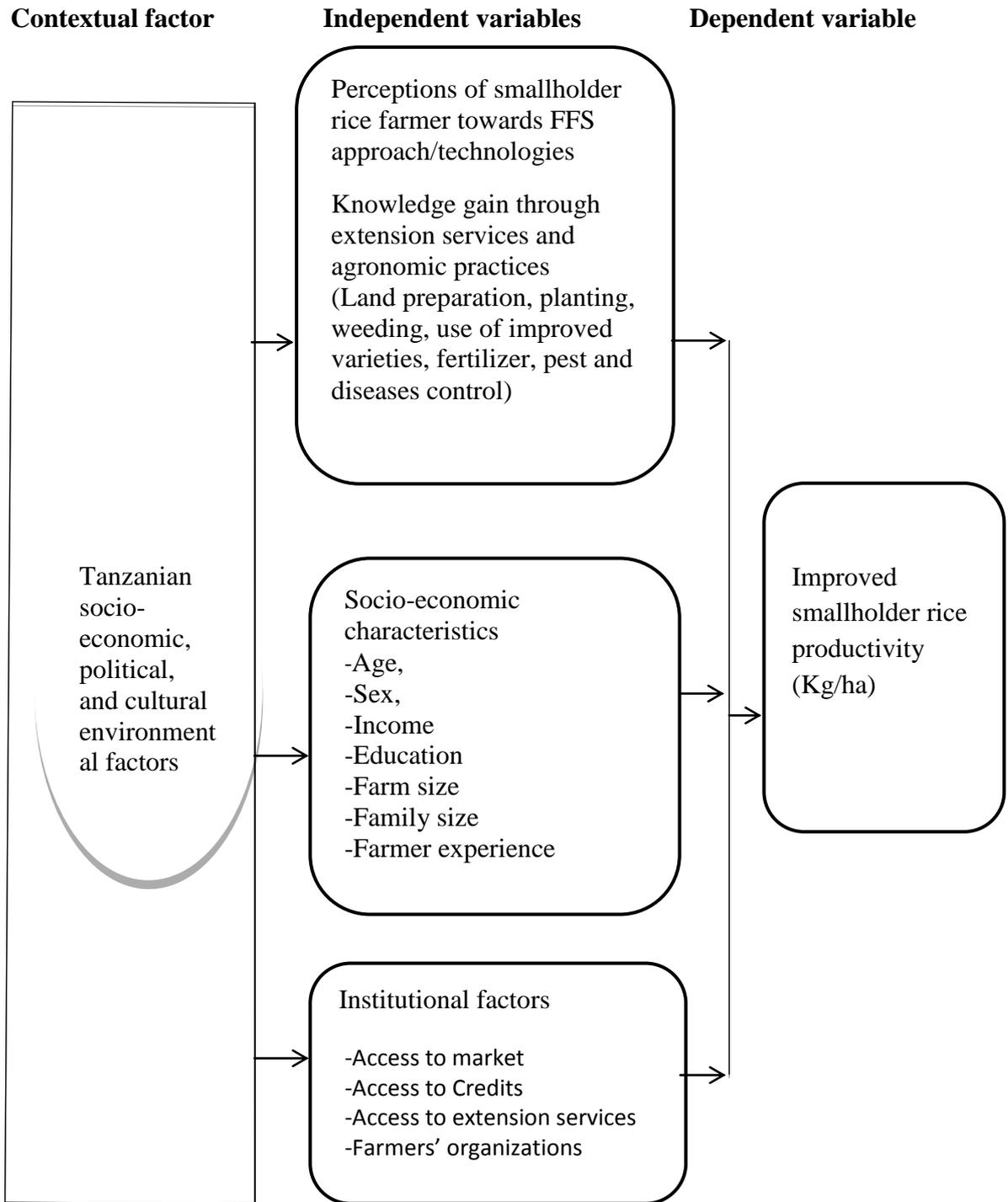


Figure 1: Conceptual Framework

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Overview

This chapter reviews relevant literature pertaining to the concept of FFS, effectiveness of FFS in improving rice productivity, socio-economic characteristics of smallholder rice farmers that enhance knowledge acquisition and utilization of improved rice technologies, extent of utilization of acquired improved rice technologies, knowledge and/or practices between FFS and non-FFS graduates, comparison of rice productivity Kg/ha between FFS and Non- FFS graduates and the perception of smallholder rice farmers on the effectiveness of FFS in improving rice productivity.

2.2 The Concept of Farmer Field School

Farmer Field Schools consist of groups of farmers about 25- 30 per group who meet regularly with a facilitator during the cropping season to study a particular topic from conservation agriculture, organic agriculture, animal husbandry, and soil husbandry, to income generating activities such as handicrafts. These topics help in sharpening the farmers' ability to make critical and informed decisions and sensitizing farmers about new ways of thinking and problem solving (Gallagher *et al.*, 2005). Farmer field schools are sometimes viewed as “schools without walls” where facilitators use experiential learning, group dynamics, and simple experimentation to “co-learn” with farmers. The process involves field days where neighbours and officials are invited and taught by the farmers, and culminates in a graduation ceremony (Davis, 2006).

According to Gallagher (2005), the broad problem which FFS was designed to address, was lack of knowledge among farmers relating to agro-ecology. It is strongly contended

that FFS help farmers increase their family income by educating them on better growing techniques, crop diversification, and other productivity enhancing practices (van de Fliert and Braun, 2005; Ebewore, 2011; David, 2005). The thrust of using FFS in Tanzania revolves around empowering farmers to be their own technical experts and to adapt potentially applicable technologies to their own particular conditions by enhancing farmers' knowledge (technical and socio-economic), decision making and problem solving skills, and stimulating collective action that ultimately lead to increased uptake of agricultural innovations (URT, 2011). District-level extension services are now using FFS approach as a method, which improves farmers' participation and practical learning. There are, however, important variations in the quantity and quality of delivery between and within districts.

The (FFSs) approach in Tanzania was first introduced in 1998 piloted in the Southern Highlands under Southern Highlands Extension and Rural Financial Services Project (SHERFS) which was funded by the International Fund for Agricultural Development (IFAD) (Mvena *et al.*, 2013). Thereafter, a curriculum development workshop for farmer participatory training was held at Mkindo Farmers' Training Centre (FTC) in Morogoro region in 1999, by the Indonesian Farmers' Fund (Kaihura *et al.*, 2006).

2.3 Effectiveness of FFS

Persons belonging to different disciplines view effectiveness differently. To agricultural extension, effectiveness refers to the extension system ability to achieving goals (results) (Schewartz and Kampen, 1992). Similarly, Erlendsson (2002) defined the term effectiveness as the measure to produce result that is wanted or intended for a successful result. Furthermore, Erlendsson argued that, effectiveness can be measured to which a programme or project is successful in achieving its objectives. Many studies show that it

is difficult to measure effectiveness since it is a complex concept and it is even difficult in agricultural development since it depends on many other factors. Therefore, this study conceived effectiveness as the performance of FFS graduates meeting their goals in terms of acquisition and utilization of improved rice production technologies, knowledge and/or practices resulting in increased production and productivity of rice.

A Study done by Mattee *et al.* (2013) showed that, effectiveness of FFS approach to a large part is reflected by the rate of adoption of improved agronomic practices such as land preparation, proper planting and weeding, improved varieties, use of inputs as well as pest and diseases control. Leeuwis and Rolling (1998), while comparing FFS approach to the Training and Visits approach (T&V) in Zanzibar, concluded that FFS had many promising attributes which give it much higher chances of being effective as an extension methodology in Sub-Saharan African than T&V. Bunyatta (2004) found out that, FFS approach has the potential to empower farmers to become self-reliant and improves their problem solving abilities. Evaluation of its effectiveness on the basis of fiscal sustainability, the study concluded that, FFS approach was effective in knowledge acquisition, technology adoption and diffusion to enhanced agricultural productivity. The approach is gaining prominence as an extension approach in most developing countries and its degree of effectiveness in influencing farmer's uptake of knowledge for future use is promising.

Similarly, Feder and Quizon (2004) also concluded that FFS graduates benefited significantly with higher knowledge acquisition of better pest management in Indonesia. Mwangi and Onyango (2003), conducted a similar study and found that the adoption of technology on organic and inorganic fertilizer combinations by FFS farmers was significantly higher than those of non-FFS. It is important that FFS graduates accrue much

more additional benefits which can be difficult to quantify in monetary terms. According to Mattee *et al.* (2013), the acquisition of effective knowledge by FFS farmers is the most successful extension approach used in terms of technology adoption with increased productivity, output and income.

2.4 Socio-Economic Characteristics of Smallholder Farmers Influencing Knowledge Acquisition and Utilization of Related Improved Rice Technologies/ Knowledge and or Practices

On the basis of literature review socio-economic characteristics of smallholder farmers such as sex, age, marital status, farm size, occupation, income and level of education have been reported to have an influence on the utilization of technology and consequently increased productivity.

2.4.1 Sex

Most studies have demonstrated that sex is one of the socio-economic characteristic that influence acquisition and utilization of agricultural/rice technologies and related practices aimed at improving agricultural productivity (Chirwa, 2005). According to Davis *et al.*, (2010) sex did not have a significant impact on participation in technology utilization in Kenya and Tanzania. However, in Uganda female-headed households were less likely to participate in the farmer field schools. However, Doss and Morris (2001) report that the utilization of technologies depends primarily on access to resources, rather than on sex. If utilization of improved rice depends on access to land, labour, or other resources, and if in a particular context men tend to have better access to these resources than women, then in that context the technologies will not benefit men and women equally. Sex affects technology adoption since the head of the household who happen to be mainly men is the primary decision maker and this have more access to and control over vital production

resources than women due to socio-cultural values and norms (Tesfaye *et al.*, 2001; Mesfin, 2005; Omonona *et al.*, 2006; Mignouna *et al.*, 2011). For instance, a study by Obisesan (2014) on the utilization of technology found that, sex had a significant and positive influence on adoption of improved cassava production in Nigeria. His results were in conformity with those of Lavison (2013) which indicated male farmers were more likely to adopt organic fertilizer than their female counterparts.

