EVALUATION OF THE EFFECTIVENESS OF KATC APPROACHES IN IMPROVING SMALLHOLDERS' IRRIGATED RICE PRODUCTIVITY: A CASE OF SELECTED IRRIGATION SCHEMES IN TANZANIA

BY

HANIF JAMAL NZULLY

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ABSTRACT

Farmer training is essentially an agricultural extension education with a non-formal function, which applies to any institution that disseminates information and advice with the intention of promoting knowledge, attitudes, skills, and aspirations. When systematically and effectively provided, extension is known to enhance social and economic development. In terms of agricultural extension systems, different approaches can be employed to organize and implement extension activities. Each approach may be conceived as appropriate in particular circumstances and each has its own advantages and disadvantages. The present study evaluates the effectiveness of KATC training approaches in improving smallholders' irrigated rice productivity whereby two irrigation schemes, namely, Mombo and Mwega irrigation schemes in Korogwe and Kilosa districts respectively were selected. A cross-sectional survey design was applied in the study. A simple structured questionnaire and interview schedule were used in data collection from a sample of 122 respondents, which included three categories of trained farmers and extension officers. The study findings revealed statistical significant differences at $p<0.000$ between means among the trained farmers towards their preferences to the use of KF-IF-OF extension approach. The results also showed that the majority of the respondents 102 (94.4%) preferred field training approaches, 100 respondents (92.6%) preferred demonstrations and farmer managed trials, and 99 respondents (91.7%) field and farmers days. Since the KFs and the IFs had higher levels of adoption in 18 out of 24 innovations, the study concludes that the KF-IF-OF extension approach was effective

in dissemination and increasing the adoption of innovations within the first two categories of KFs and IFs. Of all the 108 respondents, 88 (81.5%) indicated that the greatest strength of the KATC training approaches was the participatory nature of all approaches used in the training programme. However, the study results revealed that the IFs had more weaknesses in fulfilling the training requirement than the KFs. Generally, the study findings imply that the KF-IF-OF approach had been effective in increasing the adoption of innovations leading to an increase in irrigated rice yields. This study recommends that in order to deliver effective and efficient extension services to other farmers through KF-IF-OF extension approach, the KATC should give KFs and IFs appropriate and adequate training suitable in solving common problems encountered in implementing their roles as farmers and as farmer extensionists.

DECLARATION

I, HANIF JAMAL NZULLY, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my original work and has not been submitted for a higher degree in any other University.

_____ _____

Hanif Jamal Nzully Date

(MSc. Student)

The above declaration is confirmed

_____ _____

Prof. M.R.S. Mlozi Date

(Supervisor)

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DEDICATION

To my beloved mother Grace Nakomolwa Nzully who made a lot of effort in laying down the foundation of my education.

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LIST OF ABBREVIATIONS

AERDD	Agricultural Extension and Rural Development Department
AKAP	Awareness, Knowledge, Adoption and Productivity
ASDS	Agricultural Sector Development Strategy
BACAS	Bureau of Agricultural Consultancy and Advisory Services
CAP	Community Action Plan
CATAD	Centre for Advanced Training in Agriculture and Development
CBO	Community Based Organizations
CHAUMWE	Chama cha Ushirika wa Umwagiliaji Maji Mwega
DSMS	District Subject Matter Specialist
FAO	Food and Agriculture Organization
FFS	Farmer Field Schools
FO	Farmers Organization
FTF	Farmer-to-Farmer extension
HIMA	Hifadhi ya Mazingira
IF	Intermediate Farmer
IFAD	International Fund for Agricultural Development
ILO	International Labour Organization
INADES	African Institute for Social and Economic Development
IPM	Integrated Pest Management
IT	Irrigation Technician
ITCZ	Inter-Tropical Convergence Zone
JICA	Japan International Co-operation Agency
KATC	Kilimanjaro Agricultural Training Centre
KF	Key Farmer
MAC	Ministry of Agriculture and Cooperatives
MAFS	Ministry of Agriculture and Food Security
MFEC	Mogabiri Farm Extension Centre
MIAD	Mwea Irrigation Agricultural Development Centre
NAEP	National Agricultural Extension Project

NARO	National Agricultural Research Organization
NES	National Extension System
NGO	Non Governmental Organization
NIMP	National Irrigation Master Plan
NPES	National Poverty Eradication Strategy
O&M	Operation and Maintenance
OF	Other Farmer
PARA	Paraprofessional
PELUM	Participatory Ecological Land Use Management Association
PLA	Participatory Learning and Action
PMA	Plan for Modernization of Agriculture
PRA	Participatory Rural Appraisal
PRSP	Poverty Reduction Strategy Paper
SACCOS	Saving and Credit Co-operative Society
SNAL	Sokoine University of Agriculture National Agricultural Library
SPSS	Statistical Package for Social Sciences
SUA	Sokoine University of Agriculture
TARP II	Tanzania Agricultural Research Project Phase II
TDV	Tanzania Development Vision
UMADEP	Uluguru Mountains Agriculture Development Project
URT	United Republic of Tanzania
USD	United States Dollar
VAEO	Village Agricultural Extension Officer
WAEO	Ward Agricultural Extension Officer
WUA	Water Users Association
ZIU	Zonal Irrigation Unit

CHAPTER ONE

INTRODUCTION

1.1 Background information

Due to its strategic importance, the Tanzania Development Vision 2025 through its Poverty Reduction Strategic Paper classifies agriculture as the priority sector in attaining the envisioned development goals (URT, 2001a). This is because for about four decades agriculture has remained the most dominant sector of the Tanzania economy (Nagu and Howlett, 1997). The country's GDP was US$9.9 billion in 2003, and the value added in agriculture was 43.4 percent of the GDP. The agricultural sector continues to lead economic growth, and have the highest impact on the levels of overall economic growth in spite of the recent emergence of the new high-growth sectors of mining and tourism. Agriculture provides work for 14.7 million people, or 79 percent of the total economically active population. Small-scale subsistence farmers comprise more than 90 percent of the farming population, with medium- and large-scale farmers accounting for the rest (FAO, 2004). Production in agriculture is highly labor intensive and with low yields due to low input use and limited access to new technologies. Agricultural production is also highly vulnerable to climatic conditions (IFAD, 1999).

The main problem facing Tanzania as well as other countries within the region is that of keeping food supply in balance with the ever-increasing demand. This entails a rapid growth in agricultural productivity, which has to be done in a sustainable way

so as to conserve a fragile ecosystem and genetic heritage (TARP II SUA, 2004). Tanzania is partially self-sufficient in food, with maize and rice surpluses in some years. The major reason for such deficits has for a long time been dependency on rain fed cropping systems whereby the rains are in most cases erratic and insufficient (URT, 2003). According to Kaswamila and Masuruli (2004) crop failures are common, for example, 11 out of 20 regions of the mainland are prone to drought. One option of meeting the challenge of food deficit as per TARP II SUA (2004) is through the expansion of the area under the rain fed cultivation and the use of additional inputs. This means that much of the increase in agricultural production has to come from the expansion of the irrigated area or through increased productivity of irrigated land. However, rainfall unreliability makes this option rather risky. This is because drought affects both rain fed agriculture and areas dependent on seasonal watercourses for irrigation. Resorting in intensification of irrigated agriculture should entail significant improvements in irrigation efficiencies rather than additional of water supplies.

The Tanzania development vision (TDV) 2025 (URT, 2001a), lays the long-term development goals and perspectives. The development vision envisaged that the economy will have been transformed from a low productivity agricultural economy to a semi-industrialized one led by modernized and highly productive agricultural as well as industrial and service activities in rural and urban areas. Food self-sufficiency and food security are articulated as the top goal of the first attribute i.e. high quality livelihood among the five attributes of the TDV. As one of the priority areas in “Policies and Strategies for Creating Capacity for Poverty Eradication” in the

National Poverty Eradication Strategy (NPES), the agriculture sector has been given the utmost importance. The NPES states “Investment in agriculture should be promoted and enhanced.”

Tanzania has a substantial irrigation potential that is not yet explored. Tanzanian farmers cultivate only 6.3 million hectares of the total 43 million hectares of arable land. Out of one million hectares of land classified suitable for irrigation, only about 20 percent are so far under irrigation (URT, 2001b). This shows that land and water resources are not effectively utilized presently. A large proportion of irrigated area (85,000 - 100,000 ha) is farmed by smallholders using diversion furrows. The main crops in such areas are paddy and horticultural crops.

Irrigation is seen as a key to developing agricultural production in order to improve food security, increase farmers’ productivity and income, and also to produce more high valued crops such as fruits and vegetables (URT, 2004a). Irrigation has a multi-facetted role in contributing towards food security, self-sufficiency, food production and exports. It also encompasses a wide range of interventions that enhance productivity and result into profitability for the rural farming population and the nation as a whole (Chiza, 2005). When approached holistically, with equal levels of support in both the soft and hardware aspects, irrigation has major positive impacts at household and village levels and can contribute significantly to Poverty Reduction Strategy (PRS) objectives. When examined purely in investment terms, it seems that irrigation development requires high investments that benefit relatively few people. This perception ignores the substantial spin-off effects to the surrounding

communities who not only become involved in direct activities, but who also benefit from the improved irrigation facilities and supporting services.

Chiza (2005) has also argued that if farmers have both irrigated and rain fed pieces of land, they will opt to invest fertilizer in the irrigated land rather than in the rain fed land. Thus, they are more likely to achieve the projected yields in investing in irrigated land than they will have managed in the rain fed land through their risk aversion measures. Current yield levels on unassisted irrigation projects are well below potential, although still above rain fed production. Recent support for irrigation has shown that with full beneficiary involvement, these yields and returns can be significantly increased. In irrigation projects doubling and tripling of yields within three years of the first project interventions are achievable and can contribute significantly to food production and security as well. The returns to labour amount to between USD three to USD five per day, thereby providing alternatives to farmers for casual off farm labour. Where perennial water sources are not available but water harvesting techniques are utilized, then this return is lower, but still sufficient to encourage many to stay in their home.

According to The National Irrigation Master Plan (NIMP) main report (MAFS, 2002), the Government of Tanzania is now putting more emphasis on enhancing small and large scale irrigation projects. To achieve the government’s goal on food security and poverty alleviation at the household level and at the nation level as a whole, irrigation development and practicing is important in curbing the recurring erratic and insufficient rainfall. This means that the irrigation development and

practicing needs proper policy and strategies for implementation. However, irrigation practices alone, without interlinking it with other activities or sub sectors like extension services which cut across the whole agricultural sector, cannot achieve the national goal for food sufficiency and farmers' income raising (Kallinga, 1999). Successful agricultural activities rely on the use of various technologies in the fields of production, storage, processing, marketing, etc., in order to realize set goals. The modality by which these technologies become available to users (farmers) is through the extension system, which involves transfer of agricultural technology from experts (including progressive farmers) to farmers, livestock keepers, and other stakeholders (MAC, 1997a).

One important limitation to agricultural growth is the low use of technology. About 70 percent of crop area is cultivated by hand hoe while 20 percent is cultivated by ox plough and 10 percent is cultivated by tractor (URT, 2004b). Input use is also low, for example, only 27 percent of the farmers buy fertilizer and 19 percent buy pesticides. As a result, productivity per unit of labour and land is low. The removal of subsidies for agricultural inputs has worsened the situation since it has increased further the number of smallholder farmers who cannot afford these inputs.

Besides technology, there are also other institutional limitations to agricultural growth. For example, there are many actors within the public sector who are not well coordinated, lack capacity in terms of staff, and funding and facilities for carrying out their mandated activities (URT, 2003). The private sector whose role is much emphasized in Agricultural Sector Development Strategy (ASDS) is still weak and

its capacity to provide timely agricultural services such as farm inputs and credit services is inadequate. Furthermore, unlike other sectors, agriculture does not attract much private investment because the rates of return are low (URT, 2001b). Likewise, FAO (2000) commented that the transformation of smallholder agriculture to a more science-based production system requires committed governance as well as a system of public sector organizations with the capacity to support and transform small-scale agriculture in terms of productivity and participation in the national economy.

According to NIMP, the major constraints related to farm management under irrigated farming are low use of improved varieties, late transplanting, low plant density, poor weeding control and low inputs. These constraints, according to NIMP, should be improved through strengthening of farmers supporting systems such as research, extension, input supply, marketing and access to available loans. It is further insisted that in case of irrigation development, even more careful support might be needed for proper operation of irrigation system and maintenance practices for sustainable utilization of the facilities. The comprehensive strategy on farmers supporting system should thus be organized. The NIMP clearly depicts the farming system improvement plan under the category of farmers supporting systems into two items of agricultural research and extension system. It is envisaged that the strengthening of extension services is considered essential for the successful development of irrigated agriculture. Extension services are required to give guidance to farmers concerning the proper farming practices and the effect of proper application of farm inputs under irrigated condition.

In terms of agricultural extension systems, different approaches can be employed to organize and implement extension activities. Each approach may be conceived as appropriate in particular circumstances and each has its own advantages and disadvantages. According to Axinn (1988), ‘approach’ refers to the style of action within an extension system. The approach embodies the philosophy of the system and it is the essence of the system. An approach is like a doctrine for the system, which informs, stimulates and guides such aspects of the system as its structure, its leadership, its programs, its methods and techniques, its resources, and its linkages with other organizations.

Farmer training is essentially an agricultural extension education. Jones and Garforth (1997) defined it as educational service for training and influencing farmers (and their families) to adopt improved practices in crop and livestock production. The concern is not only with the teaching and securing adoption of a particular improved practice, but also with the outlook of the farmer to the point where he will be receptive to and on his own initiative, continuously seek means of improving his farm business and home (Arnon, 1987). This non formal education, which includes agricultural extension, has had a special attraction in that it promises immediate pay off in terms of changed attitudes and skills which would have a direct impact on production.

Extension is a non-formal function that applies to any institution that disseminates information and advice with the intention of promoting knowledge, attitudes, skills, and aspirations (FAO, 2003). When systematically and effectively provided,

extension is known to enhance social and economic development. Technological changes and the knowledge systems that underpin it are a critical factor for development. The technology utilization encompasses the users of the agricultural technology, mainly farmers. User awareness, adaptation and adoption of improved technology from various sources affect farm level productivity and profitability and ultimately economic growth at national level (Peterson, 1997). Thus, extension education is generally the main, if not the only, agent for farmer education in developing countries; in other words it is a specialized form of the broader concept of adult education (Kauzeni, 1989).

Since the mid-eighties, the government of Tanzania has been taking different measures in order to improve the agricultural sector (Rutatora and Mattee, 2001a). Such measures include improvement of irrigation infrastructures in various irrigation schemes all over the country with the aim of improving agricultural irrigation activities and its productivity. Donor funds in billions of Tanzanian shillings have been invested for that matter. However, the economic turn up from these schemes have been less significance. Among other reasons for the low productivity is failure of the farmers to practice improved irrigated farming (MAC, 1997b).

The National Poverty Eradication Strategy (NPES) and the Poverty Reduction Strategy Paper (PRSP) intend to create an environment that promotes new alliances between the government and civil organizations, mobilizes all available resources, facilitates different actors, builds the capacity of the poor, and empowers civil society to participate effectively in poverty eradication. This can be achieved through

the mobilization of physical, financial and human resources with a projected target of reducing the poverty line by 50% by the year 2010 (URT 2001a, 2004c). Through this background, it is evident that the Kilimanjaro Agricultural Training Center (KATC) approach is in line with the national irrigation policy and is instrumental in eradicating poverty and ensuring food sufficiency in the country.

In an effort to avail technologies that can improve household income and food security among Tanzanian smallholder farmers in irrigation schemes, the KATC project was launched in 1994 as a collaborative project between the Government of Tanzania through the Ministry of Agriculture and Cooperatives (MAC) and the Government of Japan through the Japan International Co-operation Agency (JICA). KATC intervention through a software aspect came into action after a thorough consideration of the available mentioned facts. As a government institution, KATC through JICA started to implement training programmes to farmers, extension officers and irrigation technicians in various irrigation schemes in the country with the objective of improving the productivity on rice cultivation and thereby increasing the net return rate for the farm families. Since then significance differences have been observed regarding water utilization, and rice crop husbandry, and hence there is an increase in rice productivity in all of the irrigation schemes that are under KATC training (KATC, 2004).

As a project type extension, KATC is aimed at increasing productivity of rice through training. The now famous “farmer to farmer extension approach” in a form of Key farmer-Intermediate farmer-Other farmer (KF-IF-OF) being used by KATC

Phase II Project is already showing good results in those model sites and to some extent in the neighboring irrigation schemes. Key Farmers (KF) who received training at KATC form small groups of Intermediate Farmers (IF) after returning to their schemes. The result and method demonstrations are used to train both IFs and OFs.

The purpose of KATC Project, during its establishment, was “With respect to irrigated rice cultivation, the institutional capability of training for extension personnel and other concerned people is strengthened” (Shayo, 2000). The expected project output was as follows: (i) Technical capability of trainers is enhanced; (ii) Training methods are improved; (iii) Training materials are improved; (iv) Extension, water management and agricultural machinery personnel and key farmers are trained, and (v) Improved extension method/approach is recommended.

1.2 Problem statement

Agricultural productivity in Tanzania faces a myriad of problems, unsatisfactory extension service being one of them. This situation contributes to low productivity with consequential negative effect to the lives of the rural people who depend on agriculture for their lives (BACAS, 1997). Tanzania, extension service is still seen as a supply driven, public good, and where farmers are not consulted about what agricultural technologies might work and best meet their demand and needs. This has led to poor and insufficient delivery of information. However, despite the various attempts and efforts to improve the lives of rural farming population through increased agricultural productivity, the overall performance of the agricultural sector

has been inadequate. The failure of the extension system to influence farmers to adopt improved technologies has been pointed out to be a major cause of poor performance (Lupatu, 1995; Kauzeni, 1989; Mattee, 1989).

It is due to this fact that KATC being one of the stakeholders in improvement of irrigated farming is now playing an important role in delivering improved irrigated crops technologies with much emphasis on irrigated rice in irrigation schemes in the country and outside the country. Through participatory extension approaches, which involve KFs, IFs, and OFs, KATC has shown good results in the model sites and to some extent in the nearby irrigation schemes. Key Farmers who receive training at KATC together with their field personnel form small groups of Intermediate Farmers. These groups have been trained by using result and method demonstrations. KATC believes that this process will continue and turn into a chain reaction leading to the whole scheme adopting the improved farming techniques and will spread to other schemes with the assistance of the district councils (KATC, 2004). KATC records show that through its training approach, farmers can adopt the improved irrigated rice technologies, which has led to the increase in irrigated rice productivity. Although the achievement of the training is remarkable as per mid-term as well as the final evaluation report of KATC Phase II Project (KATC, 2004; 2006a), it is assumed that KATC training approach has strength and weaknesses, which are not well understood. Therefore, an empirical study on its effectiveness is indispensable in order to understand the KATC training approaches for recommending to other farmers in the country. It is therefore, important to evaluate the effectiveness of KATC training approaches and explore their strength and weaknesses in

dissemination of agricultural technologies for improved rice productivity, in irrigation schemes by involving the beneficiaries and other stakeholders (farmers, extension workers, irrigation technicians, Farmers Organizations in irrigation schemes).

1.3 Justification of the study

KATC believes that KF-IF-OF extension approach which is a farmer-to-farmer extension approach creates more vitality, self-confidence, and encourages farmers to experiment on agricultural innovations (KATC, 2006b). As a result, the KF-IF-OF extension approach enhances adoption of agricultural innovations leading to increased agricultural productivity. This study was therefore set to draw necessary recommendations, emanating from the evaluation of the effectiveness of KATC training approaches, particularly which will further improve the dissemination and adoption of agricultural technologies in irrigation schemes. The findings of this study will assist farmers and other stakeholders in efforts to make the KF-IF-OF extension approach effective in improving farmers' adoption of agricultural innovations hence increased agricultural productivity in Tanzania. In examining the factors influencing the effectiveness of the KATC training approaches, the study will enhance public understanding of how KATC is undertaking its responsibilities. The study will also examine factors and problems, which need to be addressed, in order to improve farmers' training programmes in Tanzania and else where.

1.4 Objectives

1.4.1 General objective

The general objective of this study was to investigate the effectiveness of KATC training approaches in improving smallholders' irrigated rice productivity.

