EFFECTIVENESS OF FARMER FIELD SCHOOLS IN PROMOTING ADOPTION OF BEST AGRICULTURAL PRACTICES BY SMALLHOLDER COFFEE FARMERS IN KENYA

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DECLARATION AND RECOMMENDATION

Declaration

This thesis is my original work and has not been presented in any University or other institution of learning for any awards.

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Recommendation

This thesis has been submitted with our approval as the university supervisors.

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DEDICATION

This work is dedicated to all my family members for their prayers, constant encouragement and understanding. They endured hard times while they stood by me as I laboured on this work.

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ABSTRACT

In Kenya, there are gaps on the availability of studies of the specific extension approaches and their effectiveness on the adoption of technologies. This study sought to determine the effectiveness of Farmer Field Schools (FFS) in promoting adoption of best agricultural practices (BAP) by smallholder coffee farmers in Kenya. The target population was the smallholder coffee farmers in the CRI's FFS pilot project numbering 4802. All the 117 farmers who trained and graduated in FFS were used owing to their small size. Proportionate random sampling technique was applied to the societies to obtain a sample of 100 farmers who did not learn through FFS, constituting a sample of 217. A descriptive survey research design was used. Data was collected using an interview schedule. The instrument was validated by experts from the Egerton University's Department of Agricultural Education and Extension. The research instrument was pilot tested to determine its reliability. Using Cronbach's alpha, an index of 0.936 was obtained. Descriptive statistics as well as inferential statistics were used to analyze data with the help of Statistical Packages for Social Sciences (SPSS) version 22 for windows. Chi-square and correlation analysis were used to determine whether FFS had statistically significant effect on enhancing uptake of BAP amongst smallholder coffee farmers in Kenya. Correlation analysis and independent samples t-test were employed respectively to determine the effectiveness of FFS in increasing coffee yields and in enhancing sharing of knowledge amongst smallholder coffee farmers in Kenya. To make reliable inferences from the data, all statistical tests were verified at $\alpha \leq 0.05$ level of significance. The study revealed that there was a significant positive relationship between extent of uptake of BAP and belonging to FFS classes. Belonging to FFS classes significantly increases the likelihood of getting higher coffee yields. Farmer Field Schools have a statistically significant effect on enhancing sharing of knowledge amongst smallholder coffee farmers. This study recommends that stakeholders including governments, farmers' organizations, and development organizations need to encourage smallholder farmers to belong to FFS classes in order to enhance the uptake of BAP in coffee farming. Farmers should be encouraged to join and actively participate in existing FFS classes for them to be able to achieve higher coffee production. FFS classes should be strengthened and supported in order for them to continue yielding better results in facilitating the sharing of knowledge among smallholder farmers in Kenya.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS AND ACRONYMS

AESA	Agro-Ecosystem Analysis
BAPs	Best Agricultural Practices
CEOs	Chief Executive Officers
CFC	Common Fund for Commodities
CRF	Coffee Research Foundation
CRI	Coffee Research Institute
DALEO	District Agriculture and Livestock Extension Officer
FAO	Food and Agriculture Organization
FCS	Farmers' Cooperative Society
FFS	Farmer Field School
FFSs	Farmer Field Schools
IFAD	International Fund for Agricultural Development
IPM	Integrated Pest Management
IPPM	Integrated Production and Pest Management
KALRO	Kenya Agricultural and Livestock Research Organization
KARI	Kenya Agricultural Research Institute
NAEP	National Agricultural Extension Policy
NACOSTI	National Commission for Science, Technology and Innovations
NALEP	National Agriculture and Livestock Extension Programme
NASEP	National Agricultural Sector Extension Policy
PRA	Participatory Rural Appraisal
SIDA	Swedish International Development Agency
T&V	Training and Visit
ToT	Transfer of Technology

CHAPTER ONE
INTRODUCTION

1.1 Background of the Study

Agricultural extension and advisory services comprise "the entire set of organizations that support and facilitate people engaged in agricultural production to solve problems and to obtain information, skills and technologies to improve their livelihoods" (Anderson, 2007) Extension was traditionally viewed as a means of transferring technologies developed in research stations as well as farm management practices to farmers, and used top-down institutions of delivery, as characterized, for example, by the World Bank's Training and Visit System (Gautam & Anderson, 2000). These traditional extension approaches were criticized for providing a "one size fits all" approaches (Madhur, 2000), which failed to factor in the diverse socioeconomic and institutional environments faced by farmers, or involve farmers in the development of technology and practices appropriate to their contexts.