2.4.2 Age

Age is one of the socio-economic characteristics affecting the utilization of technology/knowledge and or practices. Age is mostly associated with farmers' access and utilization behaviour (Khanna, 2001). Generally, young farmers are keen to adopt new knowledge and information faster than older farmers (Khanna, 2001). It may also be that older farmers are more risk averse and less likely to be flexible than young farmers and thus have a lesser likelihood of information utilization including related new technologies. Generally, as ones age increases, his/her physical strength tends to decline and this adversely affects the rate of technology/knowledge acquisition and as well as the utilization of new ideas (Sichoongwe *et al.*, 2014). Old farmers may see farming as a way of life, whereas young farmers may see it more of a business opportunity. This means that elderly farmers will not diversify while younger farmers will seek to diversify. Similar to these hypotheses previous studies (Fetien *et al.*, 2009; Ibrahim *et al.*, 2009; Aneani *et al.*, 2011) found that older farmers were less likely to diversify crops compared to younger farmers (Khanna, 2001). Furthermore, elderly farmers often have different goals other than income maximization, hence the lack of interest in adoption of income-enhancing technologies.

It is generally believed that with the increase in age the individual becomes mentally mature and takes rational decisions and this can lead to a positive effect on utilization of technology/knowledge to boost agricultural production/productivity (Ogungbile *et al.*, 2002 and Oloruntoba, 2000). According to Byron *et al.* (2005), elderly farmers seem to be somewhat less inclined to participate and adopt new technologies practices relative to younger ones. Adesina and Baidu-Forson (1995) point out that age is a primary latent characteristic for participation in FFS and adoption of decisions of a new agricultural technology/knowledge and the utilization of acquired improved farm practices. Generally, the effect of age in participation stem from accumulated knowledge and experience of farming system obtained from years of observation and experimenting with various technologies (Harper *et al.*, 1990).

2.4.3 Marital status

Marital status of farmers has an influence on participation in agricultural programmes/projects and the utilization of acquired agricultural technology/knowledge and or practices (Muraleedharan, 2006). Unmarried/single women and women heads of households participate more in community projects compared to married women (Muraleedharan, 2006). Nevertheless, married individuals participate more in technology development than non-married due to the support from a marriage partner than singles and other groups who lack support (Nathaniels, 2005; Matata *et al.*, 2010; Solomon, 2008).

Hence, marital status of women could be an important factor in their participation in FFS and adoption of technologies/knowledge and as well as the utilization of agricultural practices (Ani *et al.*, 2004).

2.4.4 Household size

Study done by Rahman *et al.* (2002) revealed that the utilization index may be either positively or negatively related to the household size depending on the nature of the age structure and the amount of labour contributed among members. On the other hand Banmeke (2003) asserted that a large household could probably serve as an insurance against short falls in supply of farm labour. Household size has a great role to play in family labour provision in the agricultural sector (Sule *et al.*, 2002).

2.4.5 Farm size

Farm size is an indicator of wealth and perhaps a proxy for social status and influence within a community. Farm size can affect and in turn be affected by the other factors influencing adoption or acquisition and utilization of new/improved agricultural technology and related practices (Lavison, 2013). Many studies (Gabre-Madhin and Haggblade, 2001; Alamu *et al.* 2002; Rogers, 2002; Ahmed, 2004; Uaiene *et al.*, 2009; Mignouna *et al.* 2011), have reported a positive relationship between farm size and the utilization of agricultural technologies. Farmers with large farm size are likely to adopt new technologies as they can afford to devote part of their land to try them unlike those with less farm size (Uaiene *et al.*, 2009). However, some studies have shown a negative influence of farm size on adoption of new agricultural technologies. Small farm size may provide an incentive to adopt a technology especially in the case of an input-intensive innovation such as a labour-intensive or land-saving technologies. Farmers with small land may adopt land-saving technologies such as greenhouse technology, zero grazing among others as an alternative to increased agricultural productivity (Mugisa-Mutetikka *et al.*, 2000; Bonabana- Wabbi 2002; Samiee *et al.*, 2009). The above studies showed that farm size did not affect Integrated Pest Management (IPM) adoption implying that IPM dissemination may take place regardless of farmers' scale of operation. According to

IFPRI Davis *et al.* (2010) farm size did not have a significant impact on the probability to participate in an FFS in Kenya and Tanzania and for all countries combined, but it was positively related to FFS participation in Uganda.

2.4.6 Occupation

Generally, off farm jobs have been shown to have a positive impact on adoption of technologies. This is because off-farm income acts as an important strategy for overcoming credit constraints faced by the rural households in many developing countries (Reardon *et al.*, 2007). Off-farm income is reported to act as a substitute for borrowed capital in rural economies where credit markets are either missing or dysfunctional (Ellis and Freeman, 2004; Diiro, 2013). However, not all technologies have shown a positive relationship between off-farm income and their adoption. Some studies on technologies that are labour intensive have shown negative relationship between off-farm income and adoption. According to Goodwin and Mishra (2004) the pursuit of off-farm income by farmers may undermine their adoption of modern technology by reducing the amount of household labour allocated to farming enterprises.

Furthermore, the opportunity cost faced by farmers who engage in non-farm activities may be higher, and therefore such farmers may not be able to participate in FFS activities and may not be able to adopt improved rice technologies promoted by the field schools. A further limitation to the utilization of technology may be the relative high off-farm income contribution from sources outside of agriculture, which could influence the way that farmers approach the utilization of high input technologies. The above are supported by findings of Eastwood *et al.* (2006) and Sasa (2009). The low level of reliance on own-farm income may contribute to low adoption rates of technologies that result in increased complexity of farming systems and these are perceived to add to labour requirements.

Off-farm income, may therefore adversely affect the need for adoption of certain crop production practices. Low farm productivity and off-farm income are therefore inter-related. In addition, poor farm productivity may result in abandonment of farming activities and subsequent total reliance on off-farm sources of income (Baiphethi and Jacobs, 2009). The relevance of new or improved technologies to farmers and the need for the farmers to improve their situation are therefore important driving factors of adoption (Ndove *et al.*, 2006).

2.4.7 Income

Income may enhance participation of smallholder farmers in agriculture extension activities including FFS, improving access to farm inputs and utilization of improved agricultural technologies and accompanied practices (Yahaya, 2001). Generally, farmers with higher income are more likely to be early adopters of new practices than farmers with low income. According to Yahaya (2001), a farmer's income level determines the degree of utilization of new technologies/knowledge and or practices. For instance, a farmer may be convinced of the benefit of fertilizer application to crops but will not utilize the practice due to lack of sufficient capital or credit to purchase the fertilizer. This implies that the inability of most farmers to utilizing improved technologies/knowledge could be attributed to their low or poor income. Thus, a farmer with high level of income is likely to acquire and utilize the improved agricultural technologies and practices and improve crop productivity compared to those with less income (Mujuni *et al.*, 2012). In addition, farmers with low income tend to offer labour to others so as to supplement their immediate cash requirement. A number of studies that have been conducted report positive contribution of income to household's participation and adoption of improved agricultural technologies (Mulugeta, 2009).

2.4.8 Level of education

Education represents the level of formal schooling completed by the respondent while lack of formal education depicts failure of an individual to attend school. Lack of education has been associated with negative impact on the utilization of technology, while more years of education have been found to have positive influence on effective participation in development oriented activities such as FFS and adoption of innovations (Namara *et al.*, 2005) including agricultural technologies that require intensive management skills (Caswell *et al.*, 2001). Education has been found to have a relationship with utilization of agricultural technologies/knowledge and or practices Adeogun *et al.* (2010). Furthermore, Adeogun in his study on utilization of cocoa rehabilitation technology among cocoa farmer found that of the 381 respondents, only about 29.1% were educated. Thus, suggesting that cocoa technology was less utilized by farmers with low level of education while farmers with higher levels did very well in terms of technology acquisition and utilization. Studies have shown that farmers with low education level are less likely to utilize agricultural technology and practices. Adeogun *et al.* (2010), in the study on utilization of cocoa rehabilitation technology among cocoa farmers indicated that, of the 381 respondents, only about 29.1% were educated. Thus, suggesting the relatively low level of education among the respondents. They said this negatively impacted on the utilization level of the respondents since literacy level is known to influence utilization capacity. Where the respondents' level of education is low as in the above study and studies by Sule *et al.* (2007), and Tologbonse (2004), one thing is obvious is that, utilization level will also be low if the measures enunciated by Adeogun (2010) are not utilized. These studies have also shown that, low level education is a common phenomenon among peasants in the rural sector.

Generally, it is argued that exposure to education increases a farmer's ability to obtain, process, and use information relevant to the adoption of improved rice technology and associated or accompanied practices. It is thus perceived that the higher the education level the lower the complexity involved in understanding the technology packages (Bonabana-Wabbi, 2002). According to FAO (2010), farmers with more education get higher gains in income by using new technologies and they adjust more rapidly to technological changes. So, educated farmers may be more logical in their decisions regarding the adoption of new agricultural technologies with better cognitive values and of good foresight. Furthermore, they can easily get new information from print as well as mass media and adopt the same in their fields in order to increase farm production and farm income.

2.5 Utilization of Acquired Improved Rice Technologies, Knowledge and/or Practices by Graduate FFS Smallholder farmers

According to Daud and Yusoff (2010) knowledge is the process of absorbing and storing new information in memory, the success of which is often gauged by how well the information can later be remembered (retrieved from memory). The process of storing and retrieving information depends heavily on the representation and organization of the information. As revealed by Mattee *et al.* (2013) proper utilization of acquired knowledge/technology by FFS facilitates farmer's empowerment in agricultural decision-making; strengthening farmers' problem-solving and management ability; facilitating self-experimentation and adoption of technologies and/or improved farming practices; enhanced interaction among women and men farmers; and improved community mobilization for planning and action including monitoring and evaluation.