1.4.2 Specific objectives

i. To describe the KATC approaches as used in the irrigation schemes.
ii. To assess awareness, knowledge, adoption and productivity (AKAP), of the KATC trained farmers.
iii. To assess the perceptions of farmers on the effectiveness of KATC training approaches in meeting farmers increased rice productivity.
iv. To examine extension workers' perceptions on the effectiveness of KATC training approaches towards increasing smallholders' irrigated rice productivity.
v. To analyze strengths and weaknesses of the KATC training approaches and its sustainability.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

According to Anderson and Feder (2003) many studies have demonstrated the high economic returns of investment in agricultural extension despite the difficulty of isolating its impact on agricultural productivity and growth from other factors. Investment in agricultural research and extension is thus crucial of agricultural growth. In a developing country like Tanzania, agriculture is the mainstay of the majority of the people's livelihood in the rural areas and of the national economy at large (URT, 2003). Therefore, focusing on improving viable farm production technologies for smallholder farmers and livestock keepers as a matter of priority will encourage the adoption of new technologies and help to raise farm profitability.

For many years, conventional extension practices in Tanzania emphasized on oral communication at the expense of visual stimuli. Farmers were frequently assumed to be illiterate, and often little attention was paid to female farmers who often felt inhibited in male dominated groups. The authorities used promises of higher yields, material benefits that made farmers to carry out technical interventions developed by outsiders. However, the most effective pedagogic way to come to farmers' understanding of complex issues is "learning by doing", "action learning", "experiential learning" and "discovery learning". All these principles stress the need to be involved in actions and debate in order to build up experiences, which, in turn,

are showed with other people and learn more in an interactive process of action, reflection, self evaluation and new action. Instead of being taught extension techniques, farmers are inspired to analyze their situation together, to put forward and try out their own ideas and other technical options they know. These experiences and lessons are then shared with other farmers and the larger community (Wambura *et al.*, 2000).

In the past, the government adopted systems and/or approaches to extension that have been mere extrapolation of approaches in donor countries and have essentially been supply driven. In other words, agricultural technologies were developed at research stations and chosen for delivery by scientists or bureaucrats in the government. Limited training capacity and poor back up from the main support services to agriculture have added constraints on extension. The adopted systems and/or approaches never took into consideration farmers' issues, needs and their involvement. They never undertook systematic investigation of what farmers expect from extension and of the role it should play. As a result they ended up developing and disseminating blanket recommendations (Moris, 1991).

In order for scientific research to achieve a real impact on farm productivity and livelihoods, new methodologies for dissemination of information have to be developed or adapted (Madukwe, 2006). The main direction of reform in agricultural extension is towards learning rather than teaching paradigm. This learning approach should incorporate new methodologies and approaches that are

demand-driven and increase the real, interactive participation of local people at all levels of decision making in an extension delivery network. These methods require that the roles and responsibilities of researchers, extensionists, and local people be re-defined and shared. However, it is imperative that individual countries make situational analyses of the social, political, technical, economic and natural conditions prevalent in their areas before adapting any method, approach, or strategy. An integrated approach (comprising of different strategies) is recommended in diverse socio-cultural, economic and political situations in order to achieve the desired goals. Generally, a sound agricultural extension policy is indispensable to achieve success in transferring knowledge to farmers.

2.2 Farmer training in Tanzania

Farmer training is not a new phenomenon in developing countries. In Tanzania, farmer training existed before colonial era. Farmer had their own informal way of sharing agricultural knowledge. During the colonial era, the colonial administrators were responsible for providing extension services. The main extension approach was the focal point approach. It was a one-way flow of information and farmers did not participate in decisions that conceived their farming problems and their life in general. Farmers were regarded as the passive recipient of technology and agricultural officers were seen as doctors who gave prescription on farmers' problems. Human capital development was not regarded to be important by itself but only as a way to production improvement. To ensure high returns "focal point"

which concentrated in high potential areas in the north and western part of the country was adopted.

According to Kauzeni (1992), extension education falls into the category of informal education. In order to enhance agricultural education at the grassroots level, several farmer training centres were established in the early years of independence. These centres were aimed at training farmers in various disciplines of agriculture, according to the locality. Farmer training centres performed very well up to 1972, when they were transferred to the Prime Minister's office and subsequently to the Ministry of Education.

After independence, different agricultural delivery systems were adopted, which include transformation, modernization and improvement approaches. In these approaches, the work of extension officers was to help farmers to access credits, technical information and acquire inputs. However, decisions were centrally made and farmers were there to implement. Since the mid 1980s, Tanzania has taken a number of reform programmes in various sectors including agriculture underpinned by implementation of structural adjustment programmes. Governments in most developing countries adopted a pluralistic mode of delivery extension service. More participatory approaches that are aimed at increasing farmers' participation, human capital development, extension-research linkages, needs based assessment were adopted. Participatory approach has been adopted by KATC as well in the delivery of agricultural extension services.

2.3 Extension service and farmer training in rice farming

Although the farmer training has been the basic function in the National Extension System (NES), which entails the residential training at a farmer training center involving one day course on specific topic and farm tour/inter regional study tour; the overview given is about extension and farmer training in general. The type of extension given is holistic in that it covers all major crops and livestock (Mwasha, 2000). However, of recent, a pilot initiative on “Farmer Field Schools” (FFS) was initiated by FAO to work in collaboration with MAC to try this type of extension approach on rice farming. A trial run of this pilot training was carried out in Mkindo in Morogoro region and its results are promising. Efforts have been to pilotize this concept further to various districts.

According to Nduru (2000), farmers training in rice farming in Kenya have been done in Mwea Irrigation scheme (MIAD – Mwea Irrigation Agricultural Development Centre) where the training facilities were available. The farmers training which had been carried out in irrigation schemes in one week intervals have been well organized since 1996. The training is residential for Key farmers selected from the schemes that are outside the district and non-residential for Mwea farmers. Before training, farmers’ training needs are assessed through questionnaires given out to all the farmers and training is then managed based on the identified training needs. Training is also based on research findings where new technologies on crop husbandry and new varieties are communicated to farmers.

A total of 30 farmers have been attending these trainings per year and other farmers were expected to be learning from the trained farmers. The key farmers are elected and recognized by other farmers as leaders and have a duty to teach them whatever they have learnt during the sectional meetings. Farmers outside the irrigation scheme get a different kind of training. They are not given specific training for rice farmers, but aspects of rice agronomy are covered in crop husbandry courses organized by the extension staff from the Ministry of Agriculture.

In Uganda, agricultural production reached its peak in the 1960s in some of the major crops (Abong, 2000). This achievement was also backed by a strong extension system and farmer training. Each of the old districts had a District Farm Institute where farmers are brought in, accommodated and given practical training which exposes them to different field experiences. Agricultural shows, and field days, were common phenomena. This went on very well until the country was plunged into chaos upon which time farmer training was greatly affected. It was not until recently when most of the programmes are again being revived.

Abong, (2000) also reported that many training events on improved technologies in Uganda are conducted by the National Agricultural Research Organization (NARO) for extension staff and farmers. Some of these events are organized by NARO's own initiatives but many are also responses to demands from farmer groups and extensionists of Non Governmental Organizations (NGOs) and Community Based Organizations (CBOs). On-farm trials and demonstrations are conducted by NARO.

These trials and demonstrations cover all farming systems and embracing new technologies in crops, agricultural engineering, post harvest technology, livestock production, aquaculture, and agro forestry. The trials and demonstration are conducted in a participatory manner with the farmers and/or farmer groups in collaboration with extension staff and technology transfer agents from the NGOs and CBOs.

Each of the NARO institute has established an outreach programme initially targeting a radius of 10 km around the institute. More than 50 farmer groups have been identified, and the technology needs assessment has been organized which, included demonstrations, trials training courses and sensitization workshops. It was realized that up to the year 2000 there were no proper farmer training programme in Uganda. It was then expected that the government policy in the Plan for Modernization of Agriculture (PMA) will go a long way to set up a proper training policy for farmers in addition to extension workers in the service.

2.4 Background of KATC

Kilimanjaro Agricultural Training Center (KATC) was established in 1994 with the aim of spreading the successes of Lower Moshi Irrigation Scheme to all other schemes practicing irrigated rice cultivation through training of technical personnel i.e. Village Agricultural Extension Officers, Irrigation Technicians and some Key Farmers. As a government institution, belonging to the Ministry of Agriculture, Food Security and Co-operatives, the Directorate of Research and Training, KATC,

through Japan International Co-operation Agency (JICA) started to implement training programmes in various irrigation schemes in the country. The overall objective of this being improving irrigated rice productivity and the general social-economic conditions of the small-scale farmers in irrigation schemes on improved irrigated farming with special emphasis on irrigated rice cultivation and thereby increasing the net return rate for the farm families.

2.4.1 KATC extension approaches

KATC applies Participatory Farmers Training and Extension Approaches in reaching farmers in the irrigation schemes. In these approaches, KATC uses group approaches in training of Key Farmers (KFs), Intermediate Farmers (IFs) and extension officers. Farmer-to-farmer extension approach is used by KATC whereby, the training involves training of key farmers who later train five intermediate farmers. The intermediate farmers are then involved in sharing their knowledge to other two farmers who are termed as Other Farmers (OFs). The chain goes on to the extent of involving other irrigated rice growers in and out of the scheme through field days and farmers' days.

The KATC training approach consists of five major steps. These steps are as follows: Step 1: Field survey using participatory approaches (PLA) to identify training needs. Step 2: Short courses for scheme leaders and KFs at KATC to motivate key players in the scheme. Step 3: Field training programme in the respective irrigation schemes for intermediate farmers. Step 4: Follow-up activities to ensure that action plans for

trials, demonstrations, organizational activities are implemented, Step 5: Farmer-to-Farmer extension is carried out involving all other farmers in the model sites with support from local governments (district councils).

2.4.2 KATC Phase II project

KATC Phase II Project was a five years project established since October 2001 by the Government of Tanzania in collaboration with the Government of Japan through Japan International Cooperation Agency (JICA). The Project was implemented under the Ministry of Agriculture, Food Security and Cooperatives using Kilimanjaro Agricultural Training Centre located in Moshi. The project was designed with the participation of local communities and other stakeholders. The main focus of the project was to improve the living standard of the people through increased rice productivity, increased area for irrigation, and increased net returns of farmers in the model sites through training and technical advice.

The project covered about six irrigation zones in Tanzania, namely Kilimanjaro, Morogoro, Mtwara, Tabora, Mwanza and Mbeya. It facilitated one selected irrigation scheme in each zone with the view that the surrounding schemes will emulate the technologies from the trained scheme. The trained schemes included Mombo in Korogwe, Mwega in Kilosa, Nakahuga in Songea, Mwamapuli in Igunga, Mbuyuni in Mbeya and Nduguti in Shinyanga. Parallel to the training of farmers from the six model sites across Tanzania, the project reached farmers beyond the borders of the country. Farmers from neighboring Kenya, Uganda, Zambia, and Malawi were

offered an opportunity to visit KATC for a two-week training program on irrigated rice production systems. The program included at least one field trip to one of the successful irrigation schemes in Tanzania, giving farmers from different countries an opportunity to exchange views and learn from each other.

2.4.3 Key farmers' training

Before the training and selection of key farmers is done, KATC, through Participatory Learning and Action (PLA), carries out a baseline survey in order to identify training needs in a participatory way by involving farmers and other stakeholders like the district and the zonal irrigation officials. Thereafter, twenty farmers are selected from each irrigation scheme as "key farmers" to undergo the training. The residential training course that the key farmers attend takes a period of three weeks whereby village agricultural extension officer together with the scheme irrigation technician also attend. The Key farmers training is then followed by scheduled in-field trainings which are carried out in each irrigation scheme following their cropping calendar. This is where more practical application of all the training undergone by the key farmers is done. Key farmers now become the main facilitators of the training in collaboration with their extension officers. KATC trainers also attend the training in order to give necessary assistance during the training. In order to make sure that women attend the course, the criteria for the selection of key farmers have been set whereby 50 percent of key farmers must be men and 50 percent women. The selection of Intermediate and Other farmers, who attend in-field training in their schemes, also follow the same criterion of selection.

With a goal of improving rice farming in rural communities, a key farmer is one with the following desirable qualities: must be exemplary rice farmer with relatively long experience in rice growing, preferably with good leadership qualities, must display a degree of co-operation with other farmers, must be willing to share knowledge and experiences gained at KATC with fellow farmers, and must have ability to read and write in Kiswahili. They are called key farmers because, upon their return to their own villages, they perform the fundamental function of training and guiding their fellow farmers. To ensure that this transfer of knowledge and skills is smooth, a unique scheme was designed where each key farmer is asked to select five fellow farmers to be intermediate farmers. The key farmers are obliged to share their acquired knowledge and skills with the intermediate farmers. Through this communication among the farmers, the information provided by the instructors at KATC is disseminated to as many farmers as possible in each of the six model sites.

In dealing with different irrigation schemes, spread out across the country as model sites that are different in size and condition, tailor-made training programmes/curricula are designed to meet the training needs of rice growing farmers. Therefore, rice farmers and the village agricultural extension officers participate in the training programs that have been adjusted according to their different conditions and needs. The curriculum period is three weeks and consists of improved rice cultivation as a core subject, supported by other subjects like water management, agricultural extension and agricultural machinery. Beside the major subjects, cross cutting issues of gender, environmental, family nutrition, and health

hazards are also taught. The curriculum devotes much time for study trips and farm visits as well as hands on activities as compared to theory classes. During the key farmers training courses, the farmers and the extension officers discuss ways of improving rice productivity in their areas. After the discussions they prepare rice improvement extension plan which is presented to other participants and trainers as a sign of commitment of what the farmers are to implement in their areas after they return home.

2.4.4 KATC training methods

At KATC, participative training methods are used for more efficient training and hence learning. These methods are presentation methods, which involve lectures and demonstrations; interactive methods, which involve group discussions and role plays; and explanatory methods, which involve exercises and case studies. Others include participatory approaches, which involve hands on activities; and exploratory methods, which involve study trips and farm visits.

Training objectives are achieved through two ways communication between participants and trainers and among the participants themselves. Course participants i.e. Farmers and extension workers are also given freedom to participate fully in the evaluation of the training course for each subject/topic taught. The participants, among themselves and with the trainers, share individual experiences within the total collective strength of the learning group and the facilitating team. Approximately,

40% of the learning time is devoted to classroom lectures and group discussions, and 60% to exercises, field studies, practical assignments and group activities.

2.4.5 Achievement made through training of key farmers

During the KATC Phase II Project, KATC training has remarkably improved the rice yields from the average of 3 100 kg per hectare in year 2002 to the average of 4 300 kg per hectare in year 2005. The unit net returns from the rice cultivation in the model schemes has also increased from the average of 66.7% in year 2002 to the average of 73.1% in year 2005 (KATC, 2006a). Before the start of KATC Phase II Project, fifteen key-farmers' courses were conducted during KATC Phase I Project, which took place from 1995 to 1999. During the follow-ups made in different regions, observation made indicated that training of key-farmers at KATC had some positive effects on irrigated rice farming.

2.5 Agricultural extension approaches

According to Madukwe (2006), the failure of the various extension delivery approaches in developing countries to effectively engineer significant and sustainable agricultural growth has become a major concern to all stakeholders, including the donor community. The concerns have been fueled lately by the wave of pluralism, market liberalization and globalization sweeping across the world and giving rise to initiatives that will enhance efficiency and effectiveness of not only the sub-components of extension delivery but the entire system of technology generation, dissemination and use.

Despite the various attempts and efforts to improve the lives of rural farming population through increased agricultural productivity, the overall performance of the agricultural sector has been inadequate. The failure of the extension system to influence farmers to adopt improved technologies has been pointed out to be the major cause of poor performance, and which has been attributed to a number of reasons. These include inefficient bureaucratic management, ineffective extension approaches and methodologies, and unaffordable innovations. Others are project approach to extension with the consequence of gradual decline in extension performance after the expiration of the project phase, poor staffing in terms of quality and quantity, and financial constraints which lead to poor transport facilities, poor infrastructure and low salaries for extension workers (URT, 2003).

Studies by Isinika *et al.* (2005) and Mwasha (2005) showed that the poor response towards extension has been blamed on insufficient qualified extensionists, inadequate budgetary allocations, supply driven extension systems and insensitive response of agricultural extensionists to farmers' demands, due to seemingly inadequate financial compensation. As a result, extension efforts have failed to increase farmers' demand for extension services.

Mbozi (2001) and URT (2003), assert that farmers have for decades been subjected to a one-way barrage of general agricultural extension services provided by professional extensionists. The farmers have never been looked at as partners but as ignorant people who should be filled with all agricultural innovations from

professional extensionists. Scarborough *et al*. (1997) asserted that general extension approaches have limited effectiveness in making available a range of technological options from which farmers can choose. The reasons for the limited effectiveness of the general extension approaches are many. For example, Mutimba (1997) argues that in the general extension approaches there is lack of farmers' involvement in many extension programmes and little understanding of the needs of farmers. As a result, the general extension approaches have been seen as being ineffective in enhancing farmers' adoption of innovations.

The search for improved extension methodologies is an ongoing process (Madukwe, 2006). The triggering forces are a growing dissatisfaction with the existing methodologies and socio-economic developments that necessitate fresh approaches. The earlier approaches were followed by the integrated rural development approach, farming systems methods, the training and visit (T&V) system, the farmer-to-farmer extension approach, Farmers Field Schools (FFS) and other even more recent methodologies. Of the various methodologies developed over the past two decades, the T&V system enjoyed the widest geographical coverage and financing, owing to the World Bank patronage. However, this methodology is now falling out of favour. Two of the main criticisms leveled against it are that it follows a top-down approach, and that it is not sustainable, i.e. it collapses as soon as external funding runs out. Many countries are modifying the T&V system for several reasons, including high recurrent staff costs and difficulties in creating a unified extension service.

The extension through integrated rural development approach did not prove to be effective, mainly owing to a lack of interdepartmental coordination. Farming system methods remain useful when the planning of several farming-related components is focused on achieving optimal efficiency in resources use. Participatory extension methods have taken different forms, such as farmers' group methods, community based planning and FFS.

Farmer field schools are schools without walls where groups of farmers meet periodically with facilitators during the crop or animal cycle (Davis and Place, 2003). It is a participatory method of technology development and dissemination (FAO, 2001), based on adult learning principles and experimental learning. It reflects the four elements of experiential learning cycle, namely: concrete experience, observation and reflection, generalization and abstract conceptualization, and active experimentation. It has now been established in several African, Asian and South American countries, with millions of farmers participating. For example, over 900 FFSs are being successfully implemented in Kenya (Davis and Place, 2003).

The operation of the extension delivery approach is that of developmental organizations partner with extension personnel to identify or form farmer groups based on particular topics. For instance, there are groups based on passion fruit, poultry, beekeeping, and vegetable production. Farmer field schools hold field days for other FFS groups and neighboring farmers. This provides an opportunity for each participant to teach others what they have learned. At the end of the FFS cycle,

certain farmers are chosen by the group to be farmer facilitators. They can then lead their own farmer field school the following season. The extension officer's role has evolved from that of a primary knowledge source to that of a facilitator of knowledge creation. The extension agent no longer has to have all the answers, and the messages of extension are not centrally contrived but, instead, related to locally relevant problems emerging from the FFS study field. The FFS methods have transformed farmers from recipients of information to generators and manipulators of local data (Madukwe, 2006).

One important issue in FFS is that of sustainability without outside funding. It is a participatory approach, which facilitates farmer to demand for knowledge, and offers opportunity for the end users to choose, test and adapt technologies according to their needs. Through participation in FFS, farmers develop skills that allow them to continually analyze their own situation and adapt to changing circumstances.

Anderson and Feder (2003) substantiated that a key weakness of extension organizations that the FFS seeks to rectify is accountability. This aspect is addressed in two ways:- (i) The official trainers who conduct the field school are bound by a strict timetable of sessions within a pre-specified curriculum, which can be easily verified by supervisors; (ii) The continuous interaction with a cohesive group of trainees creates certain accountability to the group. This is followed by the participatory nature of the training methods. Accountability to farmers is greatly enhanced when farmer-trainers, who are members of the same community,

administer the training. These features are thus expected to ensure the quality of the service (knowledge) provided to the farmers.