Extension was considered to have failed in achieving its main objective of farm productivity improvements and in reaching the poor, particularly in Africa (Anderson, 2007). Since the 1980s, the approaches to reaching rural smallholder farmers have drawn increasingly on more participatory approaches, which enable farmer self-learning and sharing, and also allow those facilitating farmer training, as well as agricultural researchers further upstream, to learn from the farmers (Braun, 2006).

Since the late 1980s, support to agricultural extension has shifted from top-down approaches to those identifying technologies and approaches of communicating technologies which are suitable to support farmers' livelihoods in a sustainable manner, including participatory approaches based on the notion of creating spaces for farmer self-learning. One such approach is the farmer field school (FFS), an adult education intervention with the objectives of providing skills in such areas as integrated pest management (IPM) and empowering communities. Farmer Field Schools have been implemented in 90 countries worldwide, reaching an estimated 10–15 million farmers. The role of agricultural extension is to help people identify and address their needs and problems (Ministry of Agriculture, 2012). There is a general consensus that extension services if successfully applied, should result in outcomes which include observable changes in attitudes and adoption of new technologies, and improved quality of life based on indicators such as health, education and housing (Kibbet, Omunyinyi & Muchiri, 2005).

In Kenya and other developing countries, attempts have been made to change conventional extension approaches to participatory approaches (Ajayi & Okafor, 2006). Conventional extension approaches were perceived as top-down, inflexible and with limited farmer participation. Transfer of Technology and Training and Visit were conventional approaches widely in Kenya between 1950s and 1990s (WB-OED, 1999). They were supply driven and externally initiated without the involvement of the target farmers, hence not farmer-problem oriented (LDG, 2004).

Farmer Field Schools have been widely used in different countries for farmer empowerment. In FFS, farmers are no longer positioned as receivers of already developed technological packages, but as field experts, who work with the extension staff to find solutions relevant to the local realities. Farmer field schools emphasize farmers' ownership, partnership and group collaboration. They have been used in many crops including cotton, tea, coffee, cacao, pepper, vegetables, small grains and legumes (Potinus, Dilts, & Bartlett, (Eds.) (2002).

Farmer Field Schools were conceptualized between 1970s and 1980s and first implemented in Indonesia in 1989 to deal with the wide spread of pest out breaks in rice that threatened the security of Indonesia's basic food supplies (Potinus, Dilts & Bartlett, (Eds.) (2002). The training was first introduced in East Africa in 1995 under the Food and Agricultural Organization (FAO) special program for food security in Western Kenya (FAO, 1995). Braun (2006) noted that FFS provide an environment in which farmers acquire knowledge and skills for sound management decisions, sharpen their ability to make critical decisions that render their farming profitable and sustainable and empower them to become "experts" on their own farms.

The farmer field school networks in Eastern Africa support about 2000 FFSs with close to 50,000 direct beneficiaries (Braun & Duveskog, 2008). Farmer Field Schools focus on building farmers' capacity to make well-informed crop management decisions through increased knowledge and understanding of the agro- ecosystem. Farmer field school participants make regular field observations and use their findings, combined with their own knowledge and experience, to judge for themselves, what, if any, action needs to be taken (Kolb, 1984).

The long term empowerment goals of FFS seek to enable graduates to continue to expand their knowledge and to help others learn and to organize activities within their communities to institutionalize different practices (Danida, 2011). Farmer Field Schools differs from other extension approaches is that, the role of extension worker is very much that of a facilitator rather than a conventional teacher. Once the farmers know what it is they have to do, and what it is they can observe in the field, the extension worker takes a back seat role, only offering guidance when asked to do so (Mutandwa & Mpangwa, 2004). The aim of FFS is to build the farmers' capacity to analyze their production systems, to identify their main constraints, and to test possible solutions, eventually identifying and adopting the practices most suitable to their farming system (Braun, 2006).