Field schools assume that farmers already have a wealth of experience and knowledge which facilitators can tap and make use of to enhance farmer learning and experimentation or continued practice. FFS harnesses this knowledge through the process of participatory agro ecological analysis and learning by doing. Participatory training and hands-on experimentation are key principle of the FFS, and the purpose of the training is to make the graduates confident experts and farmers' experience to be integrated into the programme (FAO, 2000). According to Rola *et al.* (2002), FFS trained farmers fared better in a test of the knowledge learnt compared to the non FFS trained farmers. They attributed this to the characteristic of the FFS approach of using adult training techniques of “educating rather than instructing” which makes it suitable for passing on “knowledge-intensive technologies” to all categories of farmers even those who have little or no formal schooling. Thiele *et al.* (2001), Rola *et al.* (2002), Mwangi, Onyango, Mureithi, and Mungai (2003) and Feder *et al.* (2004) reported that FFS graduates benefited more from the significantly higher knowledge acquisition compared to non-FFS farmers due to their participation in FFS training. According to Godtland *et al.* (2003) technical knowledge among FFS graduates is not only valuable as an outcome impact indicator, but could also serve as a reasonably reliable predictor of the adoption of management practices, particularly for crops and technologies where there is a relatively long time lag between adoption and impact.

It is therefore important to note that FFS graduates accrue many more additional benefits which can be difficult to quantify in monetary terms. For example, Mwangi *et al.* (2003) reported that FFS graduates gained superior leadership skills and became more cohesive as a group than the non-FFS farmers. In addition, a study by David and Asamoah (2011) on farmer knowledge as an early indicator of IPM adoption suggests that the level of farmers' knowledge after FFS can provide early indications of the adoption of ICPM practices, it is therefore important to determine under what circumstances and conditions

assessing farmer knowledge can be a useful first step in FFS impact assessment given the complex nature of the relationship between knowledge and practice. They further asserted that improving farmers' understanding of ICPM principles acted as a strong catalyst for adoption because farmers were already familiar with nearly all practices, although they generally lacked an understanding of the underlying processes and concepts. It can be hypothesized that farmers are likely to delay integrating recently acquired knowledge into existing knowledge systems and applying it in their farms where many of the technical skills, information and knowledge farmers acquire from FFS are new, thereby leading to low adoption initially. Most of the interventions introduced by the FFS are skills or knowledge based, as was the case with most of the cocoa ICPM practices, farmer knowledge is likely to be a good indicator of uptake. Where input technologies (e.g. new varieties, fertilizer) are the key components of ICPM practices, farmer knowledge is less likely to be strongly associated with technology utilization.

2.6 Comparison of Rice Productivity between FFS and Non FFS Graduates

Comparison of rice productivity among FFS and non FFS members is the important aspect in the determination of effectiveness of FFS approach as stated earlier. Crop productivity is defined as the value of production per unit area (Davis *et al.*, 2010; Nyamai *et al.*, 2012). Based on the Indonesia-experience, Feder *et al.* (2004) indicated that there is an insignificant impact attributed by the FFS approach. They further argue that it is difficult for FFS graduates to achieve significant yield gains when there are systemic factors causing yield declines such as decline in soil fertility, increased plant diseases and climate change. In addition, there is limited or conflicting evidence as to the FFS effect on productivity and poverty, especially in many places (Davis *et al.*, 2010; Godtland *et al.* (2004). In contrast, a Meta-analysis of 25 impact studies commissioned by FAO concluded that the majority of studies reported sustained and consistent reduction in

pesticides use (under IPM) attributable to be the effect of training in the number of cases; there was a convincing increase in yield due to training. Moreover, evaluation of the impact of FFS in Indonesia found that although the overall rice yield of all farmers declined by an average of 10% from 1991 to 1999, FFS graduates obtained consistently higher yields compared to the average of Java rice farmers (Feder *et al.*, 2003).

Further to the above, an impact assessment study done by IFAD in Zanzibar in 2013 in respect to Agricultural Services Support Programme and Agricultural Sector Development Programme-Livestock (ASSP/ASDP-L) revealed that as a result of effective women and men smallholder farmers' involvement in FFS, beneficiaries were able to increase productivity of both crop and livestock enterprises by three or four fold as a result of improved access to agricultural knowledge and technology. For example, rice and banana production increased from 256 and 200 Kg per hectare to 1120 and 660 kg per hectare respectively after their involvement in FFS (IFAD, 2013). On the other hand, a number of FFS beneficiaries reported increases in milk yields by 67% as a result of improved access to improved knowledge and skills, access to improved health care, access to artificial insemination and better price incentive.

2.7 Perception of Smallholder Rice Farmers on the Effectiveness of FFS in Terms of Acquisition and Utilization of Improved rice Technologies; and Improved Rice Productivity

Perception generally refers to how people select, organize and interpret information gained through the senses or experience (Encyclopaedia Britannica, 2004). Perception of farmers towards a new technology is a key precondition for adoption or acquisition of knowledge to occur. According to Nyanga (2011), perceptions are location specific due to heterogeneity of factors that influence them such as culture, education, gender, age,

resource endowments and institutional factors. Mignouna *et al.* (2011) argue that, farmers who perceive a technology to be consistent with their needs and compatible to their environment are likely to adopt since they find it as a positive investment. Farmers' perception about the performance of the technologies significantly influences their decision to adopt them. This further implies that the mental attitude of the farmers are not actually shaped by misconceptions of technology, but rather because of their firm understanding of what is good and what is bad according to their own realities. According to Mish (2001), perception is the conscious understanding of something.

Huluka and Negatu (2016), point out that some farmers could be more reluctant to adopt new technologies than others not necessarily because of lack of knowledge but because of their cost benefit analysis of the technologies. Studies show that modern technologies such as High Yielding Varieties (HYV) are less stable and riskier compared to the traditional varieties and hence poorer farmers are exposed to greater dangers of crop failure and hunger with HYVs than with local technology (Duflo *et al.*, 2006).

Huluka and Negatu (2016) argue that some farmers tend to limit their level of technology adoption to their risk absorbing capacity, which is, in turn, the function of their existing assets. In addition, most farmers have expressed their concern over the inappropriate timing of technologies supply, poor quality of the technologies, supply of inappropriate technology for their agro ecology, as well as the increasing trend of the prices of technologies. Thus, it could be argued that smallholder farmers are not utilizing technology packages fully not because of demand side problems, but rather mainly because of the supply side problems. They further asserted that there is no linear relationship between increased knowledge acquisition and increased technology utilization. Generally, the desired outcome of FFS is to improve knowledge of the

smallholder farmers as means to increase their agricultural technology utilization and hence their productivity. Studies by Rola *et al.*, (2002), Feder *et al.* (2004), Duflo *et al.* (2006), Todo and Takahashi (2011) reveal that although knowledge is important as predisposition in utilizing farm technologies, there are other conditioning factors which influence the timing and amount of technology utilization such as resources and availability of such technologies at the right time.

Generally, knowledge can be translated into practices if a set of enabling factors and conditions exist, including farmers' positive perception of the technology benefits, access to complementary inputs, availability of crop insurance scheme, arrangement of credit facilities and favourable output markets as incentive for fully utilizing the technologies. According to Sosu (2004) farmers' perception is essential for successful development strategies. Sosu further points out that many promising agriculture policies have failed because they were not in line with farmer's needs and perception. It is therefore important that for any new technology to be introduced to farmers, they should be involved in its evaluation to find its suitability to their circumstances (Karugia *et al.*, 2004).

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Overview

This chapter gives an overview of the study area, describes research design, definition of study population, sampling procedures and sample size, data collection, data processing and analysis.