According to Yang *et al.* (2002), in the FFS approach, indigenous technical knowledge of farmers is given a central place in the most literal sense. The roles of the extension and research staff as ‘teachers’ and that one of farmers as ‘listeners’ are completely reversed. The farmers teach the scientists, who are sitting in the classroom, their knowledge of and experience with agricultural innovations. The farmers’ problems should be the guidelines for agricultural research. The most important precondition in this approach is that researchers have to identify themselves with the members of their target group. An adequate understanding of the farmers’ needs and aspirations must be realized.

The FFS method has demonstrated its usefulness in Integrated Pest Management (IPM) Programmes, especially in Southeast Asia, mainly because it is environmentally friendly. However, this method is now being almost over promoted, and other suitable and less expensive extension methods are not being identified, a situation that is reminiscent of the history of the T&V system. The main strength of the FFS system is its use of participatory processes for learning and decision-making by farmers, who attend regular training sessions, which are led by a facilitator and held in a farmer’s field throughout a cropping season. Its main weaknesses are that the method is too costly, hence its sustainability is questionable, it barely involves

national extension systems, and it demands farmers' and facilitator's physical presence in the field for long periods for IPM education alone.

The farmer-to-farmer extension (FTF) approach is an informal system by which a core of selected and trained individual farmers in a community spread agricultural innovations to fellow farmers. In the FTF approach, a core group of farmers are selected and trained in practical skills of various innovations to act as extension agents to their fellow farmers. Agriservices (2003) describes farmer-to-farmer extension (FTF) as an approach in which trained farmers are the primary extension agents to fellow farmers with or without the support of external change agents. Furthermore, Hoffman (2002) described "farmer trainers as individuals with little or no formal education who, through a process of training, experimentation, learning and practice, increase their knowledge and become capable of sharing it with others, functioning as extension workers".

Different names have been given to trained farmers who provide extension services to other farmers. Such names include: farmer extensionist, farmer promoters, paraprofessionals, community educators, resource farmers, farmer extension agent, extension volunteers, community agricultural advisors, farmer instructors, farmer trainers, teachers and key/intermediate farmers (Hoffman, 2002; Muok *et al*., 2002; Sonoko, 2001; KATC, 2006b; Scarborough *et al*., 1997; Alders *et al*., 1993). The main strength of the farmer-to-farmer extension method lies in its use of farmer's indigenous knowledge and the high value that it attaches to their opinions. While the

objective is to promote a grassroots methodology that does not have significant involvement from extension agents, it has its limitations. The organization of farmers in viable, homogeneous and sustainable groups is a challenge in itself. Furthermore, the technical knowledge of farmers may not reflect the latest developments in agricultural technology, and may encourage the continuation of inappropriate traditional practices. The old problem of weak linkages between research and extension still persists, and it is unlikely that there will be any real participation in research agenda formulation on the part of farmers (many of whom are illiterate).

The farmer-to-farmer approach is based on the recognition that farmers have more valuable information and experience to offer to other farmers than the external change agents have. Farmers have in-depth knowledge of local crops, practices, culture and individuals; they communicate effectively with farmers, and are almost permanently available in the community. More importantly, in the FTF approach, farmers are directly involved in all the stages of the generation and dissemination of innovations (Agriservices, 2003; Smith, 2003; Muok *et al*., 2002). Sharing of the subject matter, Mattee (1998) pointed out that the farmer-to-farmer extension approach in which the change agent plays a supporting role has been found to be effective in creating dynamism and encourages farmers to experiment on new ideas, new practices and new approaches, thereby increasing their self confidence.

From the Central American experience, farmer-to-farmer extension approach is defined as the one in which farmers help other farmers so that they can help

themselves to find solutions, and not to be dependent on technicians or the bank (PELUM and INADES, 1998). The authors further pointed out that the approach is farmer-led sharing of integrated experience whereby farmers commit themselves to change their lives and those of other people in a free and fair way with or without external influence.

Experience shows that no single system of agricultural extension is suitable for all situations and, therefore, extension approaches and methodologies should be developed according to the specific situation at hand. For this reason, it is possible that different methodologies may be needed for different situations, even within the same country. Nepal, where there are numerous microclimatic zones and agricultural activities taking place both on the mountains and on the plateaus, provides an example of such a country.

The search for improved extension methodologies is bound to continue. Turkey's extension service now offers its clientele a package of technical assistance and human resources development. A recent FAO sponsored case study carried out in northern Pakistan examines female extension office's use of rural women's community development groups. The women extension officers have used these groups as a platform for imparting extension advice rather than making individual field visits, which are difficult for cultural and religious reasons as well as from the point of view of personal safety.

Various agricultural extension approaches have been employed to deliver extension services to farmers in Tanzania. Such extension approaches include improvement approach, transformation approach, frontal approach and integrated rural development approach. Some extension approaches were more successful than others, but none of them was especially good in reaching and involving the majority of poor farmers. In general, the approaches have failed to increase farmers' adoption of agricultural innovations leading to poor agricultural production in the country (MAFS, 2001). Due to limited effectiveness of the general extension approaches, Scarborough *et al.* (1997) reports that over the last decade many organizations have found farmer-to-farmer extension approach to be effective in serving farmers' needs and are institutionally more sustainable. The farmer-to-farmer extension approach promotes farmers and other rural people as the principal agents of change in the provision of extension services.

According to Namwata (2004), the farmer-to-farmer extension approach has the potential of supplementing the existing extension approaches and of improving farmers' access to extension services. The farmer-to-farmer extension approach is comparatively inexpensive and can be used in areas where there is inadequate or absence of government extension staff. Furthermore, the farmer-to-farmer extension approach is also thought to reach and include the majority of poor farmers, thus increasing adoption of innovations. Similarly, KATC uses "farmer-to-farmer extension approach" in a form of KF-IF-OF extension approach whereby, the training involves training of Key Farmers (KFs) who later train five Intermediate

Farmers (IFs). The intermediate farmers are then involved in sharing their knowledge to other two farmers who are termed as Other Farmers (OFs).

2.6 Adoption of agricultural innovations

An innovation is an idea, practice or object perceived as new by an individual. Ngendello (2004), states that innovations have multiple sources. This makes rural people obtain information from many sources. It is widely acknowledged that the majority of farmers get to know about new technologies from extensionists, neighbours, friends, family members, community-based organizations and from the media. In addition to the public extension service, NGO's, the private sector and religious organizations are becoming increasingly important. The author continues to argue that the different objectives and working styles of these organizations complement each other and provide opportunities for improved collaboration.

Adoption of innovation decision process refers to a process through which an individual passes from first knowledge of an innovation to a decision to adopt or reject, to implementation of the new idea, and to confirmation of the decision (Supe, 1990). Five stages are conceptualized in the innovation adoption process, namely awareness, interest, evaluation, trial and finally adoption.

By awareness an individual is exposed to an idea but lacks detailed information about it. For instance, a farmer may know the name of a new crop variety, but may not know the details. Awareness makes one develop interest so that he/she becomes

motivated to find more information about the new idea. In the next stage, the individual will conduct a kind of an evaluation in which he/she will consider the relative advantages of the new practice over the other available alternatives. After having evaluated the technology the individual will apply it in small scale in order to determine its utility in his/her own situation. The innovation adoption stage is the last one in the technology adoption process. At this stage, the farmer uses the innovation continuously on a full scale as a result of being satisfied with the trials of the new innovations (Rogers, 1995).

Generally, farmers are hard to be convinced by words, they need practical demonstrations, which will stimulate them to tryout innovations themselves (Van Den Ban and Hawkins, 1996). Through demonstrations, farmers can see the causes of problems and possible solutions. Demonstrations are thus powerful tools in agriculture extension service since they can help to convince people more quickly through the triple process of observing, hearing, and learning by doing and experiencing things for oneself (Kauzeni, 1989).

According to Danda (2003), farmers should be involved in the project planning process right from the beginning. Participation helps them to learn to plan, find solutions to their problems, teach others, and organize themselves to work together. Furthermore, through participation farmers develop inventiveness, creativity and thereby promoting the adoption of improved technologies for increased production.

Peoples' participation further increases ownership, motivation, and ultimately sustainability.

In agricultural development, participatory approaches are used to assist the smallholder farmers to analyse their present situation, assess their problems and potentials, identify their objectives, and define steps necessary to achieve those objectives (IFAD, 2001). Participatory approaches comprise Participatory Rural Appraisal (PRA), Participatory Learning and Action (PLA), Community Action Plan (CAP), Participatory Monitoring and Evaluation and Participatory Beneficiary Assessment. Participatory approaches including Participatory Rural Appraisal (PRA) and Participatory Learning and Action (PLA) are now increasingly accepted as a philosophy and mode in rural development (Nagu, 1999). It describes an increasingly family of approaches and methods to enable people share and analyse their knowledge of life and conditions, plan and act. Participatory approaches have, at their core, the involvement of the beneficiaries in the designing and developing new technologies and practices, which have the potential of improving their lives.

2.7 Agricultural extension with participatory approach

Extension is an instrument of development and as such changes in our thinking on development will influence the practice. The previous formal extension model, which is based on technology transfer, has proved to be resistant to extension approaches other than itself. The shortcomings in the technology transfer model have made extensionists start thinking about an alternative model. The consensus has been

reached and participatory approach in agricultural extension has become the alternative to the formal extension model (AERDD, 1987). Participatory approach promotes shared understanding and empowerment, which lead to joint decision-making. The approach usually starts with consultations and moves to negotiations of problems, solutions and approaches to end with decision-making and action (IFAD, 2001).

Basically, extension approaches are divided into three major groups, namely personal contacts which include face to face; group methods, which involve meetings for example demonstrations; and mass methods, which entail written or spoken words. Currently, participatory approach in agricultural extension is highly advocated whereby active participation and involvement of smallholder farmers in the assessment, analysis, and action are important (Temu and Due, 1996).

2.8 Effectiveness and sustainability of agricultural extension

2.8.1 Effectiveness

Effectiveness of agricultural services has been conceived and measured differently by different people as the term depends on a number of aspects. Sonoko (2001), reports that the problem that must be faced when assessing the effectiveness of extension service is the complex organizational, economic and ecological settings, which impinge upon smallholder farmers. However, no one profession or academic discipline encompasses all the organizational, economic and ecological settings. For

example, according to Namwata (2004), those who see extension as technology transfer will focus on communicating information about improving farming practices to farmers, while those who deal with community problems will look at local leadership and how individual farmers participate in their communities.

Kauzeni (1989) and MAC (1999) substantiate that for extension to be effective, communication internally and externally, accessibility to extension services by small-scale farmers, and the ability of the extension worker to communicate and convince farmers to adopt innovations are important. Umali and Schwartz (1994), also point out that for an effective agricultural extension program, there is a need to have a smooth design and, regardless of the institutional channel, five major issues have to be resolved: these include objectives of the extension activities; the target audience; the content of the message; what methods will be the most effective to convey the messages and how can the activities of various extension sources be coordinated to ensure synergy in the extension effort. Schwartz (1994), also points out that for one to have an effective extension system, a strong linkage is required to other services like inputs, markets, advice, marketing and processing to recover costs, qualified staff, quality research, and the provision of services affordable to poor farmers.

According to Heemskerk (2006), the effectiveness of an extension approach as perceived by farmers would determine, to a great extent, the adoption of production recommendations. Many studies show that it is difficult to measure effectiveness since it is a complex concept. It is even difficult in agricultural development

stagnation or failure since it depends on many other factors. Evenson (1997) indicates that it is convenient to visualize extension as achieving its ultimate economic impact by providing information and educational training services through the following sequence: (A): Farmer awareness; (K): Farmer knowledge, through testing and experimenting; (A): Farmer adoption of technology or practices; and (P): Changes in farmers' productivity.

While the AKAP sequence has a natural ordering, it is clear that real resources in the form of skills and activities by both extension staff and farmers are required to move along the sequence (Evenson, 1997). Awareness is not knowledge. Knowledge requires awareness, experience, observation, and the critical ability to evaluate data and evidence. Knowledge leads to adoption, but adoption is not productivity. Productivity depends not only on the adoption of technically efficient practices, but of allocatively efficient practices as well. Productivity also depends on the infrastructure of the community and on market institutions. Extension services affect each part of the sequence. They can be seen as both substitutes for and complements to the acquired skills of their clientele farmers. Empirical evidence indicates that they are, on balance, net substitutes for farmers' skills as reflected in farmers' schooling. For example, extension services are typically not the only sources of information (awareness). Skilled farmers can seek information on their own. Farmers with few skills may not do so. Extension information then may have a higher impact on farmers with less schooling. The author substantiated more that it appears, however, that the awareness-knowledge part of the sequence is where extension services are

strong substitutes for farmer schooling. Through organized frequent contact, they "teach" farmers, and this is more than simply informing farmers.

According to Mattee (1994), for extension activities to be effective the cited problems hindering its effectiveness shall be addressed. These include insufficient manpower, financial constraints, and the haphazard nature of agent's contact with farmers. Others include irrelevant technological packages and services reliance on a large number of paraprofessionals. Matee and Mollel (1990) and MAC (1999), assert that extension activities are likely to be effective if they are accessible to farmers and that they address practical problems. Supporting this view, Urio (1996) substantiates that effectiveness of extension approach is determined by several factors such as the extent to which it can help farmers to increase yields, respond to the need of farmers. It is also determined by the compatibility of advice it gives to farmers' circumstances. Urio (1996) observes further that some approaches are considered to be effective because of the input package offered, effective supervision, motivation to extension workers, low bureaucracy and more realization in yield increase.

According to Pangani (2006), it was realized that effectiveness can be measured by observing the relationship between achievements of existing activities in relation to the assumed goals. Schwartz and Kampen (1992) indicate that to agricultural extension, effectiveness refers to the extension systems ability to achieve goals (results). Similarly, Weihrich and Koontz (1993) define the term effectiveness as a measure to which a programme or project is successful in achieving its objectives.

MAC (1999) reports that analysis of the rate at which recommended improved agricultural technologies have been adopted by smallholder farmers provides a measure of the effectiveness of agricultural extension services under NAEP II Project also supports this view. On the other hand, Kauzeni (1989) argues that evaluation of agricultural extension service effectiveness means measuring performance of an agricultural extension programme. The author substantiates further that the effectiveness of agricultural extension services can also be measured in terms of the adoption of agricultural innovations, acquired knowledge of farming practices and improvements of yields. In this study, the effectiveness of agricultural extension services from the KFs and the IFs was measured in terms of awareness, acquired knowledge, adoption level of improved irrigated rice innovations and productivity.

2.8.2 Sustainability

According to ILO (1990), project sustainability is defined as the extent to which a partner country institution will continue to pursue the objectives after the project assistance is over. On the other hand, Brinkerhoff and Goldsmith (1990) report that the term sustainability means continuation of benefits flow to the people with or without the programme or organization that stimulated the benefits in the first place. In the study done by TARP II SUA (2005) on the adoption of technologies for sustainable livelihoods, sustainability of the introduced technologies was measured by examining whether the farmers would continue to use the adopted technologies and through identifying constraints leading to not using the technologies.

Efforts to operate effective and efficient extension services in Tanzania are reflected in the large number of extension projects in operation in the country in both crops and livestock sectors. A study done by Mdemu (2000) revealed that the need for effective extension services prompted the development of Demand Driven Extension Services in Iringa region as practiced by other associations to make agricultural extension services sustainable.

The concept of sustainability is quite often reduced to the question of whether local institutions will be able to continue providing the services that have been provided by the donor aided project. Other aspects, however, are at least equally important for safeguarding and improving the living conditions of the target population. These include institutional sustainability, ecological sustainability, economical sustainability and social sustainability. This means that the target groups are in position to help themselves to a high degree and to effectively articulate their interests to the supporting agencies (CATAD, 1988).

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the research methodology that was used in the study. The chapter is divided into six sections which are the introductory part, description of the study area and the third part describes the research design. Other sections include sampling procedures, instrumentation and pre-testing, and lastly is data collection procedures, processing and analysis.

3.2 Description of the study area

The study was conducted in two districts which are Korogwe and Kilosa in Tanga and Morogoro region respectively. The study was specifically done in two specific irrigation schemes namely Mombo irrigation scheme in Korogwe district and Mwega irrigation scheme in Kilosa district.

3.2.1 Mombo irrigation scheme

Mombo irrigation scheme is located in the northern part of Korogwe town and it is two kilometers westward from Mombo town. The scheme is within the Mombo ward which is having a total population of 15 936 people whereby 7 659 are males and 8 277 are females (URT, 2002a). A total of 429 farmers (274 males and 155 females) who are cultivating in the scheme come from Mombo, Jitengeni, Mlembule and Mwisho wa shamba villages. The scheme is having a total of 220 ha of irrigated area

which is used for paddy production with all the year round rice crop season. The status of the scheme is improved, fully operational and is having a valid water right. The owners of the scheme are the smallholder farmers under the umbrella of a Farmer's Organization (FO) known as Mombo Irrigation Scheme Agricultural Cooperative Society with the registration number 2 702. The total number of members of the FO is 300 out of 429 farmers of the scheme. The non members are 129.

Topographically, the land, which is enriched with clay loam soils, is almost flat. The lowland areas of Korogwe district (Mombo Irrigation Scheme being inclusive) demonstrate subtropical type of climate characterized by moderate to high temperatures with mean annual rainfall ranging between 400 – 800 mm. The rainfall pattern in many parts of the district is bi-modal with two rainy seasons resulting from migration of the Inter-Tropical Convergence Zone (ITCZ). The long rains are from March to June due to north bound migration of ITCZ (from December to April) and the short rains are from November to December/January. Generally, the amount of rainfall is greater during the long rains. Likewise, the area experiences two phases of hot season which are from January to March and from October to December. The cold season is experienced in June, July and August.

3.2.2 Mwega irrigation scheme

Mwega Irrigation Scheme is found in Malolo ward which is in Mikumi division in Kilosa district in Morogoro region. It is situated some 20 km from Ruaha mbuyuni

village. The Kilosa District has a population estimate of 447 993, of which 228 476, are males and 219 517 are females. The Malolo ward, which comprises four villages of Mgogozi, Malolo A, Malolo B and Chabi, has a total population of 8 935 of which 4 775 are males and 4 160 are females (URT, 2002 b). Most of the farmers in Mwega Irrigation Scheme come from these villages. Kilosa district is located between latitude 6°04'-7°53'S and Longitude 36°30' - 37°30' with a total area of 1 424 540 ha. The district is having 536 590 ha of arable land whereby the cultivated area is 100 000 ha. While the potential irrigable area is 26 806 ha; the currently irrigated area is 3 771 ha.

The district is characterized by a dry tropical climate experiencing mean annual temperatures of 25°C where the highest temperature is 30°C recorded in March and the lowest temperature is 19°C recorded in July. The central plain and southern part of the district receive a bimodal rainfall ranging from 1000-1400 mm per year, while the Northern part of the district receives a unimodal rainfall ranging from 800-1000 mm per year (Mung'ong'o and Mwamfupe, 2003). Mwega Irrigation Scheme receives heavy rains in March – April and moderate rains during May, December and January. The hot season is experienced in February, September and October; while the cold season is in November, June and July. Land in Mwega Irrigation Scheme is undulating and comprising loam sand, sandy loam, sandy clay loam and clay loam.

Mwega Irrigation Scheme is owned by smallholder farmers who are joined together with Irrigators Organization known as CHAUMWE with a total of 790 farmers of which 593 are males and 197 are females. Out of the 790 farmers, 720 are members of CHAUMWE and 70 are non members. The scheme has a total irrigated area of 580 ha where cultivated crops include maize, onions, paddy and beans. Other crops are tomatoes, pepper and sweet potatoes. While maize is grown twice a year; the rice crop season is from October to June. The irrigation infrastructure for Mwega scheme has been improved under the financial assistance from the Government of Japan that has resulted into the expansion of the irrigated area from the former 477 ha to 580 ha. The scheme has a permanent water source and became fully operational by 2002 with a valid water right.

3.3 Research design

A cross-sectional survey design was applied in this study. A cross-sectional survey design involves a collection of data at a single point in time from a random sample selected to describe the population at that particular time (Babbie, 1990; Creswell, 1994). The design was suitable for the purposes of description as well as for the determination of the relationships between variables. The design was also considered favorable because of the limited time for collecting data.