1.2 Statement of the Problem

The role of agricultural extension is vital to the diffusion of new technologies leading to increased production. Conventional and participatory approaches have been used for information dissemination on best agricultural practices to smallholder coffee farmers in Kenya. Information dissemination through participatory approaches such as Farmer Field Schools has recorded encouraging results in several countries in the world (World Cocoa Foundation, 2007). Published research indicate that Farmer Field Schools have a substantial impact in terms of increases in farm productivity, reductions in farmers' use of pesticides and improved farming knowledge (Rola & Jamias, 2002). However, information on the effectiveness of Farmer Field Schools in promoting adoption of best agricultural practices in coffee farming is not readily available, forming the basis for this study.

1.3 Purpose of the Study

The purpose of the study was to determine the effectiveness of Farmer Field Schools in promoting adoption of best agricultural practices by smallholder coffee farmers in Kenya.

1.4 Objectives of the Study

The study was guided by the following objectives:

i) Assess the effectiveness of Farmer Field Schools in enhancing uptake of best agricultural practices amongst smallholder coffee farmers in Kenya.
ii) Establish the effectiveness of Farmer Field Schools in increasing coffee yields amongst smallholder coffee farmers in Kenya.

iii) Determine the effectiveness of Farmer Field Schools in enhancing sharing of knowledge amongst smallholder coffee farmers in Kenya.

1.5 Hypotheses of the Study

The following hypotheses derived from the stated objectives i, ii and iii respectively were tested at 0.05 alpha significance level.

H_{01}: Farmer field schools have no statistically significant effect on enhancing uptake of best agricultural practices amongst smallholder coffee farmers in Kenya.

H_{02}: Farmer field schools have no statistically significant effect on increasing coffee yields amongst smallholder coffee farmers in Kenya.

H_{03}: Farmer field schools have no statistically significant effect on enhancing sharing of knowledge amongst smallholder coffee farmers in Kenya.

1.6 Significance of the Study

The findings of the study will be of great importance to the key players in the Kenyan coffee industry, particularly the Ministry of Agriculture, Livestock and Fisheries, County Governments, research organizations, policy makers, private extension service providers, coffee processors, coffee marketing agents and traders as the information gathered will provide a valuable insight in relation to the usefulness of FFS in promoting adoption of best agricultural practices in coffee. It is anticipated that researchers and scholars could benefit from this study due to the new knowledge it will contribute particularly in the area of adoption of agricultural technologies in coffee. The research finding will provide background information for scholars who seek to do further related research and would help serve in formulating and revising agricultural extension strategies and approaches in the coffee growing areas of the country.

1.7 Scope of the Study

The study covered coffee counties where Coffee Research Institute initiated pilot coffee Farmer Field Schools under the Common Fund for Commodities' funded project. These counties were Bungoma, Machakos, Meru and Muranga. The study focused on Farmer Field Schools in promoting adoption of best agricultural practices by smallholder coffee farmers in Kenya.

1.8 Limitations of the Study

Limitations of the study included: -

i) Lack of records on agricultural information by most farmers. Farmers' production records available at the co-operatives CEO's offices were used to extract the required information.

ii) Difficulty in the communication of technical terms to the farmers. A translator conversant with local dialect and English/ Kiswahili assisted the researcher to have an appropriate communication with the farmers.

1.9 Assumptions of the Study

The study assumed that Farmer Field Schools affected adoption of best agricultural practices by smallholder coffee farmers in Kenya. The respondents were assumed to be in a position to understand the questions on the interview schedule and respond objectively.

1.10 Definition of Terms

The following terms were defined and operationalized as follows:

Adoption - It is the mental process through which an individual passes from first hearing about an innovation to final utilization (Rogers, 2003). In this study, adoption will be measured in terms of uptake of BAP, increase in coffee yields and level of sharing of knowledge. Uptake of best agricultural practices will be measured as a binary variable of Yes/ No. Respondents giving a 'Yes' response will be using the respective practice while 'No' response will have not applied the practice in question. Coffee yields will be operationalized as the kilograms of coffee cherry farmers picked within the training period. Sharing of knowledge will be measured as a binary variable of Yes/ No. Farmers who shared out knowledge learnt will respond with 'Yes' while those who never shared will respond with a 'No'.

Agricultural Extension - This refers to the process of getting information to farmers and assisting them to acquire the necessary knowledge, skills and attitudes to utilize effectively the information or technology disseminated (Swanson and Claar, 1984).