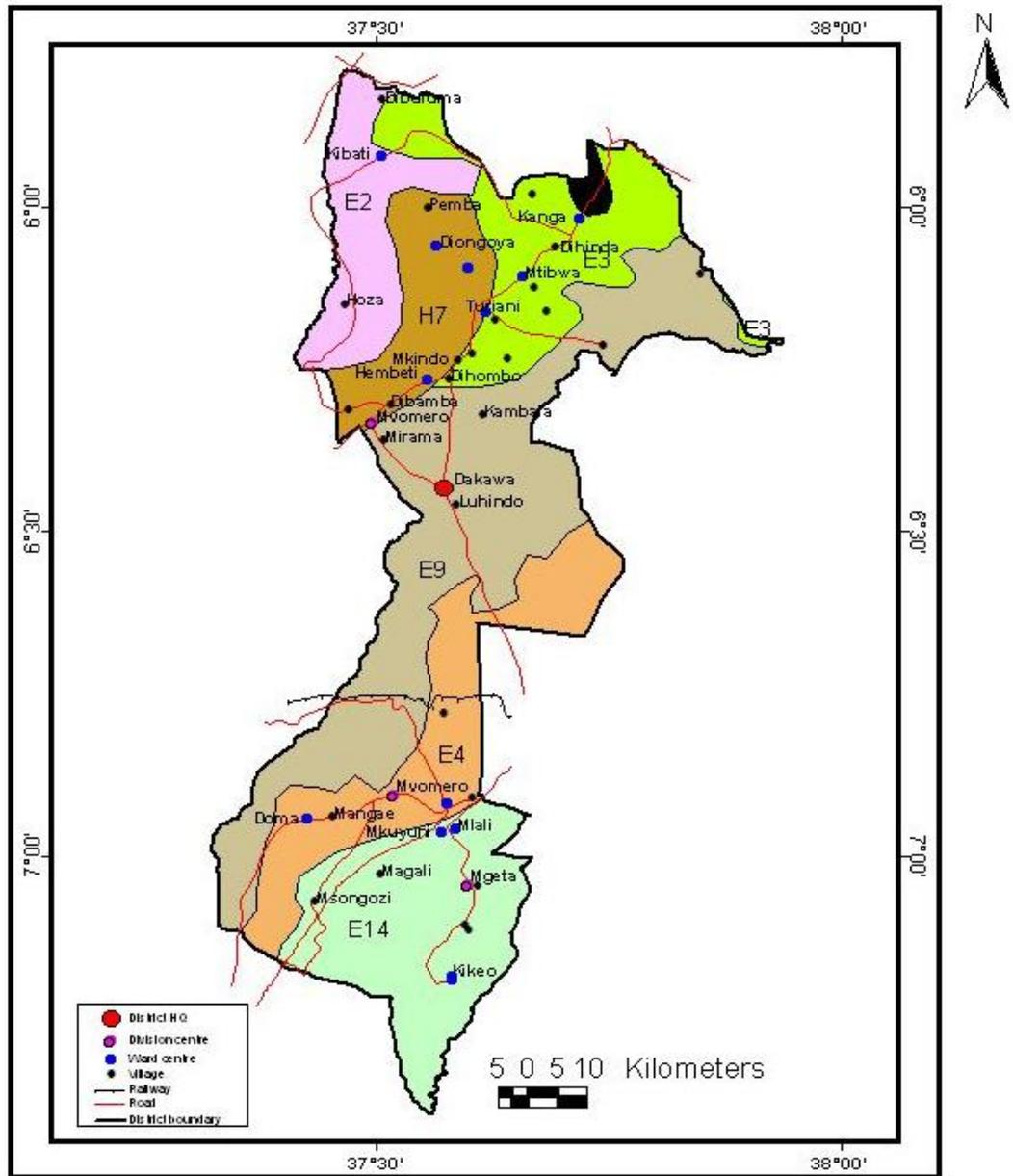
3.2 Description of the Study Area

This study was conducted in Mvomero District, which is one of the seven districts in Morogoro region, Tanzania. Other districts include, Morogoro Rural, Kilosa, Kilombero, Ulanga, Gairo and Morogoro Municipality. According to Mvomero District Council (MDC)(2016), the district is located in the North East of Morogoro region and lies between $8^{\circ}.00$ and $10^{\circ}.00$ latitudes South of the equator, and between longitudes $37^{\circ}.00$ and 28.22 East. The district altitude ranges between 400 to 2 000 meters above sea level and temperature ranges between 18°C - 30°C . The district has a total area of 6632.9 km^2 with an arable land of 5493.75 km^2 (MDC, 2016). Rainfall in the district is bimodal with short rains falling between October to December and the long rains between February and May. Rainfall ranges 600 and 2 000 mm.

Mvomero District is made up of four (4) divisions, 30 wards, and 130 villages. According to the Tanzania Population and Housing Census of 2012 (URT, 2012), the district had a total population of 312 109 of whom 159 910 were males and 156 188 were female with an annual growth rate of 2.6. The district is made up of 58 314 households with an average family size of five people (URT, 2015). Economically, agriculture employs about 80-90%, of the district population. Generally, crops grown in the district include

sugarcane, rice, maize, sisal and sorghum cultivation (MDC, 2016). The district was appropriate for the study based on the fact that, FFS have consistently been used since their inception compared to other councils; and it is an area believed to have FFS graduates who are still making use of the knowledge gained and technologies adopted. The study involved 6 villages which are Hembeti, Kigugu, Bungoma, Kisala, Mlaguzi and Kambala. The above mentioned villages were selected on the basis of availability FFS programmes/activities (e.g. existence of FFS rice graduates and Non FFS graduates in the proximity etc.). Additionally, selection was based on existence of active women and men smallholder rice farmers.

AGRO-ECOLOGICAL ZONES OF MVOMERO DISTRICT



AEZ CODE	PHYSIOGRAPHY	ALTITUDE (m)	RAINFALL (mm)
E14	Very strongly dissected mountain block	500-2000	1000 - 1200
E2	Undulating to rolling plains and plateaux	500-1200	800 - 1000
E3	Flat to rolling plains	200-750	800 - 1000
E4	Level to rolling plains	200-1000	800 - 1000
E9	Flat alluvial plains with homogenous sedimentation pattern	400-500	800 - 1000
H7	Undulating to hilly plateau with strongly dissected crests	1500-2300	800 - 1000
RT	Rocky terrain		Not applicable

Figure 2: A map of Mvomero District showing study area

3.3 Research Design

This study used the cross-sectional research design. The design allows collection of data at one point in time from the sample selected to represent a large target population (Babbie, 2010). The above design was considered appropriate because it is cost effective and it is less time consuming and can be used for a descriptive study as well as for a collection of information to allow determination of relationship between variables (Kumar, 2011).

3.4 Definition of Study Population

The study population consisted of all the rice FFS graduates and non FFS smallholder rice farmers in the selected villages of Mvomero District who have been actively involved in rice farming between the 2013 and 2016 farming seasons.

3.5 Sampling Procedures and Sample Size

The study used simple random sampling procedure to select wards, villages and sample of individuals. Mvomero district comprises of 30 wards of which only 11 have FFS. For the purpose of this study, a comprehensive list of all smallholder farmers in Mvomero District was obtained from the District Agricultural Office. The list of FFS graduates were obtained from the Principal of Mkindo farmers' Training Centre. Three wards were selected randomly from 11 wards in which the FFS programme was implemented. In this context, three villages were selected randomly from each ward making the total of six (6) villages. Likewise, sample respondents were selected using simple random sampling method from both groups of FFS graduates and non FFS farmers in each village using probability proportional to size (PPS). From 274 FFS graduates, a sample of 60 respondents of was proportionally selected across the six FFS villages under the study areas as shown in Table 1. Likewise, a sample of 60 NFFS graduates were selected across

four villages within the district under the study area using proportional to the size as shown in Table 1 respectively. The total sample size was 120 respondents (60 from FFS graduates and 60 non-FFS farmers). According to Matata *et al.* (2001) having 80 - 120 respondents are adequate for most socio-economic studies in Sub-Saharan Africa household.

Table 1: Study population and sample of FFS and non-FFS smallholder farmers in Mvomero

Study Wards	FFS Graduates			Non-FFS Graduates		
	FFS Villages	Population	Sample	NFFS Villages	Population	Sample
Mkindo	Hembeti	80	18	Kisala	250	19
Hembeti	Kigugu	58	13	Mlaguzi	255	20
Sungija	Komtongo	50	11	Kambala	125	9
	Dihombo	36	8	Kilimanjaro	155	12
	Bungoma	25	5			
	Mkindo	25	5			
Total		274	60		755	60

Note: Adapted from Bunyatta 2006

3.6 Data Collection Procedures

3.6.1 Primary data

Primary data were collected in keeping with the study objectives. Generally, the study used the mixed methods approach whereby both qualitative and quantitative methods were used to collect primary data. For quantitative data an interview schedule was developed and administered through face to face interviews with farmer's respondents while qualitative data were collected through in-depth interviews and Focus Group Discussions (FGDs) with key informants including Village/Ward extension officers using a check list and FGD guide respectively. The key informant interview and FGD were guided by the study objectives.

Pre-testing of instruments/questionnaire was done in Wami village Dakawa ward, the wards has similar field condition as the study villages, whereby, 10 randomly selected farmers participated, five FFS and Five NFFS these were later not included in the final study. The above was done in order to establish the validity and reliability of the research instrument. In addition, it aimed at identifying discrepancies and ambiguities in wording of items, clarity and comprehensiveness so as to obtain the correct reaction by respondents with respect to certain items of the questionnaire. After pre-testing, the instruments was reviewed and revised accordingly and used for data collection during the actual survey.

Primary data pertaining to socio-economic characteristic of farmers, extent of utilization of acquired improved rice technologies and practices and rice productivity levels were collected using interview schedule. Further to the above, farmers' perceptions on FFS as a participatory extension approach was measured based on their views and this involved use of a five point Likert scale whereby farmers perception was ranked from strongly agree, agree, undecided, disagree and strongly disagree. This scale was later reduced to three point scale during data analysis by combining agree and strongly agree and disagree with strongly disagree.

3.6.2 Secondary data

Secondary data were collected from national, regional and community levels. Other data also was gathered from publications of similar studies available on internet. Others were reports or records from FFS staff and offices, review of relevant studies obtained at Sokoine National Agriculture Library (SNAL), working documents available at village and district offices.

3.7 Data Processing and Analysis

3.7.1 Quantitative data analysis

Data analysis process follows various procedures with regard to the specific objectives and nature of the information reported. Data gathered by the use of questionnaire were cleaned, edited, coded and entered in to the computer software Statistical Package for Social Sciences (SPSS) version 20. SPSS was used to determine descriptive statistics such as frequency, percentages, mean, minimum and maximum. In addition, it was used for inferential statistics and independent t-test. Generally, the descriptive statistics were to help address specific objectives one and two. Frequencies and percentages were calculated to determine extent of utilization of rice technologies among FFS graduates. Objective three was analysed by the used of descriptive statistics such as frequency, percentages, mean, minimum and maximum and inferential statistics and independent t-test while the forth objective was analysed using descriptive statistics such as frequency and percentages. The significance level of $\alpha = 0.05$ was employed in deciding whether there was significant difference among the variable.

3.7.2 Qualitative data analysis

Qualitative data collected through key informant interviews and FGDs were analyzed using content analysis particularly narrative analysis. In this way, recorded dialogues with the respondents were broken down into meaningful units of information or themes and used to supplement the findings obtained through interview schedule.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

The chapter presents and discusses the major results of this study according to study objectives. The presentation falls under four main sections. The first section describes the socio-economic characteristics of the respondents. Section two describes the extent of utilization of acquired improved rice technologies, knowledge and/or practices between FFS and non-FFS graduates while section three provides the comparison of levels of rice yields per hectare between FFS graduates and non- FFS graduates. The fourth section presents the perception of smallholder rice farmers on the effectiveness of FFS in terms of acquisition and utilization of improved rice technologies; and improved rice productivity.

4.1 Socio-economic Characteristics of Smallholder Farmers that Enhance Knowledge Acquisition and Utilization of Improved Rice Technologies/ Knowledge and or Practices

The socio-economic characteristics of the respondents namely FFS graduates and non-FFS farmers are shown in Table 2. This study involved 60 FFS graduates and 60 NFFF farmers. The findings indicate that more than half (51.7%) of the FFS graduates were females and (48.3%) were male. Similarly, there was a higher number (68.3%) of male NFFS respondents compared to female respondents (31.7%). Results in Table 3 show that more than two thirds (68.3%) of the respondents (both FFS/NFFS) were married. Generally, household size ranged from one to more than six people more than half (55.8%) had 4-6 individuals. With regards to level of education, it was expected that the extent to which respondents were educated would influence their adoption of agricultural technologies (Rogers, 2003). However, Rogers (2003) argued that educated farmers have more contact with extension officers than farmers with less education. The study results

(Table 3) show that the majority (FFS and NFFS) respondents, about three quarter (74.2) had attained primary education, less than a fifth (19.2) had attained secondary education. The results also show that a few (5.8%) of the respondents had no-formal education and very few (0.85%) had college (Certificate and Diploma). From these findings one could say that most rural children after completing primary education they remained in the villages and took up farming activities, while those who finished secondary education tended to migrate to urban areas to look for jobs.