3.4 Sampling procedures

A combination of random and purposive sampling techniques was employed to sample the population from the study area. While purposive sampling was adopted to

facilitate the choice of two irrigation schemes from the group of irrigation schemes that received KATC Phase II Project training programmes; simple random sampling was employed to choose farmer respondents by using random numbers from each selected irrigation scheme. On the other hand, extension officers i.e. District Subject Matter Specialists (DSMS), Ward Agricultural Extension Officers (WAEO), Village/Scheme Agricultural Extension Officers (VAEO) and Irrigation technicians (ITs) were picked from each district and irrigation scheme where farmers' respondents were drawn. This has been adopted for the reason that it was convenient to interview extension officers in those areas where they are working. Also by virtue of being few (less than ten) it was advantageous to pick all of them.

3.4.1 Survey population and sampling frame

The survey population for this study consisted of all the trained irrigated rice farmers in the trained irrigation schemes. Others include DSMSs, WAEOs, VAEOs and ITs in the study area. Thereafter, five sampling frames for this study were identified which include: (a) the list of key farmers in the scheme, (b) the list of intermediate farmers in the scheme, (c) the list of all Extension staff, (VAEOs) and Irrigation technicians (ITs) present in the study area, WAEOs, DSMS Irrigation, DSMS crops and DEO in the respective wards and districts.

3.4.2 Sample size

The sample size consisted of one hundred and twenty two people of whom one hundred and eight were farmers and fourteen were Extension staff (DSMS, WAEO,

VAEO and ITs) working in the respective districts, wards and in the study area. The sample size of farmers in one irrigation scheme consisted of fourteen KFs (out of 20 KFs) of which seven were females and the other seven were males, twenty IFs (out of 100 IFs) of which ten were females and the other ten were males, twenty OFs (out of 200 OFs) of which ten were females and the other ten were males.

3.5 Pre-testing of the instrument

The validity of the instruments were established through pre-testing where by 14 farmers and 2 extension staff were interviewed in Mijongweni Irrigation Scheme in Hai district where the study was not intended to be done. This was done to check for any discrepancies and ambiguities in the wording of items, clarity and comprehensiveness so as to obtain the reaction of respondents with respect to certain items of the questionnaire. After pre-testing adjustments to the instruments were done accordingly prior to the data collection exercise.

3.6 Data collection procedures

Two types of questionnaires were designed as instruments for data collection. These questionnaires were aimed at collecting primary data from irrigated rice farmers and extension officers in order to cover the five specific objectives by looking through the research variables. District Subject Matter Specialists (DSMS), Ward Agricultural Extension Officers (WAEO), Village Agricultural Extension Officers (VAEOs) and Irrigation technicians (ITs) were served with self-administered questionnaires while farmers were subjected to interviewers' administered questionnaires. The interview

schedules were administered by the researcher with the assistance of trained interviewers. The questionnaires consisted of closed and open–ended questions. The study adopted a five point Likert-scale type of interview items for soliciting perceptions of farmers concerning KFs and IFs efforts in disseminating innovations, their credibility and homophily/heterophily with farmers and effectiveness of all extension approaches, methods and innovations used by KATC in the training programme. Secondary data for supplementing primary data were collected from published and unpublished reports and records relevant for the study, maintained by KATC, selected irrigation schemes as well as responsible districts and Zonal Irrigation Offices. Other areas include Internet and Sokoine University of Agriculture National Agricultural Library (SNAL).

3.7 Data processing and analysis

The collected data from the primary sources were coded, summarized and then uploaded on a computer. The analysis was done with respect to the study objectives using Scientific Package for Social Science (SPSS) 11.5 computer programme. Descriptive statistics were used to obtain frequency counts and percentages of various coded responses and to compare means of quantitative responses of variables related to respondents' characteristics like age, gender and education levels, description and sustainability of the KATC training approaches and innovations. Distribution analysis such as Cross tabulations and Chi-square tests were carried out to get joint frequency distribution of cases on categorical variables (KFs, IFs and OFs) and on the detection of associations among variables e.g. in the adoption level

of irrigated rice innovations among the trained farmers categories. Moreover, content analysis on specific information relevant for the study objectives obtained from the focus group and informal discussions with key informants were used so as to meet the study objectives.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents and discusses the findings of the study. The chapter is divided into five main sections. Section one presents the description of the KATC approaches used in the irrigation schemes and some characteristics of the respondents, while Section Two describes the respondents' decisions and reasons for deciding to participate in the training. Others aspects covered in this section include knowledge levels of respondents on irrigated rice before and after KATC interventions; interest and preferences on training approaches used; sources of awareness and knowledge on improved irrigated rice cultivation. Also, included in Section Two are adopted innovations on improved irrigated rice cultivation, reasons for their adoption, rejection and the diffusion of innovations to other farmers in the schemes. Section Three discusses the trends of rice production before and after KATC training, the achievement of targeted yield, as well as major problems encountered by farmers during implementation. Section Four looks at respondents' perceptions on the effectiveness of KATC training approaches in meeting farmers increased rice productivity; and lastly, Section Five presents the strengths and weaknesses of the KATC training approaches and its sustainability.

4.2 Characteristics of respondents

Table 1 shows the general characteristics of respondents, which included age, sex and education levels. The study results show that about half of the respondents, 57 (52.8%) from the three categories were in the age group of between 31 and 43 years

old, while 25 respondents (23.1%) were between 44 and 56 years old, 20 respondents (18.5%) were between 18 and 30 years old and six respondents (5.6%) were over 56 years old. The age structure implies that most of the respondents were in the active working group and could take risks in agriculture. Therefore, they were more likely to try innovations, evaluate and adopt them if found promising. Not only that, but also the 23.1% of the respondents who were between the ages of 44 and 56 years comprised a group of experienced farmers in rice farming. Further, Table 1 shows that there were equal representations of males and females, 14 (50%), 20 (50%) respectively for the KF and OF categories of respondents, whereas the percentage of female respondents was higher in the IF category 26 (65%) than that of the male respondents.

Table 1: Respondents' age, sex and education level (N=108)

Variable	Respondent category						Total (N=108)	
	KF (n=28)		IF (n=40)		OF (n=40)			
	n	%	n	%	n	%	n	%
Age groups								
18yrs-30yrs	5	17.5	9	22.5	6	15.0	20	18.5
31yrs-43yrs	15	53.6	21	52.5	21	52.5	57	52.8
44yrs-56yrs	7	25.0	8	20.0	10	25.0	25	23.1
>56yrs	1	3.6	2	5.0	3	7.5	6	5.6
Sex								
Male	14	50.0	14	35.0	20	50.0	48	44.4
Female	14	50.0	26	65.0	20	50.0	60	55.6
Education level attained								
No formal education	1	3.6	3	7.5	8	20.0	12	11.1
Adult literacy classes	0	0.0	12	30.0	1	2.5	13	12.0
Primary school education	26	92.9	24	60.0	30	75.0	80	74.1
Secondary school education	1	3.6	1	2.5	1	2.5	3	2.8

Despite the emphasis done by KATC on gender balance in the training, the study showed that more women than men were often available during training sessions. The results are in line with the findings of Namwata (2004) who found out that more

women than men were often available during training sessions on agricultural innovations provided by paraprofessionals (PARAs).

On education levels, 74.1% of the respondents had completed primary school education, and 12% of the respondents had attended adult literacy classes, while 11.1% and about three percent had not attended formal schooling and completed secondary education respectively. Since a big proportion of the respondents had some formal education, it implies that most farmers benefited from training programmes and easily adopted the innovations. It was therefore, expected that they were good representatives of KFs and IFs because they could write, keep records and read various extension materials.

4.3 Description of the approaches

4.3.1 Selection of KFs, IFs and OFs for the training

Table 2 presents respondents willingness and reasons for deciding to participate in the KF-IF-OF training approach. The study found out that farmers were involved in the training programme on voluntary basis and were selected mainly by involving Farmers Organizations (FOs) members in collaboration with extension workers, and village government leadership, and adhered to the set criteria for selection. According to Hoffmann (2002), the use of selection criteria in selecting farmer trainers might reduce conflicting interests and complaints from the community members. The use of selection criteria makes it easier to identify those who are willing and able to teach the technology to other farmers. The study findings showed

that all respondents were willing and eager to participate in the KF-IF-OF training approach. According to the study done by Mlozi (2005), it was found out that farmers' willingness to learn has some influence on the adoption of improved technologies and practices to occur.

Table 2: Respondents' reasons on deciding to participate in the KATC approach/training (N=108)

Variable	Respondent category						Total (N=108)	
	KF (n=28)		IF (n=40)		OF (n=40)			
	n	%	n	%	n	%	n	%
If farmer was willing to participate in the training								
Yes	28	100.0	40	100.0	40	100.0	108	100.0
No	0	0.0	0	0.0	0	0.0	0	0.0
Reasons for participation								
To gain knowledge and skills	28	100.0	40	100.0	40	100.0	108	100.0
To modernize farming business and get success	25	89.3	27	67.5	25	62.5	77	71.3
To get higher yield	28	100.0	40	100.0	40	100.0	108	100.0
To improve household food security	26	92.9	35	87.5	33	82.5	94	87.0
Impressed by success of other farmers	-	-	27	67.5	34	85.0	61	76.3
To see whether KATC approaches helps	28	100.0	31	77.5	30	75.0	89	82.4
Interested in the innovations promoted	28	100.0	40	100.0	40	100.0	108	100.0
To get quick and close services from KATC & VAEO/KFs/IFs	28	100.0	40	100.0	32	80.0	100	92.6
To improve livelihoods	21	75.0	33	82.5	31	77.5	85	78.7
To advice and train other farmers and get respect	25	89.3	36	90.0	-	-	61	89.7

All farmers decided to participate in the training in order to gain skills and knowledge on improved irrigated rice cultivation, so as to get higher rice yields. Other reasons reported by farmers included getting quick and close services from KATC/VAEOs/KFs/IFs 100 (92.6%); improving household food security 94 (87%); seeing whether KATC approaches helped 89 (82.4%); improving livelihoods 85 (78.7%) and modernizing farming business 77 (71.3%). Of the 108 respondents, 61

(76.3%) of the IFs and OFs were impressed by the success of their fellow farmers, while about 90% of the KFs and IFs respondents showed interest in advising and training other fellow farmers.

4.3.2 Awareness and preferences to training approaches

Table 3 shows respondents' awareness and their preferences to training approaches used by KATC. The study results indicate that 93 (86.1%) of the respondents remembered the training approaches used in the training programme.

Table 3: Respondents' awareness and preferences to training approaches used (N=108)

Variable	Respondent category								χ^2 value	df	Sig. level
	KF (n=28)		IF (n=40)		OF (n=40)		Total (N=108)				
	n	%	n	%	n	%	n	%			
If farmers remember the training approaches											
Yes	28	100.0	35	87.5	30	75.0	93	86.1	8.710	2	0.013NS
No	0	0.0	5	12.5	10	25.0	15	13.9			
Farmers preferences to the approaches											
Use of KF-IF-OF	28	100.0	36	90.0	26	65.0	90	83.3	16.560	2	0.000**
Residential training	28	100.0	34	85.5	30	75.0	92	85.2	8.159	2	0.017*
Field training	28	100.0	38	95.5	36	90.0	102	94.4	3.176	2	0.204NS
Demonstrations/Trials	27	96.4	38	95.0	35	87.5	100	92.6	2.451	2	0.294NS
Field and Farmers days	28	100.0	36	90.0	35	87.5	99	91.7	3.600	2	0.165NS
Study tours/exchange visits	28	100.0	31	77.5	24	60.0	83	76.9	14.829	2	0.001**
Crop competitions	21	75.0	20	50.0	15	37.5	56	51.9	9.365	2	0.009*
Printed materials	25	89.3	27	67.5	22	55.0	74	68.5	9.006	2	0.011*
PLA	28	100.0	33	82.5	26	65.0	87	80.6	13.034	2	0.001**

** Significant at 0.001; * Significant at 0.05; NS: Not significant at 0.05.

The results shows further, that the majority of the respondents 102 (94.4%) preferred field training approaches, 100 (92.6%) of the respondents preferred demonstrations

and farmer managed trials, and 99 (91.7%) of the respondents preferred field and farmers days. However, the study findings revealed statistical significant differences between means among the trained farmers towards their preferences to the use of KF-IF-OF approach at $p<0.000$. The study tours/exchange visits showed a significant difference at $p<0.001$, while 28 (100%) of the KFs and 31 (77.5%) of the IFs preferred the use of this approach compared to 24 (60%) of the OFs.

On the other hand PLA also showed a significant difference between means at $p<0.001$, while 28 (100%) of the KFs and 33 (82.5%) of the IFs preferred the use of this approach compared to 26 (65%) of the OFs. This implies that KFs and IFs benefited more from these approaches than did the OFs. Being the least beneficiaries, only few OFs participated in the study tour/farmers exchange programmes as well as in the PLA. The use of crop competitions showed a significant difference at $p<0.009$ as 21 (75%) of the KFs showed interests in the approach compared to half, 20 (50%) of the IFs and 15 (37.5%) of the OFs. The use of printed materials, on the other hand, showed a significant difference at $p<0.011$, while 25 (89.3%) of the KFs showed interest to using the approach compared to 27 (67.5%) of the IFs and 22 (55%) of the OFs. While all 28 (100%) of the KFs and 34 (85%) of the IFs preferred residential training approach, 30 (75%) of the OFs showed interest in the approach. It was found out that all KFs in the programme attended three weeks residential training on improved irrigated rice cultivation at KATC Moshi before going back to their schemes to form groups of IFs and train them.

4.3.3 Sources of awareness of improved irrigated rice cultivation techniques

According to Danda (2003), technologies and practices need to be communicated from the source to the receiver. A source in technology transfer refers to the point of origin of the message; it could be inventors, researchers, change agents, opinion leaders, etc. In the perspective of this study, source is used to mean the origin of the technology according to the perceptions of the farmers. Table 4 presents the distribution of respondents' sources of awareness on improved irrigated rice cultivation technologies. The majority of respondents 84 (77.8%) indicated that KATC trainers were the principle source of awareness, and it was significant at $p<0.003$. Most of the IFs 38 (95%) and IFs 35 (87.5%) showed demonstration and field days to be another major source of awareness and this was statistically significant at $p<0.001$.

Table 4: Respondents' sources of awareness on improved irrigated rice cultivation technologies (N=108)

Sources	Respondent category								χ^2 value	df	Sig. level
	KF (n=28)		IF (n=40)		OF (n=40)		Total (N=108)				
	n	%	n	%	n	%	n	%			
KATC trainers	25	89.3	35	87.5	24	60.0	84	77.8	11.647	2	0.003*
VAEOs and ITs	22	78.6	22	55.0	15	37.5	59	54.6	11.213	2	0.004*
KFs and IFs	-	-	36	90.0	26	65.0	62	77.5	7.168	1	0.007*
Demonstrations/Field days	-	-	38	95.0	35	87.5	73	91.3	1.409	1	0.235NS
Other fellow farmers	6	21.4	13	32.5	13	32.5	32	29.6	1.219	2	0.544NS
Researchers and NGOs	5	17.9	7	17.5	6	15.0	18	16.7	0.129	2	0.938NS
Radio and TV	3	10.7	4	10.0	5	12.5	12	11.1	0.133	2	0.936NS
Printed materials	13	46.4	6	15.0	4	10.0	23	21.3	14.543	2	0.001**

** Significant at 0.001; * Significant at 0.05; NS: Not significant at 0.05.

It was also found out from the study that 13 (46.4%) of the KFs showed printed materials to be one of the sources of awareness as compared to six (15%) of the IFs and four (10.0) of the OFs. Although the majority of the farmers were literate, the study findings revealed that few of them utilized agricultural reading materials as the source of awareness. It was found out that before KATC intervention, no agricultural reading materials on improved irrigated rice cultivation technologies were provided to farmers. Village Agricultural Extension Officers (VAEOs) and Irrigation Technicians (ITs), as sources of awareness, revealed a significant difference at $p<0.004$ whereas 22 (78.6%) of the KFs and 22 (55%) of the IFs utilized them compared to only 15 (37.5%) of the OFs.

Another significant difference was observed at $p<0.007$, for 36 (90%) of the IFs who identified KFs as a source of awareness compared to 26 (65%) of the OFs. This implied that most of the KFs were very effective in their roles of teaching the IFs, while it was not the case for the IFs in teaching the OFs. Other sources namely other fellow farmers, researchers, NGOs, radio and TV did not show any significant differences (Table 4).

Table 5 shows the respondents' sources of knowledge on improved irrigated rice cultivation technologies and practices. The majority of the respondents i.e. 79 (73.1%) indicated that KATC trainers were the main source of knowledge and this was statistically significant at $p<0.000$. This implied that KATC trainers provide more facilitation and technical backstopping to the KFs than to the IFs and the OFs.

The majority of the IFs i.e. 38 (95%) of them and the OFs i.e. 35 (87.5%) of them showed that demonstration plots and field days were the second major sources of knowledge. This was because field days were conducted at various stages of crop development and, therefore, provided excellent fora for farmers to discuss their own problems and agree on elements of the new technology to adopt.

Field days also involved farmers from other communities to participate. The third and fourth positions of the reliable sources of knowledge were taken by the VAEOs and ITs, and the KFs and IFs respectively. While the VAEOs and ITs sources showed a significant difference at $p<0.004$, the KFs and IFs observed a significant difference at $p<0.007$. Just like for the case of the KATC trainers, the study findings indicated that the VAEOs and ITs provided more facilitation and technical backstopping to the KFs and the IFs than to the OFs.

Table 5: Respondents' sources of knowledge on improved irrigated rice cultivation (N=108)

Sources	Respondent category								χ^2 value	df	Sig. level
	KF (n=28)		IF (n=40)		OF (n=40)		Total (N=108)				
	n	%	n	%	n	%	n	%			
KATC trainers	28	100.0	29	72.5	22	55.0	79	73.1	16.994	2	0.000**
VAEOs and ITs	22	78.6	22	55.0	15	37.5	59	54.6	11.213	2	0.004*
KFs and IFs	-	-	36	90.0	26	65.0	62	77.5	7.168	1	0.007*
Demonstrations/Field days	-	-	38	95.0	35	87.5	73	91.3	1.409	1	0.235NS
Other fellow farmers	8	28.6	11	27.5	13	32.5	32	29.6	0.260	2	0.878NS
Researchers and NGOs	5	17.9	7	17.5	6	15.0	18	16.7	0.129	2	0.938NS
Radio and TV	3	10.7	3	7.5	2	5.0	8	7.4	0.785	2	0.675NS
Printed materials	14	50.0	15	37.5	10	25.0	39	36.1	4.515	2	0.105NS

** Significant at 0.001; * Significant at 0.05; NS: Not significant at 0.05.

For the case of printed materials, more or less the same findings were revealed as in the sources of awareness as 14 (50%) of the KFs utilized the printed materials compared to 15 (37.5%) of the IFs and 10 (25%) of the OFs. As it was revealed in the sources of awareness, the study findings showed that few farmers utilized agricultural reading materials as a source of knowledge. This might be caused by lack of reading habit and/or lack of interest in the agricultural reading materials provided. However, other sources didn't show significant differences among the farmers' categories even though they played an important role to some farmers.

4.4 Adoption of improved irrigated rice technologies

4.4.1 Adopted innovations before KATC training

Table 6 shows the chi-square tests on the adoption of improved irrigated rice technologies among the three categories of the respondents before the KATC training. In this study, the adoption of promoted innovations was measured as the number of farmers using improved irrigated rice technologies as a percentage of the total number of all respondents. Table 6 shows that 44 (40.7%) of the 108 respondents had adopted innovations on improved irrigated rice cultivation before the KATC training programme was launched.

Some innovations like fabrication and use of simple farm tools and skills and knowledge on controlling salinity were not adopted at all, while the adoption of

proper seed selection, proper nursery preparation, sowing and its management was only adopted by eight (7.4%) of the respondents for both cases.

Table 6: Respondents' adoption of the innovations before KATC training (N=108)

Variable	Respondent category								χ^2 value	df	Sig. level
	KF (n=28)		IF (n=40)		OF (n=40)		Total (N=108)				
	n	%	n	%	n	%	n	%			
If farmers adopted innovations											
Yes	11	39.3	18	45.0	15	37.5	44	40.7	0.499	2	0.779NS
No	17	60.7	22	55.0	25	62.5	64	59.3			
Adopted innovation											
Proper seed selection	4	14.3	2	5.0	2	5.0	8	7.4	2.607	2	0.272NS
Proper nursery preparation, sowing and its management	4	14.3	2	5.0	2	5.0	8	7.4	2.607	2	0.272NS
Bunds making, repair and field leveling	4	14.3	10	25.0	7	17.5	21	19.4	1.360	2	0.507NS
Line transplanting	6	21.4	4	10.0	2	5.0	12	11.1	4.580	2	0.101NS
Use of improved varieties	4	14.3	10	25.0	5	12.5	19	17.6	2.441	2	0.295NS
Proper irrigation and water management	5	17.9	9	22.5	9	22.5	23	21.3	0.267	2	0.875NS
Proper land preparation	4	14.3	13	32.5	8	20.0	25	23.1	3.426	2	0.180NS
Timely weeding	9	32.1	12	30.0	9	22.5	30	27.8	.920	2	0.631NS
Fertilizer application	4	14.3	10	25.0	5	12.5	19	17.6	2.441	2	0.295NS
Fabrication and use of simple farm tools	0	0.0	0	0.0	0	0.0	0	0.0	0.920	2	0.631NS
Timely farm operations	9	32.1	12	30.0	9	22.5	30	27.8	-	-	-
Establishment & management of demonstration plots	7	25.0	4	10.0	0	0.0	11	10.2	11.255	2	0.004*
Controlling salinity	0	0.0	0	0.0	0	0.0	0	0.0	-	-	-
Prevention of pests and diseases	6	21.4	5	12.5	5	12.5	16	14.8	1.310	2	0.519NS
Gender mainstreaming	0	0.0	0	0.0	0	0.0	0	0.0	-	-	-
Training of other farmers	7	25.0	4	10.0	0	0.0	11	10.2	11.255	2	0.004*

* Significant at 0.05; NS: Not significant at 0.05.

According to Ngendello *et al.*, (2004), the situation might have been caused by problems in technology dissemination which is a result of/or a combination of the following: (a) technology-fit problem where the technology is not adopted to farmer

conditions, (b) information dissemination problem where farmers are not aware of the available technologies, (c) training problem where farmers may have heard about the innovation or have seen it, but cannot implement it, and (d) enabling environment problem where even when farmers are aware of the technology and have been trained, they cannot apply it because they face financial and/or labour problems. The chi-square results showed that there were no statistical significant differences on the adopted innovations among the three categories of farmers with the exception of the establishment and management of demonstration plots and training skills to other farmers which was statistically significant at $p<0.004$.

4.4.2 Adopted innovations during and after KATC training

Table 7 presents the study findings of the adopted innovations of improved irrigated rice technologies. It also shows the chi-square results on the adoption of improved irrigated rice technologies among the three categories of trained farmers during and after the KATC training programme. All the respondents in the three categories indicated to have adopted the promoted innovations during and after the training despite the variations in the level of adoption. The study findings also revealed that there were statistical significant differences in the adopted innovations of improved irrigated rice technologies and practices among the three categories of the respondents. The KFs had a highest level of adoption of disseminated innovations compared to the IFs and the OFs. Moreover, the KFs and the IFs altogether had higher level of adoption of innovations than the OFs. The innovations which showed statistical significant differences were: seed selection by using water and salt; use of

certified seeds; proper nursery preparation; routine O&M; harvesting at right time; and maintaining household food security at $p<0.000$. At $p<0.001$ statistical significant level were: use of improved varieties; bund making and field leveling using simple tools; paddling; fabrication and the use of hand leveler; and training of other farmers.

Other innovations which showed statistical significant differences were: controlling water levels for irrigation in the field and fabrication, and the use of push-weeders at $p<0.002$; fabrication and the use of threshing stand and family budgeting at $p<0.004$; controlling salinity at $p<0.005$; and timely and split fertilizers application and undertaking post harvest measures at $p<0.007$. The study results also show that all 108 respondents (100%) reported to have adopted line transplanting and timely weeding of paddy field. This is attributed to the importance of maintaining recommended crop density as well as a weed free field which contributes to an increase in rice yield. However, there were no statistical significant differences among the respondents for the controlling of pest and diseases, preparation and use of improved cooking stoves, farm record keeping, and establishment of demonstration plots.

Table 7: Respondents' opinions on adopted innovations during and after the training from 2003-2005 (N=108)

Opinions	Respondent category								χ^2 value	df	Sig. level
	KF (n=28)		IF (n=40)		OF (n=40)		Total (N=108)				
	n	%	n	%	n	%	n	%			
If farmers adopted innovations											
Yes	28	100.0	40	100.0	40	100.0	108	100.0	-	-	-
Adopted innovation											
Seed selection by using water and salt	28	100.0	38	95.0	25	62.5	91	84.3	22.989	2	0.000**
Use of certified seeds	21	75.0	17	42.5	6	15.0	44	40.7	24.641	2	0.000**
Use of improved varieties	28	100.0	30	75.0	24	60.0	92	85.2	14.447	2	0.001**
Proper nursery preparation	28	100.0	34	85.0	24	60.0	86	79.6	17.376	2	0. 000**
Bund making and field leveling using simple tools	24	85.7	26	65.0	16	40.0	66	61.1	14.888	2	0.001**
Paddling	27	96.4	30	75.0	22	55.0	79	73.1	14.503	2	0.001**
Line transplanting	28	100.0	40	100.0	40	100.0	108	100.0	-	-	-
Timely weeding	28	100.0	40	100.0	40	100.0	108	100.0	-	-	-
Timely and split fertilizers application	28	100.0	32	80.0	28	70.0	88	81.5	9.916	2	0.007*
Controlling water levels for irrigation in the field	28	100.0	31	77.5	26	65.0	85	78.7	12.093	2	0.002**
Routine O&M	28	100.0	36	90.0	26	65.0	90	83.3	16.560	2	0.000**
Controlling pest and diseases	26	92.9	34	85.0	30	75.0	90	83.3	3.909	2	0.142NS
Harvesting at right time	27	96.4	27	67.5	16	40.0	70	64.8	23.198	2	0.000**
Undertaking post harvest measures	28	100.0	32	80.0	28	70.0	88	81.5	9.916	2	0.007*
Fabrication and use of push-weeders	26	92.9	31	77.5	22	55.0	79	73.1	12.630	2	0.002**
Fabrication and use of hand leveler	24	85.7	26	65.0	16	40.0	66	61.1	14.888	2	0.001**
Fabrication and use of threshing stand	21	75.0	23	57.5	14	35.0	58	53.7	10.968	2	0.004**
Preparation and use of improved cooking stoves	9	32.1	9	22.5	6	15.0	24	22.2	2.803	2	0.246NS
Farm record keeping	15	53.6	20	50.0	14	35.0	49	45.4	2.841	2	0.242NS
Maintaining household food security	27	96.4	31	77.5	19	47.5	77	71.3	20.462	2	0.000***
Family budgeting	24	85.7	28	70.0	19	47.5	71	65.7	11.191	2	0.052
Establishment of demonstration plots	28	100.0	35	87.5	-	-	63	92.6	3.778	1	0.004*NS
Controlling salinity	20	71.4	22	55.0	13	32.5	55	50.9	10.409	2	0.005*
Training of other farmers	28	100.0	28	70.0	-	-	56	82.4	10.200	1	0.001**

** Significant at 0.001; * Significant at 0.05; NS: Not significant at 0.05.

The innovation packages in which OFs had high levels of adoption did not show any statistical significant difference and included innovation on line transplanting, timely weeding, and identification and control of rice field pests and diseases. Since the KFs and the IFs had higher levels of adoption in 18 out of 24 innovations, it could therefore be concluded that the KF-IF-OF extension approach was effective in dissemination and increasing the adoption of innovations within the first two categories of KFs and IFs. The KFs were more technologically equipped than the IFs as they received more assistance from KATC, VAEOs and the ITs which made it easier for them to disseminate information to the IFs. The study results show that there were some weaknesses of the IFs compared to the KFs in adopting skills for training other farmers. This situation might have been contributed to the low adoption of innovations on improved irrigated rice technologies and practices by the OFs.

4.4.3 Reasons for adopting and rejecting innovations

Table 8 shows major reasons that respondents indicated for adopting or rejecting the disseminated innovations of improved irrigated rice technologies and practices. The study results indicated that all 108 respondents (100%) in the three categories adopted the innovations aiming at increasing rice productivity in their fields. Moreover, there were no statistical significant differences among the three categories of respondents for the other reasons such as having effective and efficient irrigation, reducing drudgery, saving time and labour, consistence of the technologies promoted and seeing that the previous technologies were inadequate. The only exception

shown was the reason of simplicity and triability of rice technologies, whereby a statistical significant difference was observed at $p<0.000$. The study findings also showed that the KFs and the IFs perceived the innovations to be simple and easy to try and therefore decided to use them while the OFs looked at the technologies as difficult to use. This implied that the OFs lacked adequate information and skills on the use of some innovations.

On the other hand, there were statistical significant differences on the approach that influenced respondents' decisions to apply the innovations. The variation was shown at $p<0.007$ for the KF-IF-OF approach whereby 36 (90%) of the IFs indicated to have been influenced by the approach compared to 26 (65%) of the OFs. This indicated that the OFs were the least beneficiaries of the approach. The influence of the VAEOs and the ITs also indicated a statistical significant difference at $p<0.004$, the KFs and the IFs had more influence than the OFs. The study findings implied that the KFs perceived the VAEOs and the ITs to be helpful, and the IFs perceived the KFs to be supportive in their farming activities, but the OFs showed disappointment on information and skills they received from the IFs.

Another variation was shown at $p<0.000$ on the influence of study tours/farmer exchange visits. The study findings revealed that all the 28 KFs were influenced by the approach; but such an influence was low for the IFs and the OFs. This was due to the fact that the majority of the KFs had more opportunities of attending farmers exchange visits as opposed to the IFs and the OFs. Moreover, it was only the KFs

who attended a residential training course on improved irrigated rice cultivation that made them benefit from the approach. Other approaches like field training, demonstrations and field days did not show any statistical significant differences.

Further, Table 8 shows the major factors that contributed to respondents rejecting the innovations for all the categories, which were perceived as of institutional, ecological and socio-economic in nature. Innovations that were rejected included inadequate water for irrigation caused by drought, costly technologies, inadequate money to buy inputs, and insufficient knowledge and skills. The study results showed that 100 (92.6%) of the respondents were affected by drought, while 56 (51.9%) of them had inadequate money to buy inputs and 46 (42.6%) of them reported that some technologies were expensive. However, more than 30 percent of the IFs and the OFs indicated to have rejected the innovations because some of the innovations were time and labour intensive and did not address the problem of salinity in their fields.

Table 8: Respondents' reasons for adoption and rejection of innovations (N=108)

Reasons	Respondent category								χ^2 value	df	Sig. level
	KF (n=28)		IF (n=40)		OF (n=40)		Total (N=108)				
	n	%	n	%	n	%	n	%			
Reason for adoption											
Aiming at increasing rice yield per unit area	28	100.0	40	100.0	40	100.0	108	100.0	-	-	-
Aim at effective & efficient irrigation	28	100.0	38	95.5	36	90.0	102	94.4	3.176	2	0.204NS
Reduced drudgery, save time and labour	28	100.0	33	82.5	31	77.5	92	85.2	6.970	2	0.131NS
Previous technologies not adequate	28	100.0	32	80.0	30	75.0	90	83.3	7.920	2	0.069NS
Technologies are consistent	25	89.3	29	72.5	26	65.0	80	74.1	5.140	2	0.077NS
Technologies are simple, triable and observable	28	100.0	35	87.5	24	60.0	87	80.6	18.780	2	0.000**
Approach that most influenced adoption											
Residential training	28	100.0	-	-	-	-	28	100.0	-	-	-
Field training	28	100.0	38	95.5	32	80.0	98	90.7	9.213	2	0.010*
VAEOs and ITs	22	78.6	22	55.0	15	37.5	59	54.6	11.213	2	0.004*
KFs and IFs	-	-	36	90.0	26	65.0	62	77.5	7.168	1	0.007*
Demonstration/Field days	-	-	38	95.0	35	87.5	73	91.3	1.409	1	0.235NS
Study/Exchange visits	28	100.0	13	32.5	9	22.5	50	46.3	44.652	2	0.000**
Reasons for rejection											
Time and labor intensive	0	0.0	11	27.5	19	47.5	30	27.8	18.526	2	0.000**
Expensive inputs	11	39.3	17	42.5	18	45.0	46	42.6	.220	2	0.896NS
Inadequate money to buy inputs	10	35.7	20	50.0	26	65.0	56	51.9	5.745	2	0.057NS
Insufficient knowledge and skills	1	3.6	6	15.0	19	47.5	26	24.1	20.250	2	0.000**
Salinity and/or sandy soils	3	10.7	13	32.5	17	42.5	33	30.6	7.956	2	0.019*
Inadequate water for irrigation	25	89.3	35	87.5	40	100.0	100	92.6	5.159	2	0.076NS
Technologies are difficult to try	0	0.0	5	12.5	16	40.0	21	19.4	18.780	2	0.000**
Not yet decided	0	0.0	0	0.0	5	12.5	5	4.6	8.913	2	0.012*

** Significant at 0.001; * Significant at 0.05; NS: Not significant at 0.05.

It was also observed that the OFs had insufficient knowledge and skills on the use of some innovations compared to the IFs and the KFs, which revealed a statistical significant difference at $p<0.000$ hence failed to try the technologies. From the above findings, it can therefore, be concluded that the main approach of KATC i.e. the KF-IF-OF was not effective in disseminating and influencing the OFs to adopt the innovations. These findings are in line with Danda (2003) and Kauzeni (1989) who argue that in order to increase agricultural production in Tanzania emphasis should be given to the provision of relevant inputs, institutional credits, subsidies, and appropriate technology that effectively reduce drudgery in all farmers' operations.

4.4.4 Spread of irrigated rice innovations

Table 9 presents the respondents' opinions on the spread of innovations on irrigated rice cultivation to other farmers who were not involved in the training programme in and out of the scheme.

Table 9: Respondents' opinions on the spread of the irrigated rice innovations to other farmers (N=108)

Opinions	Irrigation Scheme				Total (N=108)	
	Mwega (n=54)		Mombo (n=54)			
	n	%	n	%	n	%
If innovations has spread to other farmers						
Yes	49	90.7	53	98.1	102	94.4
No	0	0.0	0	0.0	0	0.0
Not sure	5	9.3	1	1.9	6	5.6
Magnitude of other farmers who adopted the innovations						
<25%	21	42.9	11	20.8	32	31.4
25-50%	28	57.1	19	35.8	47	46.1
51-75%	0	0.0	16	30.2	16	15.7
>75%	0	0.0	7	13.2	7	6.9
Total	49	100.0	53	100.0	102	100.0

The study results showed that the majority of the respondents, that is 102 (94.4%) agreed that innovations had spread to other farmers in and out of the scheme, while six ((5.6%) of them were not sure. As for those who adopted the innovations, 47 (46.1%) of the respondents indicated that the magnitude was between 25 and 50 percent, while 32 (31.4%) reported the magnitude to be below 25 percent. On the other hand, 16 (15.7%) of the respondents indicated the magnitude to be between 51 and 75 percent, while seven (6.9%) reported it to be more than 75 percent. The data presented in Table 9 imply that other farmers who were not involved in the KATC training progrmme in and out of the schemes were interested with the improved irrigated rice technologies and practices adopted by the KATC trained farmers. Most of the non-KATC farmers (the farmers who are not KF, IF or OF) attended the field days conducted by KATC in the schemes, which were conducted on various crop stages for the whole farming season.

4.5 Trend of rice production before and after KATC training

4.5.1 Yield status of three seasons before and after the training

The respondents were asked to indicate the trend of yields obtained from the irrigated rice fields for the past two to three seasons. Table 10 summarizes the perceptions of farmers on trends of irrigated rice yields among the three categories of trained farmers for two to three seasons before and after the training. The study results indicated that the majority of the respondents, 102 (94.4%) reported a

decrease of rice yields for the past two to three years before the KATC training because of lack of knowledge and skills in irrigated rice cultivation.

However, the trend of rice yields during and after KATC training showed a statistical significant difference at $p<0.000$ whereby over 97 percent of the KFs and the IFs reported an increase compared to 28 (70%) of the OFs. The difference might have been caused by the failure of the IF to address the innovations to the OFs.

The majority of respondents from the three categories identified adoption of innovations extended by KATC approaches as a major reason for the increase in irrigated rice production. The major reasons reported for no change in the trend of rice yields during and after training were the ineffectiveness of the KATC approach in disseminating and influencing farmers, especially the OFs to adopt the innovations (30.8%), and drought and inability of farmers to apply required inputs (30.8%). Generally, the study findings implied that the KF-IF-OF approach had been effective in increasing adoption of innovations leading to an increase in irrigated rice yields.

Table 10: Respondents' perceptions on trends of rice yields status for two to three seasons before and after the training (N=108)

Variables	Respondent category								χ^2 value	df	Sig. level
	KF (n=28)		IF (n=40)		OF (n=40)		Total (N=108)				
	n	%	n	%	n	%	n	%			
Trend of rice yield before training											
Increasing	0	0.0	0	0.0	0	0.0	0	0.0			
Decreasing	26	92.9	40	100.0	36	90.0	102	94.4	3.993	2	0.136NS
No change	2	7.1	0	0.0	4	10.0	6	5.6			
Reasons for the decrease											
Inadequate knowledge & skills in irrigated rice	26	100.0	40	100.0	36	100.0	102	100.0			
Reasons for No change											
Inadequate knowledge & skills in irrigated rice	2	100.0	0	0.0	4	100.0	6	100.0			
Trend of rice yield during and after training											
Increasing	28	100.0	39	97.5	28	70.0	95	88.0			
Decreasing	0	0.0	0	0.0	0	0.0	0	0.0	19.457	2	0.000**
No change	0	0.0	1	2.5	12	30.0	13	12.0			
Reasons for the increase											
Adoption of innovations extended by KATC	28	100.0	34	87.2	20	71.4	82	86.3			
Adoption of innovations extended by other extension	0	0.0	0	0.0	0	0.0	0	0.0			
approaches	0	0.0	5	12.8	8	28.6	13	13.7	9.717	2	0.008*
Adoption of innovations extended by both											
Reasons for No change											
Ineffectiveness of KATC approach	0	0.0	0	0.0	4	33.3	4	30.8			
Drought and unable to apply required inputs	0	0.0	0	0.0	4	33.3	4	30.8			
Both reasons 1 and 2	0	0.0	1	100.0	4	33.3	5	38.5	1.733	2	0.420NS
Others	0	0.0	0	0.0	0	0.0	0	0.0			

** Significant at 0.001; * Significant at 0.05; NS: Not significant at 0.05.

4.5.2 Achievement of targeted yields

One of the major goals in the action plans that farmers prepared after the training phase was to set a target yield in their irrigation scheme for them to achieve. Table 11 therefore, summarizes the distribution of the categories of respondents according to the achievement of the targeted yields. Despite the increase in irrigated rice yields, the study found out that 67 (62%) of the respondents from the three categories failed to meet the targeted rice yields, which had a statistical significant difference at $p<0.001$. The results showed that, while 18 (64.3%) of the KFs had achieved the targeted rice yields, only 15 (37.5%) of the IFs and eight (20%) of the OFs did so. The study findings showed that drought and inability of farmers to apply the required inputs were the major reasons that made the majority of the respondents 49 (73.1%) fail to achieve the targeted rice yields.

Table 11: Respondents' opinions on achieving targeted rice yields (N=108).