According to Table 3, gross income per annum for respondents ranged from Tsh 400 000 to above 100 000. Of the FFS respondents, two fifths (40.0%) indicated to have above Tsh 100 000 per annum while about a quarter (26.7%) of the NFFS graduates reported earning an annual income of between Tsh 4001 to 600 000. The results further show that, two fifths (40.0%) of the FFS graduates had higher annual incomes of Tsh 100 000 a proportion relatively higher than that for the NFFS graduates whereby only about a quarter (26.7%) had such an income. According to Amujal *et al.* (2003), farmers with more income are less likely to adopt IPM strategies because they generally had other off-farm income generation activities. With respect to main sources of income majority (97.5%) of the respondents (both FFS and NFFS) indicated that their main sources of income was crop production. Result in Table 3 further show that land size ranges from <0.5 hectares to >1.5 hectares). Of all respondents (FFS and NFFS) slightly less than half (46.7%) and (40.0%) indicated that they owned land with the size between 1.1-1.5 hectares respectively however, they also borrowed/hired land when extract need arises. In respect to those that do not own land, indicated they borrow/hire land for their crop production. Similar results were obtained by the World Bank (1994) which indicated that 93 percent of all the farmers in Tanzania cultivated each less than 2.0 hectares.

Table 2: Respondents' socio-economic characteristic (n=120)

Variable	Farmer Field School (FFS) respondents		Non-Farmers Field School (NFFS)respondents	
	n	%	n	%
Sex				
Male	29	48.3	41	68.3
Female	31	51.7	19	31.7
Age				
18-25	3	5.0	6	10.0
26-36	14	23.3	17	28.3
37-50	28	46.7	24	40.0
51 and above	15	25.0	13	21.7
Education levels				
Non- formal education	1	1.7	6	10.0
Primary education	45	75.0	44	73.3
Secondary education	13	21.7	10	16.7
College (Certificate and Diploma)	1	1.7	0	0.0
Marital status				
Single	5	8.3	11	18.3
Married	47	78.3	41	68.3
Window	3	5.0	4	6.7
Separated	5	8.3	4	6.7
Living experience				
3 – 10	5	8.3	4	6.7
11 – 20	15	25.0	8	13.3
More than 20	40	66.7	48	80.0
Household size				
1 – 3	17	28.3	25	41.7
4 – 6	37	61.7	30	50.0
More than 6	6	10.0	5	8.3
Income in TShs		0.0		0.0
Below 400 000	7	11.7	9	15.0
400 001-600 00	10	16.7	16	26.7
600 001-800 00	6	10.0	10	16.7
800 001-1 000 000	13	21.7	13	21.7
Above 1 000 000	24	40.0	12	20.0
Land ownership				
Do not own	6	10.0	5	8.3
0.5-1.0	13	21.7	19	31.7
1.1-1.5	28	46.7	24	40.0
>1.5	13	21.7	12	20.0
Main source of income				
Crop farming	58	96.7	59	98.3
Crop and livestock Farming	1	1.7	1	1.7
Off-farm employment	1	1.7	0	0.0

Source: Field survey data 2017

4.2 The Extent of Utilization of Acquired Improved Rice Technologies, Knowledge and/or Practices by FFS and Non-FFS graduates

4.2.1 Improved rice technologies, knowledge and/or practices acquired and mastered by FFS graduates

One of the study's objectives was to describe the extent of utilization of acquired improved rice technologies, knowledge and/practices by FFS graduates and non-FFS respondents. A review from relevant Mvomero District records shows that FFS graduates had passed through a season long training in improved rice technology/knowledge and or practices through technical backstopping as need arose. As indicated in Table 3, respondents were asked to state the type of training that was provided and the knowledge/technologies acquired during the three years (2014 to 2016) period. Table 3 shows that the majority (88.3%) of FFS graduates learned on the selection and preparation of improved seeds and only a few (11.7%) indicated that they had not learnt. In addition, most (98.3%) FFS graduates were able to utilize the technologies without the assistance of a facilitator or extensionist. The results generally show that FFS graduates had very high rates of in the utilization of all the improved rice technologies. Additionally, the overall trend of utilization of acquired improved rice technologies, knowledge and/practices shows that FFS had a higher level of utilization of improved rice technologies.

The above results are in line with Feder and Quizon (2004) who reported that FFS graduates benefited significantly from knowledge and better pest management skills acquired from the FFS in Indonesia. According to Mwangi and Onyango (2003) adoption of technologies on organic and inorganic fertilizer combinations by FFS graduates was significantly higher than those of non-FFS graduates. According to Mattee *et al.* (2013), the FFS is the most successful and is a transfer extension approach when it comes to farmer technology adoption for increased productivity, output and income. Moreover,

according to Bunyatta (2004), the FFS approach has the potential to empower farmers to become self-reliant and that it improves their problem solving abilities assures fiscal sustainability. Bunyatta (2004) further points out that, FFS approach is quite effective in knowledge acquisition, technology adoption and diffusion for enhanced agricultural productivity. In addition, the approach is gaining prominence as an extension approach in most developing countries, and its degree of effectiveness in influencing farmer's uptake of knowledge for future use is promising. The above is supported by observation from the focus group discussions (FGDs) with FFS village leaders as shown in the quote below.

With the use of the acquired improved technologies/knowledge and practices on rice technologies provided through FFS, there have been an increased in our production over the years. Since the use of FFS improved seeds selection, using timely management, planting methods by the use of double row or LEGOO/10×20×40, productivity/yield increased than using the normal 20×20 spacing. (FFS Demo Plot) LEGOO/10×20×40 spacing, yield increased from 4-5 bag/acres to 7-8 bags/acres using ¼ acre (100Kg), compare to (NFFS Demo Plot) ¼ acre = 4-5 bags/acre 100 Kg.

Table 3: Extent of utilization of acquired improved rice technologies and practices**FFS graduates (n=60)**

Technologies and Practices	Learnt	(%)	Utilized	(%)
Selection and preparation of improved rice seeds	Yes	53(88.3)	Yes	59 (98.3)
	No	7 (11.7)	No	1 (1.7)
Farm lay out	Yes	51(85.0)	Yes	59(98.3)
	No	6(15.0)	No	1(1.7)
Use of proper/correct spacing	Yes	50(83.3)	Yes	58(96.7)
	No	10(16.7)	No	2(3.3)
Use of improved rice seeds varieties like SARO 5, TDX85, TXD88, SUPA TXD 306 MWANGAZA KALALU	Yes	50(83.3)	Yes	60(100.0)
	No	10(16.7)	No	0(0.0)
Weeding and green manuring (Azolla), watering, fertilizer application and timely harvesting	Yes	50(85.3)	Yes	59(98.3)
	No	10(16.7)	No	1(1.7)
Timely planting/transplanting (under irrigation)	Yes	51(85.0)	Yes	57(95.0)
	No	9(15.0)	No	3(5.0)
Land leveling during land preparation by using improved tools such as, Oxen, Power tiller and Tractor	Yes	44(73.3)	Yes	55(91.7)
	No	16(26.7)	No	5(8.3)
Pest and disease control using recommended pesticides or practices like IPM/IPN	Yes	48(80.0)	Yes	59(98.3)
	No	12(20.0)	Not	1(1.7)
Post-harvest and Proper storage of rice	Yes	45(75.0)	Yes	57(95.0)
	No	15(25.0)	No	3(5.0)

Source: Field Survey data 2016

4.2.2 Reasons that facilitated acquisition of improved rice technologies, knowledge and/or practices by FFS graduates

In order to establish reasons that facilitated acquisition and utilization of improved rice technologies, knowledge and/or practices, respondents were asked to give reasons that enabled them to acquire improved rice technologies, knowledge and/or practices. Table 4 presents the reasons and/or factors that enhanced acquisition of rice technologies and practices. According to Table 4, it is vivid that (35.0%) of respondents indicated that acquisition and mastery of rice technologies and practices were due to farmer-to-farmer consultations and exchange of ideas and a quarter (25.0%) indicated that acquisition and mastery of rice technologies was due to knowledge on pest and disease control using recommended pesticides or practices like IPM/IPN. Nevertheless, other respondents (16.7%) and (11.7%) indicated that acquisition and mastery of rice technologies and practices were due to regular technical backstopping from village extension officers (VEO), and visits to other FFS graduates respectively. According to the respondents, facilitators were knowledgeable and ensured training was well planned and emphasized teaching by showing while learners learnt by doing/experimenting/ practicing with immediate follow-up by the facilitator.

Table 4: Reasons that facilitated acquisition and mastery of improved rice technologies, knowledge and/or practices (n=60)

Attribute	Frequency	Percent
Knowledge on Pest and disease control using recommended pesticides or practices like IPM/IPN	15	25.0
Frequent farm visit and advise from facilitated on agricultural practices	7	11.7
Farmer-to-farmer consultations and exchange of ideas	21	35.0
Regular technical backstopping from VEO	10	16.7
Study tours to other FFS farmers	7	11.7

NB-Total frequencies exceed 60 due to multiple responses

4.3 Comparison of Rice Productivity between FFS and Non FFS Graduates (Kg/ha)

Comparison of rice productivity among FFS and non FFS graduates is the important aspect in the determination of effectiveness of FFS approach as stated earlier. The study results (Table 5) show rice yields for the FFS graduates and NFFS farmers for three years period (i.e. 2014 to 2016 farming seasons). According to the Table, rice yields (kg/hectare) were relatively higher for FFS graduates compared to NFFS graduates. The results further show that the differences between the two groups, were statistically significant ($p < 0.000$) for the three years. The implication of the above is that farmers who attended the FFS had benefited from knowledge and skills gained in season-long training sessions (including additional technical backstopping) and had made use of knowledge acquired on improved rice practices compared to those who did not attend FFS training.