Variables	Respondent category								χ^2 value	df	Sig. level
	KF (n=28)		IF (n=40)		OF (n=40)		Total (N=108)				
	n	%	n	%	n	%	n	%			
If rice yield target have been achieved											
Yes	18	64.3	15	37.5	8	20.0	41	38.0	13.722	2	0.001**
No	10	35.7	25	62.5	32	80.0	67	62.0			
Reasons for Yes											
Adoption of innovations extended by KATC	18	100.0	15	100.0	8	100.0	41	100.0	-	-	-
Reasons for No											
Ineffectiveness of KATC approach	0	0.0	0	0.0	6	18.8	6	9.0			
Drought and unable to apply required inputs	10	100.0	19	76.0	20	62.5	49	73.1	10.394	4	0.034*
Both reasons (above)	0	0.0	6	24.0	6	18.8	12	17.9			

* Significant at 0.05 level ($p\leq0.05$); ** Significant at 0.001 level ($p\leq0.001$).

Furthermore, 12 (17.9%) of all the respondents reported that both reasons i.e. ineffectiveness of KATC approach in disseminating and influencing farmers, especially the OFs to adopt the innovations, and drought and inability of farmers to apply the required inputs were responsible for the failure in achieving the targeted rice yields. Therefore, it was clear that drought had caused shortage of water for irrigation and therefore affected rice yields.

4.5.3 Problems faced in implementing KATC training

Table 12 shows the major problems that the respondents faced when implementing the KATC training programmes in their fields.

Table 12: Respondents' opinions on problems encountered during the implementation of training in their fields (N=108).

Variable	Respondent category								χ^2 value	df	Sig. level
	KF (n=28)		IF (n=40)		OF (n=40)		Total (N=108)				
	n	%	n	%	n	%	n	%			
If farmers encountered problems											
Yes	26	92.9	40	100.0	40	100.0	106	98.1	5.822	2	0.054ns
No	2	7.1	0	0.0	0	0.0	2	1.9			
Problems encountered											
Drought/Shortage of water for irrigation	26	92.9	40	100.0	40	100.0	106	98.1	5.882	2	0.054ns
Interference of training sessions	12	42.9	12	30.0	14	35.0	38	35.2	1.195	2	0.550ns
Expensive/poor supply of farm inputs	28	100.0	40	100.0	40	100.0	108	100.0	-	-	-
Pests and diseases outbreaks	5	17.9	7	17.5	8	20.0	20	18.5	.094	2	0.954ns
Salinity	6	21.4	6	15.0	9	22.5	21	19.4	.813	2	0.666ns
Unreliable markets	28	100.0	40	100.0	40	100.0	108	100.0	-	-	-
Lack of farming capital	23	82.1	40	100.0	35	87.5	98	90.7	7.045	2	0.030*
High labor costs	15	53.6	22	55.0	31	77.5	68	63.0	5.772	2	0.056ns

* Significant at 0.05 level ($p \leq 0.05$).

The majority of the respondents 106 (98.1%) agreed to have faced problems when implementing KATC training programmes related to poor supply of farm inputs such as fertilizers and the cost of such inputs that were so expensive that most of the respondents could not afford. The second problem was the unreliable markets for rice, while other problems included drought, outbreaks of pests and diseases, and soil salinity. Also, lack of farming capital was a serious problem which showed a statistical significant difference at $p<0.030$.

Similarly, interference of training sessions and high labour costs were common but also specific to some schemes; for example respondents in Mombo irrigation scheme faced high labour costs while those in Mwega experienced interference of training sessions. Furthermore, Mwega respondents also grew irrigated maize and horticultural crops throughout the year and therefore the training sessions were sometimes interfered by these activities (Table 12).

4.6 Effectiveness of KATC training approaches

One of the specific objectives of this study was to assess the perceptions of respondents on the effectiveness of KATC training approaches in meeting farmers' increased rice productivity. A self–administered questionnaire was designed to collect this type of data. The questionnaire items were largely developed from records pertaining to the KATC training activities and training performance of KFs and IFs. Overall, 22 items were identified based on training approaches, methods and innovations used by KATC in the training programme that were deemed vital to the

effectiveness of KATC programme in meeting farmers' increased rice productivity. To achieve this, the study adopted Likert-scale items to solicit opinions of respondents concerning the KFs and the IFs efforts in disseminating innovations, credibility and homophily/heterophily. Also, there was a question item on the effectiveness of all extension approaches, methods and innovations used by KATC in the training programmes. From the items, the respondents were requested to indicate whether they strongly agreed, agreed, undecided, disagreed or strongly disagreed with each of the statement. Strongly agreed and agreed responses were later combined and treated as positive opinions. Likewise, strongly disagreed and disagreed responses were also combined and treated as negative opinions towards the effectiveness of KATC training approaches in meeting farmers increased rice productivity. The neutral item indicated that farmers were not sure or knew nothing. Based on a three-point rating of responses (2 = Agree; 1 = Disagree; and 0 = Undecided), mean and standard deviation values associated with each item were determined. For the purposes of data interpretation, the mean values ranging from 1.50 and above were considered as indicating positive responses, while those below 1.50 were considered as reflecting negative responses.

4.6.1 KFs and IFs efforts in disseminating innovations

Table 13 summarizes respondents' opinions on efforts of KFs and IFs in disseminating innovations, their credibility and homophily/heterophily with farmers. The study findings showed that there were significant variations on the opinions given by the IFs towards the KFs compared to the opinion given by the OFs towards

the IFs. The study results revealed that out of 12 items that the IFs answered, 11 of them showed the domain mean values of above 1.5, which implied that the IFs positively responded to the items concerning the efforts of the KFs and the IFs in disseminating innovations, their credibility and homophily/heterophily with farmers. On the other hand, the study found that nine out of 12 responses given by the OFs showed a domain mean value of below 1.5, which implied that the OFs had negative attitude towards the services rendered to them by the IFs. Since the IFs had higher levels of adoption of improved irrigated rice technologies and practices than the OFs, it implied that the KFs devoted more effort to persuade the IFs to adopt innovations than what appears to be the case for the IFs towards the OFs.

Table 13: Respondents' opinions on the KFs and IFs efforts in disseminating innovations (N= 80).

Items	Respondent category			
	IF (n=40)		OF (n=40)	
	Mean	SD	Mean	SD
KFs bring extension services closer to IFs	1.77	0.620	1.62	0.740
IFs bring extension services closer to OFs	1.70	0.687	1.43	0.549
KFs have been effective in creating awareness and dissemination of innovations to Ifs	1.77	0.620	1.62	0.740
IFs have been effective in creating awareness and dissemination of innovations to OFs	1.72	0.640	1.45	0.639
KFs/IFs give priority to my farming issues	1.58	0.675	1.43	0.549
I feel free to contact with KF/IF	1.78	0.530	1.55	0.639
I have more opportunities to contact KF/IF	1.62	0.667	1.38	0.705
KFs/IFs offer much practical advice	1.70	0.687	1.35	0.662
KFs/IFs promote the innovations which they have already adopted	1.82	0.549	1.30	0.853
KFs/IFs have good rapport with farmers	1.70	0.648	1.35	0.662
KFs/IFs give technical advice confidently	1.85	0.427	1.27	0.679
KFs/IFs are not creative as they rely on what they have been trained	1.22	0.733	1.28	0.784

Also, the study findings revealed that the attribute of homophily was much more persistent between the KFs and the IFs, while the relationship between the IFs and the OFs was more heterophilous. According to Namwata (2004), the element of homophily or heterophily could encourage or discourage farmers to get into contact with PARAs and become potential factors in influencing the adoption of innovations. Opinions on the credibility clearly indicated that the KFs offered much practical advice, had good rapport with other farmers, and showed confidence when giving technical advice compared to the IFs. Meanwhile, both the IFs and the OFs argued that the KFs were not creative as they relied on what they have been given by KATC in its training sessions. The standard deviation (SD) values indicated that all the responses of the OFs were scattered from the mean with SD ranging from 0.549 to 0.853. Similarly, the SD (>0.500) values indicated that most of the IFs responses were scattered from the mean, which implied that their credibility and homophily/heterophily were generally not similar.

4.6.2 Effectiveness of KATC approaches

Table 14 shows respondents opinions on the effectiveness of KATC approaches as compared to other extension approaches. The study results indicated that while nine out of ten responses given by the KFs and the IFs had mean values of more than 1.5; only five out of ten responses from the OFs had mean values of more than 1.5.

The extent to which farmers increased production from their farms was among the determinants of the effectiveness of the extension approach. The study findings

showed that respondents from all the three categories agreed that KATC extension approaches had helped farmers to increase rice yields since all the domain mean values were above 1.5. Contending on the issue of rice yields, KATC (2006b) final report indicated that there was an increase in rice yields per unit area which was brought by technical know-how given to farmers in the training sessions. KF-IF-OF extension approach which is a farmer-to-farmer extension approach, had promoted farmers to become knowledgeable on irrigated rice farming. Experiences from UMADEP, MFEC and HIMA in Tanzania, showed that, farmers through farmer-to-farmer extension approach have been the most effective channel for spreading farming technologies (Rutatora *et al.*, 2005; Djalou, 2005; Namwata, 2004; Sonoko, 2001).

The results of this study indicated that PLA approach (mean above 1.50) was a useful and effective tool in creating awareness of farmers before the training. KATC interventions were designed based on the PLA to create awareness, identify training needs, and seeking commitment from the farming communities. The study by Rutatora *et al.* (2005), Rutatora and Mattee (2001b) and Djalou (2005) indicated that PRA has been used by UMADEP for the purpose of introducing project facilitators to the communities, establishing rapport with the communities, identification of areas that needed intervention and established frameworks for implementing development actions.

Institutional capacity building was one of the important key issues that KATC programme strived to address during the training period (KATC, 2006b). The findings from this study showed that the respondents agreed on the improvement in the management, organization and operation of irrigators' organization (mean above 1.50). Furthermore, information from the meetings with leaders and members of Mombo Irrigation Scheme Agricultural Cooperative Society and Mwega Irrigators Association revealed that there were substantial improvement in participation of farmers in operation and maintenance (O&M) activities, payment of O&M fees, by-laws enforcement and increased membership. The study by Djalou (2005) found out that, farmers needed a strong organization to represent both their interests and to give them means of taking collective actions. Likewise, Danda (2003) argued that farmer organizations were important vehicles capable of orienting agricultural research and policy towards the needs of rural poor living in complex and risk prone environment.

Regarding the effectiveness of KATC extension approaches in involving farmer's participation in technology development/testing, the results of the current study showed that the KFs and the IFs had a mean value of more than 1.5, while the OFs had a mean value of below 1.5 (Table 14). This implied that the involvement of the KFs and the IFs in technology development/testing was higher compared to, that of the OFs. Emphasizing on the involvement of farmers in the development of appropriate solutions to their problems, Rutatora *et al.* (2005) observe that the basic processes which farmers go through during participatory technology development are meant to empower them and therefore, develop a sense of autonomy, ownership and independence.

The results of the current study showed a mean value of more than 1.5 on the effectiveness of KATC extension approaches in follow-ups/supervisions and technical back-stopping to the KFs and the IFs through the VAEOs and the ITs. For example, Sonoko (2001) indicated that the farmer-to-farmer extension approach used by MFEC in Tarime, Tanzania was efficient in terms of supervision. Likewise, Urio (1996), in Dodoma region, reported that effective supervision increases contact between farmers and extension officers, and therefore, helps to get quick feedback and give possible solutions to problems. It can be concluded that KFs/IFs worked best where there was support from professional extension worker.

Table 14: Respondents' opinions on the effectiveness of KATC approaches (N=108).

Variable	Respondent category					
	KF (n=28)		IF (n=40)		OF (n=40)	
	Mean	SD	Mean	SD	Mean	SD
KATC approaches have helped farmers to increase rice yields	2.00	0.000	1.75	0.630	1.72	0.640
KF-IF-OF approach has been effective & influenced high adoption of disseminated innovations	2.00	0.000	1.80	0.608	1.48	0.751
PLA was useful and effective for creating awareness of farmers before the training	1.93	0.378	1.65	0.662	1.60	0.672
KATC approaches have been effective at improving and strengthening WUAs/FOs	1.57	0.790	1.58	0.675	1.50	0.679
KATC approaches are effective in follow-ups/supervisions and technical back-stopping	1.68	0.723	1.70	0.687	1.35	0.622
KATC approaches are effective in involving farmers participation in technology development/testing	1.68	0.723	1.57	0.747	1.23	0.862
KATC innovations are compatible with farmers' condition	1.54	0.838	1.67	0.730	1.60	0.672
KATC approaches are flexible to farmers' conditions	1.64	0.780	1.67	0.694	1.48	0.716
Reading materials were useful and effective to compliment the training	1.71	0.600	1.65	0.700	1.52	0.751
KATC approaches are more cost effective in dissemination of innovations	1.21	0.876	1.50	0.555	1.32	0.656

According to the KFs and the IFs, the study results showed that KATC approaches responded positively to changes in its training programmes (mean above 1.50), which was not the case for the OFs (mean below 1.5), (Table 14). The study by Urio (1996) indicated that agricultural activities are dynamic due to developments in research findings, technology, economic and environment changes and therefore, the extension approaches should respond to these changes. Compatibility of innovations to farmers' social cultural circumstances was taken onboard by the KATC training programme as a mean value indicated to be more than 1.5. Namwata (2004) and Rogers (1995) also indicated that the compatibility of new idea as perceived by members of a social system is positively related to its rate of adoption.

With regard to the usefulness and effectiveness of reading materials, the study reported a mean value of more than 1.5 for all the categories of farmers, meaning that all three categories of respondents had utilized the handbooks, newsletters and brochures provided by KATC during and after the training. Similarly, the study by Djalou (2005) found out that publication as a mass media of extension method has been widely used to literate farmers in order to create awareness on new innovations as well as supporting the training.

Through the KF-IF-OF extension process, KATC argued that the dissemination of improved irrigated rice cultivation techniques to more farmers was effected in an easy and cost effective way (KATC, 2006). However, the opinions given by the respondents in this study revealed the opposite as the mean value for this statement was less than 1.5, i.e. the respondents disagreed with the statement. It was therefore,

evidenced that the domain mean values for most statements were generally and consistently higher for the KFs and the IFs compared to the OFs, as more contacts were with the KFs and the IFs than the OFs (Table 14). Meanwhile, the standard deviation values indicated that all the responses of the IFs and the OFs were scattered from the mean with SD ranging from 0.555 to 0.862, which implied that the responses on the KATC approaches and methods given by the three categories of respondents were generally not similar.

4.7 Strengths and weaknesses of the KATC training approaches

Table 15 summarizes the chi-square results on the strengths and weaknesses of KATC approaches compared to other approaches. Of all the 108 respondents, 88 (81.5%) indicated that the participatory nature of all approaches used in the training programme was good. The strengths identified indicated variations as the KFs showed higher responses ranging from 20 (71.1%) to 28 (100%), the IFs ranged from 15 (37.5%) to 33 (82.5%), and the OFs ranged from 17 (42.5%) to 30 (75%) and the statistical significant difference ranged from $p \leq 0.001$ to $p \leq 0.05$. High statistical significant differences at $p < 0.000$ were observed for the follow-ups/supervision and backstopping done by KATC trainers, VAEOs/ITs, the KFs and the IFs during the training period. It was found out that only 24 (60%) of the OFs indicated frequencies of follow-ups/supervision and backstopping as adequate compared to 32 (80%) of the IFs and 24 (85.7%) of the KFs. This implies that follow-ups/supervision and backstopping were effective for the first two categories of the KFs and the IFs in the KF-IF-OF extension approach but weak to the OFs.

Most of the weaknesses that the respondents indicated showed commonness among the three categories, which included fluctuating attendances of farmers in the training sessions 84 (77.8%), irresponsibility of some stakeholders in fulfilling their assignments and promises 53 (49.1%), and training concentrating much on irrigated rice cultivation 51 (47.2%). Others were short training phases per year 43 (39.8%), and the interference of the training programme to other crops activities 38 (35.2%). The other two weaknesses i.e. some KFs and IFs having inadequate skills in extending technologies and negligence/laziness of some KFs and IFs in their responsibilities showed high statistical significance differences at $p<0.000$ between the OFs and the other two categories. This implies that the IFs had more weaknesses in fulfilling the training requirement than the KFs. It can also be concluded that the OFs' quest for knowledge and skills on irrigated rice were not adequately fulfilled by the KFs-IFs-OFs chain of extension approach.

Table 15: Respondents' opinions on the strengths and weaknesses of KATC approaches (N=108).

Variable	Respondent category								χ^2 value	df	Sig. level
	KF (n=28)		IF (n=40)		OF (n=40)		Total (N=108)				
	n	%	n	%	n	%	n	%			
Strengths											
Implementation of all planned training programmes	24	85.7	21	52.5	24	60.0	69	63.9	8.292	2	0.016*
Intensive training of KFs through residential training & field training	28	100.0	33	82.5	20	50.0	77	71.3	14.162	2	0.001**
All approaches are participatory	26	92.9	32	80.0	30	75.0	88	81.5	3.573	2	0.168NS
Empowerment of farmers' organizations	23	82.1	22	55.0	19	47.5	64	59.3	8.665	2	0.013*
Frequent follow-ups/supervision and backstopping	24	85.7	32	80.0	24	60.0	84	77.8	15.429	2	0.000**
Sustainability of the innovations and approaches	24	85.7	29	72.5	19	47.5	72	66.7	11.796	2	0.003*
Flexibility and compatibility of the approaches and innovations	24	85.7	26	65.0	23	57.5	73	67.6	6.180	2	0.045*
Intensive training in irrigated rice cultivation	28	100.0	33	82.5	26	65.0	87	80.6	13.034	2	0.001**
Provision of reading materials	20	71.4	15	37.5	17	42.5	52	48.1	8.406	2	0.015*
Planning of training done at scheme level	28	100.0	31	77.5	27	67.5	86	79.6	10.903	2	0.004*
Weaknesses											
Short training phases per year	14	50.0	18	45.0	11	27.5	43	39.8	4.192	2	0.123NS
Irresponsibility of some stakeholders in fulfilling their assignments and promises	14	50.0	20	50.0	19	47.5	53	49.1	.063	2	0.969NS
Some KFs and IFs having inadequate skills & knowledge in extending technologies	10	35.7	18	45.0	40	100.0	68	63.0	37.979	2	0.000**
Training concentrated much on irrigated rice cultivation	11	39.3	22	55.0	18	45.0	51	47.2	1.758	2	0.415NS
Interference done by training programme to other crops activities	12	42.9	12	30.0	14	35.0	38	35.2	1.195	2	0.550NS
Fluctuating attendances of farmers in the training sessions	20	71.4	31	77.5	33	82.5	84	77.8	1.171	2	0.557NS
Negligence and laziness of some KFs and IFs in their responsibilities	0	0.0	8	20.0	33	82.5	41	38.0	56.304	2	0.000**

** Significant at 0.001; * Significant at 0.05; NS: Not significant at 0.05.

4.7.2 Measuring institutional sustainability of KATC extension approaches

Institutional sustainability of the KATC KF-IF-OF extension approach meant the ability of the respondents, their organizations (FOs) and other stakeholders to organize and support KF-IF-OF extension approach after the cessation of KATC programme. The KATC programme financed the residential training of the KFs and in-field training of the KFs and the IFs as well as financing farmer' exchange visits in collaboration with the respective district councils. Institutional sustainability of the KATC KF-IF-OF extension approach was therefore to include the support from farmers and local government authorities without donor assistance. The main areas examined in this context were as follows: Identified technical deficiencies of the KFs and the IFs and their possible causes, plans/strategies in place for the institutional sustainability, levels of satisfaction or dissatisfaction, attitudes of farmers towards the approach and their suggestions for the improvement of KATC extension programmes.

4.7.2.1 Technical deficiencies of the KFs and the IFs

Despite the intensive training provided to the KFs and the IFs, 95 (88%) of the respondents reported to had experienced technical deficiencies in their farming and extension activities as presented in Table 16. Of all the respondents, two thirds, i.e. 70 (64.8%) indicated that they had deficiencies in controlling soil salinity in paddy fields, 66 (61.1%) lacked entrepreneurship skills, and 51 (47.2%) were deficient in fabricating simple farming tools. Other deficiencies reported include not undertaking proper irrigation and water management as well as identification and control of pests

and diseases indicated by 49 (45.4%) of the respondents, timely and split fertilizer application indicated by 48 (44.4%) of the respondents, and ability in training other farmers indicated by 47 (43.5%) of the respondents. Not only that but also 40 (37%) of the respondents reported the deficiencies in bunds making and field leveling and 32 (29.6%) of the respondents reported the deficiencies in the use of improved varieties and certified seeds were reported. These data imply that additional training was required to backstop the observed deficiencies for improving the technical competencies of the KFs and the IFs for them to convey proper messages to other farmers.