These above findings are consistent with several other studies showing positive effects of FFS on productivity (Gockowski *et al.*, 2006; Godtland *et al.*, 2004; Ortiz *et al.*, 2004; Yamazaki and Resosudarmo, 2006). For example, the study conducted in Peru by Godtland *et al.* (2004) showed that use of FFS improved farmers' knowledge about IPM practices and that this was positively correlated with productivity in potato production. However, the study's results contradict those of Feder, *et al.* (2004), who found that FFS had no significant impact on rice yields in Indonesia. These differences in performance of FFS are possibly due to situation specific circumstances as socio-economic and cultural ones as well as ecological in different parts of the world.

Table 5: Comparison of Rice Productivity between FFS and Non FFS Graduates
(Kg/ha) (n=120)

Year	Category	Mean yield	Maximum yield	Minimum yield	t	df	P value
2014	FFS	3 698.1	8 750	750	5.425	118	0.000**
	Non FFS	2 257.4	5 000	400			
2015	FFS	3 932.0	10 000	300	4.772	118	0.000**
	Non FFS	2 478.3	6 250	350			
2016	FFS	4 006.2	10 500	500	4.905	118	0.000**
	Non FFS	2 444.8	6 250	200			

Source: Field Survey data 2016/17**= significant at $p < 0.05$

4.3.1 Reasons for the increase and decrease crop yield for FFS graduates

As much as there were increases in rice yields in the study area, it was nonetheless made clear by respondents during in-depth interviews that rice yields would have been higher as compared to the ones shown in Table 5 if factors mentioned in Table 6 were controlled. Table 6 shows that more than half (61%) of the FFS respondents indicated that reasons for the increased in rice yield over time were the use of improved technologies and practices while slightly less than half (45.0%) indicated that increased in rice yield was due to FFS training. Also the study findings indicated that more than two fifths (43.3%) and a few (16.7%) of the respondents indicated that the increase in rice yields were due to the use of irrigation water and use of certified rice seeds respectively. On the other hand, more than two fifths (45.0%) of the respondents pointed out that the decreased in rice yield were caused by weather fluctuation, while over a third (36.7%) and under a third (30.0%) indicated that low production in rice yields were due to over flooding of plots during transplanting and the construction of poor irrigation infrastructure. Yet, under a quarter (23.3%) indicated that the decreased yield was a result of using uncertified rice seeds. This result is also in consonance with the reports from URT (2015) that the agricultural sectors over the years has faced key constraints to achieving its targets including high

transaction costs due to the poor state or lack of infrastructure; un-managed risks with significant exposure to variability in weather patterns with more periodic flooding and droughts.

Table 6: Reasons for the increase and decrease in rice yield among FFS graduates

(n=60)

Reasons for the increase in rice yields	Frequency	Percent	Reasons for the decrease rice yield	Frequency	Percent
FFS Training	27	45.0	Weather fluctuation	27	45.0
Improved technologies and practices	37	61.7	Flooding during transplanting	22	36.7
Use of certified rice seeds	10	16.7	Poor irrigation infrastructural	18	30.0
Use of irrigation water	26	43.3	Use of uncertified rice seeds	14	23.3

Source: Field Survey data 2016/17. NB-Total frequencies exceed 60 due to multiple responses

4.3.2 Reasons for the increase and decrease in rice yields for NFFS graduates

Results in Table 7 show that (46.7) of the NFFS graduates indicated that the increase in rice yields were due to use of recommended fertilizers while (38.3%) mentioned that their yield increased due to construction of bonds/plots, about (35.0%) and about a fifth (18.3) of the respondents mentioned that favourable weather and good farm management practices strongly contributed to the increased yields overtime. However, though most of the respondents mentioned that increased yields were a result of recommended agricultural inputs, further probing revealed that farmers yield increased through seeking information from fellow farmers, inputs suppliers/stockists and as well as information acquired from District extension staff on the use of agricultural inputs.

As regards to reasons for the decreased in rice yields among NFFS respondents, Table 8 shows that about half (53%) reported that poor management of agricultural inputs and

over flooding and drought to be responsible for the reduction in yield. Over a quarter (28%) and a few (15.0%) reported that lack of training and used of uncertified rice seeds respectively were responsible for the decreased yields. According to Sanchez (2002), one of the major factors in sub-Sahara Africa (SSA) that leads to decline in crop yields is climate variability and reduced soil fertility which in turn compromises food security. According to FAO (2010), climate variability over the years has led to a major decline in per capita food output in SSA and the region has the highest proportion of undernourished people in the world, estimated to be 30% of the total population or 239 million people.

Table 7: Reasons for the increase and decrease in rice yield NFFS graduates (n=60)

Reasons for the increased	Frequency	Percent	Reasons of the decreased	Frequency	Percent
Favorite weather	21	35.0	Poor management of agricultural inputs	32	53.3
Construction of bonds /plots	23	38.3	Flooding and Drought	32	53.3
The used of recommended fertilizers	28	46.7	Use of uncertified rice seeds	9	15.0
Good farm management practices	11	18.3	Lack of training	17	28.3

NB-Total frequencies exceed 60 due to multiple responses

Source: Field Survey data 2016/17

4.4 Perceptions of Smallholder rice Farmers on the Effectiveness of FFS in Terms of Acquisition and Utilization of Improved rice Technologies; and improved rice productivity

4.4.1 Perceptions of FFS graduates on the effectiveness of FFS

The fourth objective of this study aimed at assessing the perception of FFS graduates on the effectiveness of FFS in terms of knowledge acquisition and utilization of improved rice technologies. To achieve this, the study adopted a five point Likert scale to solicit opinions of farmers concerning awareness, perception and the usefulness of FFS

programme. Sets of questions were asked to respondents to find out whether farmers perception was positive or negative towards the effectiveness of FFS. From the items, respondents were requested to indicate whether they strongly agreed, agreed, were undecided, disagreed, or strongly disagreed with each statement. Strongly agreed and agreed statements were treated as positive perception and strongly disagreed and disagreed were treated as negative perception towards the effectiveness of FFS approach. During data analysis the five point scale was reduced to a three point scale by combining agrees and strongly agrees and disagrees and strongly disagrees.

As shown in Table 8, all (100 %) of the respondents agreed with the statement that FFS uses experimental learning by doing to impart knowledge to farmers. FFS enable farmers to diagnose their problems, identify solutions and develop plans and implement them with or without support from outside, all (100%) of the respondents agreed with the statement. These findings show that farmer's perception about a new technology is the first step in the utilization process; the agricultural innovation literature suggests that knowledge only translates into adoption if a set of enabling factors and conditions exist, including farmers' positive perception of the technology's benefits knowledge acquisition and utilization (Adesina and Zinnah, 1993; David, Mukandala and Mafurum, 2002). According to Mvena *et al.* (2013) FFS are an effective and comparatively cheap tool for speeding the uptake of improved technologies at community and national levels. The above conformed to Bunyata *et al.* (2006), who argue that the FFS methodology is a very effective tool for cultivating farmers learning, capacity building and knowledge empowerment. In particular, they encourage farmers to develop their critical thinking and make sound farm management decisions, resulting in adoption of improved technologies. The same outcome is reported from the Peruvian Andes even though it takes a longer time to achieve (Godtland *et al.*, 2004).

Table 8: Perception of FFS graduates on the effectiveness of FFS (n=60)

Attribute	Agree		Undecided		Disagree	
	n	%	n	%	n	%
FFS uses experimental learning by doing with emphasis on participatory group approaches to help farmers make decision and solve problem	60	(100)	0	(0)	0	(0)
FFS enable farmers to diagnose their problems, identify solutions and develop plans and implement them with or without support from outside	60	(100)	0	(0)	0	(0)
FFS enhance acquisition of knowledge, skills and technique on new improved agricultural technologies	58	(96.7)	2	(3.3)	0	(0)
FFS enhance sharing and diffusing of knowledge amongst participant and neighbours	58	(96.7)	2	(3.3)	0	(0)
FFS enhance effective utilization and/or adoption of new/improved agricultural technologies and improved farming practices	57	(95)	0	(0)	3	(5)
With FFS, farmers decides a specific needs and come up with an action plan to address such needs together	56	(93.3)	1	(1.7)	3	(5)
FFS encourages effective use of participatory approaches whereby each individual is actively involved	57	(95)	3	(5)	0	(0)
FFSs encourage smallholder farmers to learn through experimentation, building on their own knowledge and practices and blending them with new ideas	58	(96.7)	0	(0)	2	(3.3)
Overall, FFS training emphasizes building on the farmer's ability to experiment and draw conclusion and it empower farmers to improve their socio-economic conditions	59	(98.3)	0	(0)	1	(1.7)

Source: Field Survey data 2016/17

4.4.2 Awareness of NFFS graduates on the effectiveness of FFS

This section provides data pertaining to the level of awareness among NFFS graduates on the effectiveness of FFS on improved agricultural productivity. To determine this, respondents were asked if they had ever heard of FFS in their area. The results in Table 9 show that of the 60 respondents interviewed only a quarter (25%) had heard about the

FFS. However, of the 25% respondents, two fifths (40%) indicated that they knowledge about FFS and that it is all about providing new technologies to farmers through training, a third (33.3%) said FFS was a means of training farmers using demonstration plots, yet about a quarter (26.7%) stated that they heard about FFS but lack more knowledge on the same.

Additionally, the study investigated the level of contact between NFFS graduates and extension officers. Based on information obtained by the study as shown in Table 9, it is indicated that of the 60 respondent interviewed, majority (93.3%) stated that they had contact with extension officers however, a few (6.7%) do not have any contact with extension officers. Similarly, the study further investigated how frequent NFFS graduates are being reached by extension officers; about a third (35%) reported that they contacted extension officers once every two weeks. Further to the above, 31.7%, 20%, and 6.7% of the respondents pointed out that they had contact with extension officers once a month, once in three months, and once in six months respectively.