Table 16: Respondents' deficiencies and their possible causes (N=108)

Variable	Respondent category						Total (N=108)	
	KF (n=28)		IF (n=40)		OF (n=40)			
	n	%	n	%	n	%	n	%
If trained farmers (KFs and IFs) were deficient in some aspects of skills and knowledge								
Yes	15	53.6	40	100.0	40	100.0	95	88.0
No	13	46.4	0	0.0	0	0.0	13	12.0
Deficiency areas of skills and knowledge								
Fabrication of simple farming tools	9	32.1	16	40.0	26	65.0	51	47.2
Bunds making and field leveling	6	21.4	14	35.0	20	50.0	40	37.0
Control of soil salinity	11	39.3	28	70.0	31	77.5	70	64.8
Proper irrigation and water management	6	21.4	20	50.0	23	57.5	49	45.4
Identification and control of pests and diseases	5	17.9	18	45.0	26	65.0	49	45.4
Use of improved varieties and certified seeds	0	0.0	13	32.5	19	47.5	32	29.6
Timely weeding and fertilizer application	5	17.9	20	50.0	23	57.5	48	44.4
Entrepreneurship	9	32.1	28	70.0	29	72.5	66	61.1
Training/extending innovations to other farmers	5	17.9	11	27.5	31	77.5	47	43.5
Possible causes of deficiencies								
Ineffectiveness of KF-IF-OF approach in extending innovations	0	.0	2	5.0	6	15.0	8	7.4
Insufficient training to KFs and IFs	2	7.1	5	12.5	21	52.5	28	25.9
Fluctuating and/or poor attendance in training	20	71.4	31	77.5	33	82.5	84	77.8
Shortage of water for irrigation/drought	5	17.9	12	30.0	20	50.0	37	34.3
Expensive and poor inputs supply	26	92.9	39	97.5	36	90.0	101	93.5

Furthermore, the major causes of deficiencies of the KFs and the IFs were the high cost of inputs and its poor supply, which was indicated by 101 (93.5%) of the respondents. Shortage of water for irrigation/drought as hindering proper irrigation, paddling, sowing, transplanting and use of push weeders was reported by 37 (34.3%) of all the respondents. Fluctuating and/or poor attendance in training sessions was reported by 35 (32.4) of all the respondents. Other possible causes of deficiencies were insufficient training to the KFs and the IFs reported by 28 (25.9%) of the respondents and ineffectiveness of KF-IF-OF approach in extending innovations reported by 8 (7.4%) of the respondents. More than 50 percent of the OFs indicated that the IFs had insufficient training from the programme which caused them not to have sufficient skills and knowledge in extending technologies to the OFs. The study findings implied that the provision of extension services especially to the OFs was not effective and hence institutional sustainability of the approach became questionable.

4.7.2.2 Plans/strategies for institutional sustainability of the extension approaches

Respondents were asked to indicate whether or not they have ever discussed and agreed on the plans and/or strategies for institutional sustainability of the KF-IF-OF extension approach after the pull out of KATC programme. Table 17 shows respondents' opinion on this and whereby 64 (59.3%) of the respondents agreed to had discussed the plans/strategies for institutional sustainability of the KF-IF-OF

extension approach in their schemes. It was further revealed that 47 (87%) out of the 54 respondents in Mombo irrigation scheme agreed to have the plans/strategies in place as opposed to 17 (31.5%) out of the 54 respondents in Mwega. The study results indicated that respondents in Mombo irrigation scheme had discussed plans/strategies for institutional sustainability, while those in Mwega irrigation scheme were still doubtful. The respondents in Mombo had several plans for the institutional sustainability of the KF-IF-OF extension approach in their scheme because of the advantages they had seen from it.

Table 17: Respondents' opinions on the presence of plans/strategies for sustainability of the approaches (N=108)

Variable	Irrigation scheme				Total (N=108)	
	Mwega (n=54)		Mombo (n=54)			
	n	%	n	%	n	%
If there are plans/strategies for sustainability						
Yes	17	31.5	47	87.0	64	59.3
No	37	68.5	7	13.0	44	40.7
Identified plans/strategies for sustainability						
Establish farmers learning groups by using the same approaches	19	35.2	19	35.2	38	35.2
Establish FFS by using groups of KFs, IFs, and OFs	0	0.0	48	88.9	48	44.4
KFs and IFs to continue extending rice technologies to more OFs through demonstrations and field days	25	46.3	43	79.6	68	63.0
Carry out crops competitions among farmers	2	3.7	25	46.3	27	25.0
DCs has a training plan to farmers using the same approaches	0	0.0	0	0.0	0	0.0
Establish a special fund for farmers training and input loans	0	0.0	54	100.0	54	50.0
To have strong FOs with strong leadership	26	48.1	43	79.6	69	63.9
Imposing by-laws	17	31.5	51	94.4	68	63.0
No clear strategies/plans	40	74.1	3	5.6	43	39.8
Reasons for not having discussed plans/strategies						
Farmers didn't know from the beginning if KATC support will end	7	13.0	7	13.0	14	13.0
Leaders/FOs have never organized any meeting after the withdraw of KATC	31	57.4	0	0.0	31	28.7
KATC had no plans for sustainability of the approaches right from the beginning	6	11.1	0	0.0	6	5.6
Leaders/FOs do not care about farmers' concern	21	38.9	0	0.0	21	19.4

Also, the study results showed that 68 (63%) of the KFs and IFs respondents would continue extending improved irrigated rice technologies and practices to more OFs through demonstrations and field days. Likewise, the plans of establishing farmer learning groups by using the same approaches was indicated by 38 (35.2%) of the respondents, establishing of FFS was mentioned by 48 (44.4%) of the respondents, and conducting crops competitions was indicated by 27 (25%) of the respondents.

Further, the study found out that the respondents in Mombo irrigation scheme, through their Saving and Credit Co-operative Society (SACCOS), had established a special fund for farmer training and input loans. About 80% of the respondents in Mombo indicated that the presence of able leadership and by-laws for implementing farmers' issues had contributed to institutional sustainability of their FO. Also, the presence of a strong farmers' organization have had enabled the mobilization of funds in paying for water fees and other contributions for the association. According to Namwata (2004), farmers' organizations can enhance self-organizing capacities to facilitate the sharing of skills and knowledge between farmers and other stakeholders. Moreover, all the respondents indicated that the respective District councils (DCs) of Korogwe and Kilosa had not indicated to have training plans for their farmers using the KATC approaches. Likewise, it was found out that 43 (39.8%) of the respondents reported of there being no clear strategies/plans in place for achieving institutional sustainability of the approaches. Of these, 40 (74%) of the respondents were from Mwega irrigation scheme and only three (5.6%) respondents came from Mombo.

The second part of Table 17 indicates the reasons for not discussing the plans/strategies for institutional sustainability. The results of the current study indicated that 14 (13.0%) of the respondents had never discussed plans/strategies for institutional sustainability as they did not know from the beginning that KATC support would come to an end. Likewise, 31 (28.7%) of the respondents reported that scheme/FOs leadership had never organized any meeting to discuss the plans/strategies for institutional sustainability of the KF-IF-OF extension approach after withdraw of KATC. Further, 21 (19.4%) of the respondents reported that the scheme/FOs leadership did not care about farmers' concerns. However, as noted earlier, most of the respondents from Mwega irrigation scheme gave reasons for not discussed the plans/strategies for institutional sustainability of the KF-IF-OF extension approach after the phasing out of KATC programme. Hence, this implied that some schemes needed to be reminded on the importance of discussing the plans and strategies for institutional sustainability of the KF-IF-OF extension approach.

4.7.2.3 Satisfaction or dissatisfaction with the extension services rendered

Table 18 shows chi-square results on the levels of satisfaction with the extension services rendered by KATC, KFs and IFs together with their reasons for satisfaction or dissatisfaction. It was revealed that the level of satisfaction was significantly different at $p<0.000$ between the OFs and the two groups of the KFs and the IFs. This implies that, in the whole process of training, the OFs did not get adequate extension services from the IFs and the VAEOs. The reasons for farmers' satisfaction with the extension services showed variations between the IFs and the OFs

categories. These included: high ability of the KFs and the IFs to extend technologies at $p<0.001$, adequate contacts with KF/IF at $p<0.008$, getting immediate assistance from KF/IF when needed, ability to negotiate farming issues at $p<0.006$ and giving practical-oriented advice at $p<0.002$.

Table 18: Respondents' satisfaction on the extension services rendered by KATC, KFs and IFs (N=108)

Variables	Respondent category						Total (N=108)		χ^2 value	df	Sig. level
	KF (n=28)		IF (n=40)		OF (n=40)						
	n	%	n	%	n	%	n	%			
If farmers are satisfied											
Satisfied	28	100.0	35	87.5	25	62.5	88	81.5			
Not satisfied	0	0.0	5	12.5	15	37.5	20	18.5	16.875	2	0.000**
Reasons for satisfaction with KFs/IFs											
High ability of KFs to extend technologies	28	100.0	35	87.5	25	62.5	88	81.5	16.875	2	0.000**
High ability of IFs to extend technologies	-	-	35	87.5	21	52.5	56	70.0	11.667	1	0.001**
Adequate contacts with KF/IF	-	-	33	82.5	22	55.0	55	68.8	7.040	1	0.008*
Getting immediate assistance from KF/IF when needed	-	-	31	77.5	19	47.5	50	62.5	7.680	1	0.006*
Able to negotiate farming issues	-	-	30	75.0	18	45.0	48	60.0	7.500	1	0.006*
Giving practical-oriented advice	-	-	28	70.0	14	35.0	42	52.5	9.825	1	0.002*
Reasons for satisfaction with KATC training approaches											
Increase in rice yield	28	100.0	36	90.0	25	62.5	89	82.4	18.502	2	0.000**
Increase in income from rice	25	89.3	30	75.0	19	47.5	74	68.5	14.569	2	0.001**
Improved household food security	26	92.9	36	90.0	25	62.5	87	80.6	13.308	2	0.001**
Adoption of improved irrigated rice technologies	28	100.0	37	92.5	24	60.0	89	82.4	22.641	2	0.000**
Effective & efficient irrigation	27	96.4	28	70.0	18	45.0	73	67.6	20.055	2	0.000**
Increase in number of irrigated rice farmers	24	85.7	26	65.0	14	35.0	64	59.3	18.413	2	0.000**
Timely implementation of planned activities	25	89.3	33	82.5	22	55.0	80	74.1	12.430	2	0.002*
Coverage on cross cutting issues	25	89.3	27	67.5	19	47.5	71	65.7	12.856	2	0.002*
Empowerment of FOs and scheme extension agents	23	82.1	22	55.0	19	47.5	64	59.3	8.665	2	0.013*

** Significant at 0.001; * Significant at 0.05.

High variations were observed for all the reasons for satisfaction with KATC training approaches between the OFs on one hand and the KFs and the IFs on the other hand and were statistically significant at $p \leq 0.001$ and $p \leq 0.05$ respectively. The reasons included the increase in rice yield and the adoption of improved irrigated rice cultivation technologies and practices, which were statistically significant at $p<0.000$ and was reported by 89 (82.4%) of the respondents, improved household food security, which was statistically significant at $p<0.001$ and was mentioned by 87 (80.6%) of the respondents, and timely implementation of planned activities, which was statistically significant at $p<0.002$ and was indicated by 80 (74.1%) of the respondents. Other reasons were increase in income from rice, which was statistically significant at $p<0.001$ and reported by 74 (68.5%) of the respondents; attaining effective and efficient irrigation, which was statistically significant at $p<0.000$ and was indicated by 73 (67.6%) of the respondents; coverage on cross cutting issues like gender and environmental conservations, which was statistically significant at $p<0.002$ and was mentioned by 71 (65.7%) of the respondents; an increase in number of irrigated rice farmers, which was statistically significant at $p<0.000$ and empowerment of farmers organizations and scheme extension agents, which was statistically significant at $p<0.013$. It can be concluded that while the KFs and the IFs had high levels of satisfaction, the OFs had high levels of dissatisfaction with the extension services rendered by the IFs and KATC in the whole training period.

4.7.2.4 Attitudes of respondents toward adopted technologies and practices

The majority of all the respondents 98 (90.7%) agreed that they would continue to use irrigated rice cultivation technologies and practices. This aspect was statistically

significant at p<0.045. Of all the 40 OFs, 32 (88%) indicated that they would continue with the technologies compared to 38 (95%) of the IFs and 28 (100%) of the KFs. This implies that the innovations would be sustainable in years to come. The study found out that all the 98 (90.7%) of the respondents who agreed to continue with the technologies showed to have had enough skills and knowledge on irrigated rice cultivation, while 94 (87%) reported to have increased their rice yields per unit area.

Table 19: Respondents' attitudes toward use of technologies and practices (N=108)

Variables	Respondent category						Total (N=108)		χ^2 value	df	Sig. level
	KF (n=28)		IF (n=40)		OF (n=40)						
	n	%	n	%	n	%	n	%			
Continue using the adopted innovations											
Yes	28	100.0	38	95.0	32	88.0	98	90.7			
No	0	0.0	0	0.0	2	5.0	2	1.9	9.753	4	0.045*
Don't know	0	0.0	2	5.0	6	15.0	8	7.4			
Reasons for continuing											
Have the knowledge	28	100.0	38	95.0	32	88.0	98	90.7	9.213	2	0.010**
Have seen the benefits	28	100.0	38	95.0	28	70.0	94	87.0	16.709	2	0.000**
Have increased yields	28	100.0	38	95.0	28	70.0	94	87.0	16.709	2	0.000**
Reasons for not continuing/no decision											
Need of loans for inputs	-	-	0	0.0	6	15.0	6	5.6			
Still need KATC assistance	-	-	2	5.0	8	20.0	10	9.3			
Problem of salinity	-	-	1	2.5	2	5.0	3	2.8			
Sandy soils in the field	-	-	1	2.5	4	10.0	5	4.6			

** Significant at 0.001; * Significant at 0.05.

However, there were statistical significant differences at p<0.010 and at p<0.000 for the reason given in Table 19. Of all the 108 respondents, ten (9.3%) still needed technical assistance from KATC/VAEO/KFs and/or IFs, while six (5.6%) said they

could not afford to buy inputs, and five (4.6%) reported to have problems of sandy soils in their fields and three (2.8%) of the respondents reported that soil salinity was a problem in their fields.

4.7.2.5 Suggestions for the improvement

Table 20 presents suggestions that respondents gave in the two schemes to improve training programmes. Of all the 108 respondents, i.e. 89 (87.4%) of the respondents suggested that KATC, DCs, ZIUs and other stakeholders should look for reliable markets for farm produce, while 88 (81.5%) of the respondents recommended for KATC, DCs, ZIUs and other stakeholders to look for reliable input supply systems. Other suggestions that respondents gave include, KATC to continue making follow-ups and technical backstopping to farmers in the trained schemes indicated by 74 (68.5%) of the respondents; trainings to include arrangements for sourcing inputs loans reported by 61 (56.5%) of the respondents; and provision of capacity building and motivation package to the scheme extension agents reported by 58 (53.7%) of the respondents.

Yet, other suggestions included KATC, DCs, ZIUs and other stakeholders to buy hand tractors and lining of irrigation canals reported by 51 (47.2%) of the respondents, KATC to train more scheme members reported by 47 (43.5%) of the respondents, and KATC to provide training in other crops like horticultural crops and other high value crops reported by 46 (42.6%) of the respondents. Meanwhile, 36 (33.3%) of the respondents urged all the stakeholders in the KATC training

programmes including ZIUs and DCs to be more responsible in fulfilling their assignments and promises. It has been learnt from the study that some stakeholders did not participate fully in the training programme despite their commitment during the action plan preparation.

Table 20: Respondents' suggestions for improving KATC extension programmes (N=108)

Suggestion	Irrigation scheme				Total (N=108)	
	Mwega (n=54)		Mombo (n=54)			
	n	%	n	%	n	%
Include training of other crops	33	61.1	13	24.1	46	42.6
Stakeholders to be more responsible	26	48.1	10	18.5	36	33.3
KATC to continue making follow-ups and technical backstopping to farmers	39	72.2	35	64.8	74	68.5
KATC to train more schemes	22	40.7	25	46.3	47	43.5
Invest more money to the scheme by providing more hand tractors and lining of irrigation canals	25	46.3	26	48.1	51	47.2
Trainings should go together with arrangements for inputs loans	34	63.0	27	50.0	61	56.5
Arrangement for reliable input supply	45	83.3	43	79.6	88	81.5
Measures for reliable markets for farm produces	45	83.3	44	81.5	89	87.4
Provide capacity building and motivation package to the scheme extension agents	29	53.7	29	53.7	58	53.7

4.8 Perceptions of extension workers on the training approaches

4.8.1 Effectiveness of the KATC training approaches

Table 21 presents opinions on the effectiveness of the KATC training approaches and innovations as perceived by the extension officers in the schemes, ward, and district levels. In order to assess the perceptions of extension workers on the effectiveness of KATC training approaches in meeting farmers increased rice productivity, the study adopted Likert-scale items for soliciting opinions. The major areas covered included extension approaches, methods and innovations used by KATC in the training

programme. Generally, the statements were meant to solicit opinions from the respondents as to whether KATC approaches facilitated the improved irrigated rice technologies through creation of awareness, imparting of knowledge, adoption of technologies and practices, and increased rice productivity. Based on a three-point rating of response levels (2 = Agree; 1 = Disagree; and 0 = Undecided), the mean and standard deviation values associated with each item were determined. For the purposes of data interpretation, the mean values ranging from 1.50 and above were considered indicating positive responses, while those below 1.50 were considered as reflecting negative responses.

The study results indicated that responses from the respondents were positive on 16 variable statements out of 20, since their mean value happened to be more than 1.5. The results showed a domain mean value of 2.0 on the effectiveness of KF-IF-OF approach, PLA, demonstrations, field and farmers days, and study tour/farmer exchange visits in influencing awareness, dissemination and adoption of disseminated innovations. Other approaches and methods that showed a mean value of 2.0 were on the effectiveness of field training and participatory farmers' selection. The study results also indicated that the respondents have agreed on the usefulness of residential training for the development of KFs, effectiveness of KATC approaches in improving and strengthening WUA/FOs as well as on the effectiveness of KATC approaches in follow-ups/supervisions through VAEOs and ITs since their mean values were above 1.5. With regard to the qualities of the innovations, positive responses were given by the respondents (mean above 1.5), which indicated to agree

on the flexibility and compatibility of KATC promoted innovations to farmers' conditions. From the above study findings, it can be concluded that the respondents showed to agree on the effectiveness of KATC approaches in that they have influenced high adoption of disseminated innovations, which caused knowledge level of farmers on irrigated rice to increase and eventually helped farmers to increase rice yields per unit area. The study results also revealed that while the mean value for the KFs effectiveness in creating awareness and disseminating of innovations to the IFs is above 1.5, the mean value for the IFs is below 1.5. This implies that IFs were not effective in creating awareness and disseminating of innovations to the OFs.

Furthermore, negative responses were also reported with respect to the usefulness and effectiveness of crop competitions in dissemination and adoption of innovations as well as on the usefulness and effectiveness of reading materials in complementing the training (mean below 1.5). A high level of disagreement was also reported on the cost effectiveness of KATC approaches in dissemination of innovations, which indicated the lowest mean value of 1.21. This implies that the cost effectiveness of KATC approaches in disseminating innovations is a questionable statement. Meanwhile, the standard deviation values indicated that while half of the responses had SD=0.00, the other half were scattered from the mean with the SD ranging from 0.633 to 0.994. This implied that while half of the responses on the effectiveness of the KATC approaches and methods were generally not similar, the other half were similar.

Table 21: Respondents distribution by opinions on the effectiveness of KATC approaches as compared to other extension approaches (N=14)

Variable	Mean	SD
KF-IF-OF approach has been effective in influencing high adoption of disseminated innovations	2.00	0.000
PLA/PRA was useful and effective for creating awareness of farmers before the training	2.00	0.000
KFs have been effective in creating awareness and dissemination of innovations to IFs	2.00	0.000
IFs have been effective in creating awareness and dissemination of innovations to OFs	1.43	0.756
Demonstrations and Farmer managed trials have been effective in facilitating dissemination of innovations	2.00	0.000
Field and farmers days were useful and effective in dissemination and adoption of innovations	2.00	0.000
Study tour/Farmer exchange visits were useful and effective in dissemination and adoption of innovations	2.00	0.000
Crop competitions were useful and effective in dissemination and adoption of innovations	1.29	0.994
Farmers selection was participatory and motivated farmers to participate in the training	2.00	0.000
Residential training was useful and effective for the development of KFs	1.56	0.756
Field training was useful and effective for the development of IFs and OFs skills	2.00	0.000
Reading materials were useful and effective to compliment the training	1.29	0.914
KATC approaches have helped farmers to increase rice yields	2.00	0.000
KATC approaches have been effective at improving and strengthening FOs	1.64	0.633
KATC approaches are effective in follow-ups/supervisions through VAEOs and ITs	1.50	0.855
KATC approaches are effective in involving farmers participation in technology development	1.50	0.855
KATC innovations are compatible with farmers' condition	1.71	0.726
KATC approaches are flexible to farmers' conditions	1.57	0.756
KATC approaches are more cost effective in dissemination of innovations	1.21	0.699
Knowledge level of farmers on irrigated rice after KATC intervention has increased	2.00	0.000

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the conclusion and recommendations based on the study findings. For the sake of convenience and easy interpretation, the major conclusions and recommendations are summarized and organized around the study objectives which are in line with the results presented in the preceding chapter.

5.2 Conclusion

The study found out that 100% of the respondents were involved in the training programme on voluntary basis in order to gain knowledge and skills on improved irrigated rice cultivation. It was also revealed that there were equal representations of males and females, for the KF and OF categories of respondents; the percentage of female respondents was higher in the IF category 26 (65%) than that of the male respondents, which indicated that more women than men were often available during the training sessions. On education levels, a big proportion of the respondents (>80%) had some formal education, which enabled them to benefit more from training programmes and made it easy for them to adopt the innovations and therefore became good representatives of KFs and IFs because they could write, keep records and read various extension materials.

The study findings revealed statistical significant differences at $p<0.000$ between means among the trained farmers towards their preferences to the use of KF-IF-OF approach. The results also showed that the majority of the respondents i.e. 102 (94.4%) preferred field training approaches, 100 (92.6%) of the respondents preferred demonstrations and farmer managed trials, and 99 (91.7%) of the respondents preferred field and farmers days.

On the adoption of technologies, the study found out that all the respondents in the three categories indicated to have adopted the promoted innovations during and after the training despite the statistical significant differences observed in the level of adoption. Since the KFs and the IFs had higher levels of adoption in 18 out of 24 innovations, it could therefore be concluded that the KF-IF-OF extension approach was effective in dissemination and increasing the adoption of innovations within the first two categories of KFs and IFs.

Of all the 108 respondents, 88 (81.5%) indicated that the greatest strength of the KATC training approaches was the participatory nature of all the approaches used in the training programme. However, the study results revealed that the IFs had more weaknesses in fulfilling the training requirement than the KFs. This implies that the OFs' quest for knowledge and skills on irrigated rice were not adequately fulfilled by the KFs-IFs-OFs chain of extension approach.

Meanwhile, both the IFs and the OFs argued that the KFs were not creative as they relied on what was provided to them during the training. This implies that the IFs were not as effective as KFs and it also implies poor extension qualities. The involvement of the KFs and the IFs in technology development/testing was higher than the involvement of the OFs. Similarly, the KFs and the IFs respondents reported that KATC extension approaches had been effective in follow-ups/supervisions and technical backstopping to the KFs and the IFs through the VAEOs and the ITs. According to the revealed facts, it can be concluded that KFs/IFs worked best where there was support from professional extension worker.

The majority of all the respondents 98 (90.7%) agreed that they would continue to use irrigated rice cultivation technologies and practices. This implies that the innovations would be sustainable in years to come. Generally, the study findings imply that the KF-IF-OF approach had been effective in increasing the adoption of innovations leading to an increase in irrigated rice yields.

5.3 Recommendations

The following recommendations are made based on the study conclusion

i) In order to deliver effective and efficient extension services to other farmers through KF-IF-OF extension approach, it is recommended that KATC should give KFs and IFs appropriate and adequate training suitable in solving common problems encountered in implementing their roles as farmers and as farmer extensionists. The countermeasures should also include effective technical

backup programme, which would strengthen the KFs-IFs-OFs chain of extension approach, address the prevailing weaknesses as well as meeting the OFs' quest for knowledge and skills on irrigated rice that were not adequately fulfilled.

ii) Although farmer training is an important factor for increasing production, other agriculture supporting services should be provided to foster the adoption of the improved technology. The services include access to credits, reliable markets for farm produce, and reliable input supply systems. According to Madukwe (2006), the old practice of asking farmers to produce in order to meet specific market demands without providing the means has not worked. Extension is therefore valuable when it is linked to specific market opportunities, and when producers are being equipped to respond to particular market demands.

iii) It is recommended that in order to come up with a sustainable extension approach, plans and strategies should be designed to ensure that there is a continuation of training so as to spread and share the technologies among needy farmers. Therefore, institutional sustainability of the KATC training approaches should be laid upon sensitization, mobilization and involvement of farmers, farmers' organizations, scheme/village leadership and district councils to discuss and come up with plans and strategies for sustainability.

iv) The development of effective KF-IF-OF or farmer-to-farmer extension approach should underscore the importance of professional extension workers. The study findings revealed that KATC extension approaches had been effective in follow-ups/supervisions and technical backstopping to the KFs and the IFs through the VAEOs and the ITs, which made them to perform well. Therefore, effective in follow-ups/supervisions as well as regular support/facilitation to the farmer extensionist from the professional extension is of paramount importance for them to be effective.

v) A condition of effective and sustainable functioning of farmer groups is that the perceived benefits to members substantially outweigh the perceived costs. Benefits are likely to be high where the production of a high value commodity is involved and where linkages with other stakeholders (private or public sector) are valued by the group. Therefore, KATC should think of diversifying their training scope in other crops like horticultural crops and other high value crops.

vi) All the stakeholders in the KATC training programmes including ZIUs and DCs should be more responsible in fulfilling their assignments and promises. It has been learnt from the study that some stakeholders did not participate fully in the training programme despite their commitment during the action plan preparation.

vii) The presence of a strong farmers' organization would enable farmers to mobilize funds such as membership and water fees and other contributions for the

association. According to Namwata (2004), farmer organizations would enhance self-organizing capacities to facilitate the sharing of knowledge and skills between farmers and other stakeholders. Therefore, farmer organizations, if well structured and provided with the necessary support, may become potential providers of extension services in their schemes.

viii) In order to foster creativity among KFs/IFs for the development of extension service, there is a need to harness indigenous knowledge. A country's knowledge base needs to be developed and fostered for both improving its competitive position and contributing to human and sustainable development goals. This is evident when local, scientific and technical information are properly managed and used. Special emphasis could be placed on developing and disseminating local content, improving the relevance of the information to local development, as well as capturing and auditing all relevant local resources.

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APPENDICES

Appendix 1: Questionnaire for trained farmers in the KATC training approach

I: RESPONDENTS GENERAL INFORMATION

1). Respondents' Number ……..Scheme……Village……..……..
Ward……..…District.……Region……

2). Respondents Category 1. KF 2. IF 3. OF

3). Age: ……. years. 1. 15-35 2. 36-55 3. 56-75

4). Sex: 1. Male 2. Female

5). Marital status:
1. Single 2. Married 3. Widowed
2. Abandoned/divorced/separated

6). What is the education level attained?
1. Non formal education 2. Adult literacy classes
3. Primary school education 4. Secondary school education
5. Others (specify)

7). What crops do you grow? (Rank them according to weight you give as source of food and income generation including rice)

S/n	Crops cultivated	Acreage	Importance as income earner	Importance as source of food
1				
2				
3				
4				
5				
6				

II: AWARENESS, KNOWLEDGE, ADOPTION AND PRODUCTIVITY OF FARMERS ON KATC EXTENSION APPROACH

8). In which year did you start participating in KATC approach. Year…….

9). Why did you decide to participate in KATC approach? (Probe) three reasons
1……
2……
3……

10). How were you selected to become a KF/IF/OF?
1. Through set criteria
2. Chosen by village leaders
3. Chosen by VAEO/IT
4. Chosen by fellow farmers

11). Did you participate in PLA when the learning needs assessment was done?
1. Yes 2. No

12). If the answer in Question 10 above is Yes, how was the process done? (probe)
1……
2……
3……

13). KATC training approach employs several approaches in disseminating innovations on improved irrigated rice technologies to farmers. Which methods/approaches do you think were the most useful in the whole process?

1. Use of KF-IF-OF ……..
2. Residential training …..…….
3. Field training ……..
4. Demonstrations/Trials ……..
5. Field and Farmers days ……..
6. Study tours/exchange visits ……..
7. Crop competitions ……..
8. Printed materials ……..
9. PLA ……..

14). What were the main sources of awareness on improved irrigated rice cultivation technologies?

1. KATC trainers ……..
2. VAEOs and ITs ……..
3. KFs and IFs ……..
4. Demonstrations/Field days ……..
5. Other fellow farmers ……..
6. Researchers and NGOs ……..
7. Radio and TV ……..
8. Printed materials ……..

15). What were the main sources of knowledge on improved irrigated rice cultivation?

1. KATC trainers ……..
2. VAEOs and ITs ……..
3. KFs and IFs ……..
4. Demonstrations/Field days ……..
5. Other fellow farmers ……..
6. Researchers and NGOs ……..
7. Radio and TV ……..
8. Printed materials ……..

16). What type of agricultural innovations in irrigated rice for the have you adopted before KATC training?
To each innovation adopted or rejected give reasons for adoption or rejection of the innovation and state to what extent have you accomplished the adopted innovations?

Type of innovation	Adopted	Rejected	Reasons for adoption/rejection
Eg. Preparation of bunds	√		It facilitate good management of irrigation water
Proper seed selection Proper nursery preparation, sowing and its management Bunds making, repair and field leveling Line transplanting Use of improved varieties Proper irrigation and water management Proper land preparation Timely weeding Fertilizer application Fabrication and use of simple farm tools Timely farm operations Establishment & management of demonstration plots Controlling salinity Prevention of pests and diseases Gender mainstreaming Training of other farmers			

17). What type of agricultural innovations in irrigated rice for the past three years during and after the training have you adopted so far?
To each innovation adopted or rejected give reasons for adoption or rejection of the innovation and state to what extent have you accomplished the adopted innovations?

Type of innovation	Adopted	Rejected	Reasons for adoption/rejection
Eg. Preparation of bunds	√		It facilitate good management of irrigation water
Seed selection by using water and salt			
Use of certified seeds			
Use of improved varieties			
Proper nursery preparation			
Bund making and field leveling using simple tools			
Paddling			
Line transplanting			
Timely weeding			
Timely and split fertilizers application			
Controlling water levels for irrigation in the field			
Routine O&M			
Controlling pest and diseases			
Harvesting at right time			
Undertaking post harvest measures			

Fabrication and use of push-weeders			
Fabrication and use of hand leveler			
Fabrication and use of threshing stand			
Preparation and use of improved cooking stoves			
Farm record keeping			
Maintaining household food security			
Family budgeting			
Establishment of demonstration plots			
Controlling salinity			
Training of other farmers			

18). What approach influenced your adoption?

1. Residential training ……..
2. Field training ……..
3. VAEOs and ITs ……..
4. KFs and IFs ……..
5. Demonstration/Field days ……..
6. Study/Exchange visits ……..

19). Which innovations extended to you by KATC approach do you perform without any external support?

1……2……
3……4…….
……..5……
6……

20). If farmers encountered problems farming activities under KATC approach?

1. Yes ……..
2. No ……..

21). What major problems did you encounter in farming activities under KATC approach?

1……2……
3……4…….
……..5……
6……

22). If innovations has spread to other farmers

3. Yes ……..
4. No ……..
5. Not sure ……..

23). Magnitude of other farmers who adopted the innovations

1. <25% ……..
2. 25-50% ……..
3. 51-75% ……..
4. >75% ……..

24). What is the trend of rice yields have you experienced?

Trend of rice yield before training	Reasons for the increase	Reasons for the decrease	Reasons for No change
1. Increasing			
2. Decreasing			
3. No change			
Trend of rice yield during and after training			
1. Increasing			
2. Decreasing			
3. No change			

25). Achievement of rice yield target

If rice yield target have been achieved	Reasons for Yes	Reasons for No
1. Yes		
2. No		

III: SUSTAINABILITY OF THE APPROACH

26). With regard to KATC approach, in what specific skills do you feel that you are not competent and hence need more support or training?

1……..2……..……
3……..4……..……
5……...…6…….

27). Have you ever discussed in your meetings about the institutional sustainability of the KATC approaches after the end of the KATC intervention?

1.Yes 2. No

28). If the answer in question 27 above is Yes what are the plans and/or strategies? (Probe)

1…….
2…….
3…….

29). If the answer in question 27 above is No, explain why?

1…….
2…….
3…….

IV: PERCEPTION TOWARDS KATC TRAINING APPROACHES

30). We would like to know the extent to which you feel about the following statements concerning KATC training approach on:

S/no	Statement/Description of activities	Strongly agree	Agree	Undecided	Disagree	Strongly Disagree
I. KFs and IFs efforts in disseminating innovations						
1	KFs bring extension services closer to Ifs					
2	IFs bring extension services closer to OFs					
3	KF have been effective in creating awareness and dissemination of innovations to Ifs					
4	IF have been effective in creating awareness and dissemination of innovations to OFs					
5	KFs/IFs give priority to my farming issues					
6	I feel free to contact with KF/IF					
7	I have more opportunities to contact with KF/IF					
8	KFs/IFs offer more practical advices					
9	KFs/IFs promote the innovations which they have already adopted					
10	KFs/IFs have good rapport with farmers					
11	KFs/IFs give technical advice confidently					
12	KFs/IFs are not creative as they rely on what they have been trained					
II. Effectiveness of KATC approaches						
1	KATC approaches have helped farmers to increase rice yields					
2	KF-IF-OF approach has been effective & influenced high adoption of disseminated innovations					
3	PLA was useful and effective for creating awareness of farmers before the training					
4	KATC approaches have been effective to improve and strengthening WUAs/FOs					
5	KATC approaches are effective in follow-ups/supervisions and technical back-stopping					
6	KATC approaches are effective in involving farmers participation in technology development/testing					
7	KATC innovations are compatible with farmers' condition					
8	KATC approaches are flexible to farmers' conditions					
9	Reading materials were useful and effective to compliment the training					
10	KATC approaches are more cost effective in dissemination of innovations					

V: STRENGTHS AND WEAKNESSES OF KATC APPROACH

31). On your opinion, what do you think are strengths and weaknesses of KATC approach in comparison with other extension approaches?

S/N	STRENGTHS	WEAKNESSES
1		
2		
3		
4		
5		
6		
7		
8		

31a). If trained farmers (KFs and IFs) were deficient in some aspects of skills and knowledge

1. Yes
2. No

31b). Deficiency areas of skills and knowledge

1……..2…….……
3……..4…….……
5……..…6……

31c). Possible causes of deficiencies

1……..2…….……
3……..4…….……
5……..…6……

32). Are you satisfied with the KATC training approaches used?

1 Satisfied 2 Not Satisfied

33). Give reasons for satisfaction with:

a) The KFs and IFs

1……..2…….……
3……..4…….……

b) KATC training approaches

1……..2…….
……
3……..4…….……

34). Will you continue using the adopted innovations on your own

1. Yes
2. No
3. Don’t know

Reasons for continuing

1……..2…….……
3……..4…….……

Reasons for not continuing/no decision

1……..2…….……

3……..4…….……

35). What suggestions do you think would improve the KATC extension approach?

1……

2……

3……

4……

5……

Appendix 2: Questionnaire for DSMS/WAEO/VAEO/IT

I : GENERAL INFORMATION

1). Respondents' Number ……Date ……..District…….....
Region…… ……Irrigation
Zone……

2). Sex: 1. Male 2. Female

3). What is the highest professional level that you attained?
1.Certificate 2. Diploma 3.Others (specify)

II: PERCEPTION TOWARDS KATC TRAINING APPROACH

4). We would like to know the extent to which you feel about the following statements concerning KATC training approach compared to other extension approaches

S/no	Statement/Description of activities	Strongly agree	Agree	Undecided	Disagree	Strongly Disagree
1	KF-IF-OF approach has been effective in influencing high adoption of disseminated innovations					
2	PLA/PRA was useful and effective for creating awareness of farmers before the training					
3	KF have been effective in creating awareness and dissemination of innovations to Ifs					
4	IF have been effective in creating awareness and dissemination of innovations to OFs					
5	Demonstrations and Farmer managed trials have been effective in facilitating dissemination of innovations					
6	Field and farmers days were useful and effective in dissemination and adoption of innovations					
7	Study tour/Farmer exchange visits were useful and effective in dissemination and adoption of innovations					
8	Crop competitions were useful and effective in dissemination and adoption of innovations					
9	Farmers selection was participatory and motivated farmers to participate in the training					
10	Residential training was useful and effective for the development of KFs					
11	Field training was useful and effective for the development of IFs and OFs skills					
12	Reading materials were useful and effective to compliment the training					
13	KATC approaches has helped farmers to increase rice yields					

14	KATC approaches has been effective to improve and strengthening WUA/FOs					
15	KATC approaches are effective in follow-ups/supervisions through VAEOs and ITs					
16	KATC approaches are effective in involving farmers participation in technology development					
17	KATC innovations are compatible with farmers' condition					
18	KATC approaches are flexible to farmers' conditions					
19	KATC approaches are more cost effective in dissemination of innovations					
20	Knowledge level of farmers on irrigated rice after KATC intervention has increased					

III: INFORMATION ON KATC APPROACH

5). With regard to KATC approach, in what specific skills or areas do you feel that KFs and IFs are not competent and hence need more support or training?

1……..……

2……..……

3…….

6). KATC approach employs several approaches in disseminating innovations on improved irrigated rice technologies to farmers. Which methods/approaches do you think were the most useful in the whole process?

1……..……

2……..……

3…….

7). Did the innovations disseminated through KATC approach spread to other farmers in the scheme and out of the scheme?

1. Yes 2. No

8). If the answer is Yes in the Question 10 above, what type of innovations?

1……..……

2……..……

3…….

9). What is the magnitude of the other farmers who adopted the innovations?

1. < 25% 2. About 50% 3. About 75% 4. >75%10).

10). In your own opinion, do you think KATC approach will be sustainable after the withdrawal of KATC support?

1. Yes 2. No

11). Give reasons to support your answer in the Question 13 above

1……..……

2……..……

3…….

12). How satisfied are you with the work of the KATC approach?

1. Satisfied 2. Not satisfied

13). Please give reasons for the answer given in No. 15, above.

1……..……

2……..……

3…….

14). Do you think that farmers like the KATC approach of teaching?

1.Yes 2. No

15). If the answer is Yes in the Question 17 above, which aspects do they like most in the approach?

1……..……

2……..……

3…….

16). Do you think farmers can continue using KATC approach in extending improved irrigated rice technologies to other farmers in the scheme and out of the scheme?

1. Yes 2. No

17). Give explanation on the answers given in the Question 19 above

1……..……

2……..……

3…….

18). Have you ever discussed in your meetings about the plans for sustainability of the KATC approach after the withdrawal of KATC support?

Yes 2. No

19). If the answer is Yes in the Question 21 above what are those plans?

1……..……

2……..……

3…….

20). What are the strategies for implementation to reach such plans question 22 above?

1……..……

2……..……

3…….

21). In your opinion, what do you think are strengths and weaknesses of KATC approach in comparison with other extension approaches?

S/N	STRENGTHS	WEAKNESSES
1		
2		
3		
4		
5		

22) In your opinion do you think that KATC extension approach has been a

1 success 2 failure

23). What should be done to ensure that KATC extension approach is more successful?

1……..……

2……..……

3…….