In as much as information sharing and contact with extension officers remain one of the major channels in providing adequate information to smallholder farmers, FGD carried out by the study with NFFS graduates revealed that, farmers were not able to create contact with extension officers due to distances from extension staff to individual farm, communications and bad road conditions to reach farmers' site/plots especially during rainy seasons.

Table 9: Awareness of NFFS graduates on the effectiveness of FFS

Attributes	Frequency	Percent
For the period you have stayed in this village, have you ever heard of FFS anywhere? (n = 60)		
Yes	15	25
No	45	75
If yes, what knowledge do you have of FFS? (n = 15)		
Training farmers on demonstration plots	5	33.3
Providing new technologies to farmers through training	6	40
No knowledge	4	26.7
Do you have contact with extension officers (n = 60)		
Yes	56	93.3
No	4	6.7
Frequency of contact with extension officers (n = 56)		
Once in two weeks	21	35
Once a month	19	31.7
Once in three months	12	20
Less than once in six months	4	6.7

Source: Field Survey data 2016/17

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Overview

The overall aim of this study was to assess the effectiveness of Farmer Field School in terms of rice productivity within selected villages in Mvomero District. The specific objectives of the study were: to describe the socio-economic characteristics of smallholder rice farmers that enhance knowledge acquisition and utilization of improved rice technologies; to determine the extent of utilization of acquired improved rice technologies, knowledge and/or practices between FFS graduates and non-FFS graduates; to compare the levels of rice yields per hectare between FFS graduates and non- FFS farmers between 2013-2016 farming seasons and to assess the perception of smallholder rice farmers on the effectiveness of FFS in improving rice productivity. In view of the study findings the following conclusion and recommendations are drawn.

5.2 Conclusions

The conclusions of this study are presented in accordance to the study's objectives and on the basis of the study findings.

On the basis of the study findings, it is revealed that FFS approach is an effective tool in improving rice productivity as a result of acquisition and effective utilization of improved rice production technologies, knowledge and related agronomic practices.

According to the results of this study the major findings are summarized in keeping with study objectives as follows:

i) Socio-economic characteristics of the FFS graduates and non-FFS farmers

From the study, it is revealed that, most of farmers engaging in rice production are people of the middle age, married, with low level of education as most of them have attained primary school education, land ownership except for few farmers who did not own land they were able to hire/rent a piece of land for rice farming. The majority of the respondents (FFS graduates and NFFS farmers) were involved in both crop and livestock activities where they derived most of their livelihood including income.

ii) Extent of utilization of acquired improved rice technologies, knowledge and/or practices between FFS and non-FFS farmers;

All FFS graduates acquired improved rice technologies, knowledge and practices on proper land preparation, proper planting, proper weeding, pest and disease control, appropriate use of fertilizers including frequency and rates of application, appropriate use of tools and mechanization and proper rice storage. FFS graduates had done very well in mastering knowledge/technologies/ practices provided during training and were able to apply without any assistance from the facilitator.

The degree of utilization of improved knowledge/technologies/practices for FFS graduates and non FFS graduates differed from one farmer to another depending on one's ability to afford or buy inputs and level of understanding of a particular practice. Although both groups were not good at the application of fertilizers (in terms of rates of application and frequency), weeding regimes (or recommended frequency of weeding) and pest and disease control, FFS graduates were doing better in all aspects than non FFS graduates. Although there were reasons provided by respondents of being impressive in the utilization of all the technologies, high

cost of inputs such as seeds, fertilizer, pesticides and labour constraints especially during weeding were found lacking.

iii) Comparison of Rice Productivity between FFS and Non FFS graduates

The results of this study have demonstrated that effective use of FFS knowledge and practices have had positive impact on the productivity of rice. This was evidenced by productivity differences between FFS and non FFS graduates. In all three years evaluated, rice yields were higher among FFS graduates than non FFS farmers and the differences in crop yields in the three years between the two groups were found to be statistically significant at $p < 0.00$. The implication of this difference is that farmers who attended the FFS had benefited knowledge and skills gained in season-long training sessions and had made use of knowledge acquired on improved rice practices compared to those who did not attend FFS training.

iv) Perception of smallholder rice farmers on the effectiveness of FFS in terms of acquisition and utilization of improved rice technologies

The study found that all the FFS respondents agreed with the statement that FFS uses experimental learning by doing to impart knowledge to farmers. It also showed that the FFS approach is a very effective tool for enhancing farmer learning in terms of information and skills acquisition and overall knowledge empowerment. According to respondents, FFS encourage effective use of participatory approaches whereby each individual is actively involved and allowed to interact freely and ask questions or experiment. Knowledge empowerment enabled FFS graduates to gain self-confidence with capacity to share their knowledge gained with other FFS and non-FFS graduates in the neighbourhood.

On the other hand, FFS training and implementation was perceived by respondents (FFS graduates) as being tedious and time consuming despite its effectiveness in enhancing knowledge acquisition, utilization and productivity. Yields might have been higher than what they are currently getting if there were no constraints revolving around finance (essential for purchase of necessary inputs like improved seeds and fertilizers), labour and time.

5.3 Recommendations

Based on the conclusions drawn from the findings of this study, the following recommendations are made:

- i) The study findings revealed that a good number of FFS graduates and non-FFS farmers was very good at land preparation and proper planting but not proper weeding, fertilizer/pesticides application because of constraints revolving around labour and affordability of inputs like fertilizers. Given this scenario it is recommended that smallholder farmers with the assistance of their facilitators or extension staff should engage themselves in viable SMEs or off-farm income generation activities to enable them afford costs of hiring labour and purchase of necessary inputs such as fertilizers and pesticides.
- ii) The Centre and Local Government, and as well as Private Agricultural Extension Services Providers should link farmers with financial institutions like CRDB, TADB and NMB so that they get credit.
- iii) With regards to non-FFS farmers that was found less aware of the FFS extension approach and its benefits, efforts should be made by MDC in particular the extension staff to sensitize all women and men smallholders including youth on

the role of FFS and the need for them to take part if they are to improve their farming activities and overall livelihoods. In this regard, smallholders should be given correct and detailed information about the FFS including its requirements so that the majority of farmers if not all can become aware and interested in participating in FFS.

Once these recommendations are effectively addressed, it will be possible to realize the benefits of FFS in terms of knowledge acquisition and effective utilization resulting in improved rice yields and eventually increased household incomes provided the issue of markets is taken care of.

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APPENDICES

Appendix 1: Interview Schedule for FFS graduates

Title: Effectiveness of Farmer Field Schools in improving agricultural productivity in Tanzania: A Case Study of Smallholder Rice Farmers in Mvomero District, Tanzania.

INTRODUCTION

My name is Peter D. Gbawoquiya. I am a MSc. student of Sokoine University of Agriculture (SUA). I am conducting a study on the above topic within your area. Basing on your experience you are requested to provide your views and information basing on the questionnaire. This interview will take about one hour. All the information will be treated confidentially and will be used for the purpose of this research

Identification

Questionnaire number Date of interview

Name of enumerator

Name of Village

Name of Ward

Name of respondent

Respondent's No

Instructions: Tick (✓) or fill in the space provided where appropriate.

Q1: Socio-economic Characteristics

Q1A. Sex of respondent:

1=Male [] 2= Female []

Q1B. Age of respondent in years

1= 18- 25 [] 2= 26-36 [] 3= 37-50 [] 4= 51 and above []

Q1C. Marital status of respondent

1=Single []

2= Married []

3= Widow []

4= Separated []

Q1D. Educational level

1=Non-formal education [] 2=Primary education []

3=Secondary education [] 4= College (Certificate and Diploma) []

5=University []

6= Other (Specify)

Q1E. How long have you been living in this village?years**Q1F.** Indicate the number of dependents in your household

1. Adult (Men) No.....

2. Adult (Women) No.....

3. Children/Child No.....

Q1G. Major occupation of the respondent:

1= Crop farmer [] 2= Livestock keeper [] 3= Crop and livestock keeper []

4= others (specify).....

Q1H. What is your gross income per annum in the household (in TShs)?

1. Below 400,000 [] 2. 400,001-600, 00 [] 3. 600, 001- 800, 00 []

4. 800, 001-1,000,000 [] 5. Above 1,000,000 []

Q1I. What are your main sources of income? (Tick only One)

1. Crop Farming []

2. Livestock farming []

3. Crop and livestock faming []

4. Off-Farm employment []

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

Q1J. Do you own land?

1=Yes [] 2=No []

A1K. If answered yes in question A10 above, what where the size of your land in 2013-2016 season?

- 1. <0.5 hectares []
- 2. 0.5 – 1.0 hectares []
- 3. 1.1 – 1.5 hectares []
- 4. >1.5 hectares []

Q1L. If yes in question A11 above, what is the total land size do you allocate for rice production?

- 1. <0.5 hectares []
- 2. 0.5 – 1.0 hectares []
- 3. 1.1 – 1.5 hectares []
- 4. >1.5 hectares []

Q1M. If no (in respect to A11 above) where do you get land for rice production?

- 1. Borrowed []
- 2. Rented []
- 3. Others (Please Specify).....

Q1N. Who in the household control the land? 1= Husband [] 2= Wife []

Q2: Extent of utilization of acquired improved rice technologies and practices

Q2A. Technologies learned and used in the last three years

Improved agricultural technology/practice	Learned	Used	Not used
Proper land preparation			
Proper planting			
Spacing			
Use of improved rice seeds varieties like SARO 5, TDX85, TXD88, SUPA TXD 306 MWANGAZA			

KALALU			
Weeding, watering, fertilizer application and timely harvesting			
Timely timing of activities			
Tools management practices like, use of Oxen, Power tiller and Tractor			
Pest and disease control using recommended pesticides or practices like IPM/IPN			
Proper storage of rice			

Q2B. Did you utilize these technologies and practices effectively; that is during the three years 2013 -2016?

1=Yes [] 2= No []

Q2C. If no in Q2B, Please explain

.....

Q2D. Are you applying all these technologies or practices appropriately?

1=Yes [] 2= No []

Q2E. If no in Q2C, Please explain

.....

Q2F. What reasons or factors that enhanced the degree of utilization of the above mentioned improved agricultural technologies and practices?

.....

Q2G. For improved technologies, knowledge and/or practices that you have not utilized effectively for the past three years kindly give candid reasons for failure to do so by writing the appropriate number in the space provided below.

Improved agricultural technology/practice	Cost not affordable	Time consuming	Inputs are not accessible	Not useful	Lack of tech backstopping and credit
Proper land preparation					
Proper planting					
Use of improved rice seeds varieties like SARO 5, TDX85, TXD88, SUPA TXD 306 MWANGAZA KALALU					
Proper Weeding, watering and fertilizer					
Timely timing of activities					
Pest and disease control using recommended pesticides or practices like IPM/IPN					
Tools management practices, such as, Oxen, Power tiller and Tractors					
Proper storage of rice					

Q2H. Given your experience in rice farming in this area what should be done to ensure continued or sustainable use of the improved agricultural technologies and practices acquired during and after FFS training?

.....

Q3: To compare the levels of rice yields per hectare between FFS graduates and non- FFS graduates.

Q3A. For the period between 2013 and 2016 (after graduation), how many Kg/ha of rice you have been harvesting from your plots?

Rice Yields Over the Years (Kg/ha)	FFS Graduate
2014	
2015	
2016	
Total units	

Q3B. State reasons for the increase in rice yields over time

.....

.....

Q3C. If you experienced decline in rice yields kindly give reasons.

.....

.....

Q3D. What strategies have you put in place to sustain increased rice productivity?

.....

.....

Q4: Perception of smallholder rice farmers on the effectiveness of FFS

Q4A. The following statements attempt to demonstrate your feelings about your involvement in FFS and the tangible benefits you have acquired as a result of your participation. Please write number in the appropriate space to indicate the degree to which you agree or disagree with the item

S/N	Statement	1. Strongly agree 2. Agree 3. Undecided 4. Disagree 5. Strongly disagree
1.	FFS uses experiential learning (with emphasis on learning by doing)	
2.	Field Schools enable farmers to diagnose their problems, identify solutions to solve them	
3.	FFS enhance acquisition of knowledge, skills and techniques on new or improved agricultural technology	
4.	FFS enhance sharing and diffusion of knowledge	
5.	FFS enhance effective utilization and/or adoption of new/ improved agricultural technology and improved farming practices	
6.	With FFS, community to decide a specific needs and come up with an action plan to address such needs	
7.	FFS encourages active involvement of researchers, extensionists	
8.	FFSs are based on equal partnership between farmers, researchers and extension agents who learn from each other and contribute their knowledge and skills.	
9.	Overall, FFS training emphasizes building on the farmer's ability to experiment and empowers farmers to improve their socio-economic conditions	
10	FFS curriculum corresponds to immediately happening	

SECTION Q5: ADDITIONAL QUESTIONS

Q5A. From your experience, do you get adequate services from extension agents?

1=Yes [] 2= No []

Q5B. Going back to the time you were undertaking FFS training, do you feel that FFS facilitator was competent in organizing and managing FFS training and related activities?

1=Yes [] 2=No []

Q5C. In either case, please explain

.....
.....

Q5D. Was the FFS curriculum relevant to target farmers and their farm families?

1=Yes [] 2= No []

Q5E. In either case, please explain with reasons

.....
.....

“THANK YOU FOR YOUR COOPERATION”

Appendix 2: Interview Schedule for Non-FFS Smallholder rice Farmers

Title: Effectiveness of Farmer Field Schools in improving agricultural productivity in Tanzania: A Case Study of Smallholder Rice farmer in Mvomero district, Tanzania

SECTION Q6: Extent of utilization of improved rice technologies and practices

Q6A.Technologies used in the last three years (2013-2016)

Improved agricultural technology/practice	Learned	Used	Not used
Improved agricultural technology/practice			
Selection and preparation of improved seeds			
Farm lay out and proper/correct spacing			
Use of improved rice seeds varieties like SARO 5, TDX85, TXD88, SUPA TXD 306 MWANGAZA KALALU			
Weeding, watering, fertilizer application and timely harvesting			
Timely timing of activities			
Tools management practices like, use of Oxen, Power tiller and Tractor			
Pest and disease control using recommended pesticides or practices like IPM/IPN			
Post-harvest and proper storage of rice			

Q6B. Did you utilize these technologies and practices effectively; that is during the three years 2013 -2016?

1=Yes [] 2= No []

Q6C. If no in Q2B, Please explain

.....

Q6D. Are you applying all these technologies or practices appropriately?

1=Yes [] 2= No []

Q6E. If no in Q2C, Please explain

.....

.....

Q6F. What reasons or factors that enhanced the degree of utilization of the above mentioned improved agricultural technologies and practices?

.....

.....

Q6G. For improved technologies, knowledge and/or practices that you have not utilized effectively for the past three years kindly give candid reasons for failure to do so by ticking the appropriate space provided below.

Improved agricultural technology/practice	Cost not affordable	Time consuming	Inputs are not accessible	Not useful	Lack of tech backstopping and credit
Selection and preparation of improved seeds					
Farm lay out and proper/correct spacing					
Use of improved rice seeds varieties like SARO 5, TDX85, TXD88, SUPA TXD 306 MWANGAZA KALALU					
Weeding and green manuring (Azolla), watering, fertilizer application and timely harvesting					
Timely planting/transplanting (under irrigation)					
Pest and disease control using recommended pesticides or practices like IPM/IPN					
Land levelling during land preparation by using improved tools such, Oxen, Power tiller and Tractors					
Post-harvest and proper storage of rice					

Q6H. Given your experience in rice farming in this area what should be done to ensure continued or sustainable use of the improved agricultural technologies and practices?

.....

SECTION Q7: To compare the levels of rice yields per hectare between FFS graduates and non- FFS graduates

Q7A. For the period between 2013 and 2016 how many Kg/ha of rice you have been harvesting from your plots?

Rice Yields Over the Years (Kg/ha)	Non-FFS farmer
2014	
2015	
2016	
Total units	

Q7B. State reasons for the increase in rice yields over time

.....

Q7C. If you experienced decline in rice yields kindly give reasons.

.....

Q7D. What strategies have you put in place to sustain increased rice productivity?

.....

SECTION Q8: Perception of smallholder rice farmers on the effectiveness of FFS

Q8A. For the period you have stayed in this village have you ever heard of FFS anywhere?

1=Yes [] 2=No []

Q9D. If yes, please give reasons

.....
.....

Q9E. If no, please give reasons

.....
.....

Q9F. What is your main source of agricultural information?

- 1. District Council extension staff []
- 2. Fellow farmers []
- 3. Input suppliers/stockists []
- 4. Crop buyers []
- 5. What about NGOs/CBOs (if any) []
- 6. Others (Please specify).....

“THANK YOU FOR YOUR COOPERATION”

Appendix 3: Checklist for FGDs**A. IN FFS VILLAGES**

1. Given your experience with FFS approach what do you see to be the important features of this approach?
2. How do you rank FFS as compared to other extension approaches that were introduced in your village such as Training and Visit (T&V)?
3. Do FFS graduates share the knowledge with the non-FFS farmers in your village and other neighboring villages?
4. If yes, please explain mechanisms or the means they use to share the knowledge acquired with other fellow farmers?
5. Since the time FFS farmers started using the knowledge and skills acquired on improved rice farming, do you see their rice yields increasing as compared to non-FFS farmers in your area? (Please substantiate with facts)?
6. From your village records is there any significant difference in rice productivity between the FFS and non-FFS farmers? Please substantiate by giving evidence
7. As leaders of this village, what strategies have you put in place to ensure effective utilization of acquired improved rice production technologies and practices amongst FFS graduates?
8. Overall, what should be done to make sure the knowledge and skills acquired through FFS training is effectively shared and/or diffused to many other farmers who never took part in FFS training?
9. For improved technologies and/or practices that have not utilized effectively by FFS graduates for the past three years kindly give candid reasons for failure to do so.

THANK YOU FOR YOUR COOPERATION

B. NON FFS VILLAGES

1. For the period you have been a Village Leader have you ever heard of FFS extension approach? Yes/No
2. If yes, what are the FFS benefits that farmers who are engaged in these schools are standing to gain compared to those farmers who are not involved?
3. If you are aware of these good benefits what reasons have made you and your extension officer not to demand for the introduction of FFS in your village? (please explain in details and with facts)
4. Looking at what rice FFS farmers are benefiting as a result of their involvement in FFS what initiatives are you taking to make sure your village becomes one of the FFS villages?
5. What do you see to be the major challenges that you may encounter as you strive to introduce the FFS in your village and how are you prepared to deal with such challenges?

THANK YOU FOR YOUR COOPERATION

Appendix 4: Checklist for village extension officers 2013-2016

1. Did you attend any FFS training? Yes/No? If Yes, of what duration and what subject matter areas were covered?
2. Did this training make you competent in planning and managing smallholder rice farmer FFS including facilitation of farmer learning? Please explain while giving candid examples
3. Since the time you have been in this village how many rice FFS groups you have promoted and trained; and with what purpose?
4. Of these FFS groups how many are successful and can sustain themselves? (What makes you think so? Give evidence)
5. Which improved rice technologies and practices have you disseminated to farmers during FFS training sessions?
6. Of the rice technologies and practices stated above which ones were mostly adopted and why?
7. Since rice farmers under FFS started making use of the knowledge and skills acquired has rice productivity been increasing? Give records for at least three years back.
8. How many non-FFS farmers have been reached by FFS members?
9. What has worked very well under FFS? Why? Give reason.
10. What has not worked well under FFS? Why? Give reason
11. How many exchange visits do you perform and what farmers share amongst them?
12. What other support and motivations do you get from the District council/NGOs?
13. What strategies have you put in place to improve the performance of FFS in your area and ensure sustained use of the acquired improved rice knowledge and skills?

THANK YOU FOR YOUR COOPERATION