Best Agricultural Practices (BAP) - These are the research-generated recommendations on crop agronomic practices aimed at improving yields and quality while minimizing the cost of production. In this study, they will include use of certified planting materials, coffee establishment protocol, soil and moisture conservation techniques, application of mulch, weed management, use of cover crops, soil nutrient management practices, canopy management practices, use of shade trees in coffee, top-working traditional varieties into disease resistant varieties (varietal conversion), pests and disease management strategies, and timely picking of the red-ripe cherry for processing (CRF, 2014).

Conventional Extension Approaches - The extension trainings characterized by top-down and non-participatory approaches that have traditionally been used in the public extension service in the dissemination of knowledge and skills on use of agricultural technologies (Roling, 1995).

Effectiveness - Effectiveness is defined as producing the desired results (Simpson, 2001). In this study, 'Effectiveness was measured by the success of the uptake of best agricultural practices, increase in the coffee yields and level of sharing of knowledge amongst the smallholder coffee farmers.

Extension - Is the on-going process of getting useful information to people (the communication dimension) and then in assisting those people to acquire the necessary

knowledge, skills and attitudes to utilize effectively this information or technology (the educational dimension). Generally, the role of extension is to enable people use skills, knowledge, and information to improve their quality of life (Madhur, 2000).

Extension Approach - It is the total fabrics of extension organization action as a conduit through which educative and problem solving innovations are disseminated to the appropriate target by a specialized agent (Ogunfiditimi & Ewuola, 1995). In this study the approach under investigation was the farmer field schools.

Farmer Field Schools (FFS) - FFS are platforms and "schools without walls" for improving decision-making capacity of farming communities and stimulating local innovation for sustainable agriculture (Braun, 2006). In this study it meant the extent to which farmers participated in FFS activities.

Increase in Coffee Yields – It is the steady improvement in the amount of cherry harvested per coffee plant per year.

Sharing of Knowledge - The activities relating to the exchange of meaningful information along with interpretations and potential applications of the information (Wai, 2009).

Smallholder farmer - A farmer whose land under coffee cultivation is less than five (5) acres (Coffee Board of Kenya, 2001).

Uptake of Best Agricultural Practices - Refers to the act of accepting and putting into practice the learnt practices (Free online dictionary, 2015).

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

The chapter covers agricultural extension service delivery approaches in Kenya, mainly the convectional extension and the farmer field schools, as well as the variables under the study. Theoretical frame work and conceptual frame work of the study are too covered in the chapter.

2.2 Agricultural Extension Service Delivery Approaches in Kenya

Agricultural extension is the dissemination of information and technologies to farmers by using adult learning techniques. Its` overall goal is to improve knowledge and skills and change attitudes of farmers in order to enhance adoption of new technologies that contribute to improving production, income and general welfare of the farmers (Duveskog, 2006). It enables farmers to better use the available resources by increasing technological options and organizational skills (Ministry of Agriculture, 2012). Agricultural extension achieves this by training farmers on how to use technologies effectively to their benefit under their circumstances. However, farmers do not adopt technologies merely because they have been disseminated to them (Swanson & Claar, 1984). They have to learn about them, and in the process, acquire knowledge and skills necessary to the successful use of those technologies.

Kenya's experience of using unsuccessful approaches to deliver services to farmers has taught policy makers that in order to be effective; extension agents should avoid top-down planning and implementation of intervention to farmers' problems in favour of demand-driven and farmer led, participatory approaches. These include Farming Systems Approach, Rapid Rural Appraisal (RRA), Participatory Rural Approach (PRA), Focal Area Development Approach (FADA) and Farmers Field Schools (Kibbet, Omunyinyi & Muchiri, 2005). According to Braun, Janice, Niels, Henk and Paulsnijders (2006), a good extension approach motivates and trains farmers to experiment more accurately on their own and become trainers of others.

Conventional extension services were structured and operated on the assumption that farmers were largely passive, illiterate, ignorant and therefore unable to innovate or integrate new livestock or cropping practices into their farming systems (Technical Centre for Agriculture and Rural Cooperation [CTA], 1997). The results of extension services tended to be poor

because farmers did not feel ownership of ideas imposed on them (Jurgen, Chuma, Murwira, & Connolly, 2000). Extension approaches should enhance participation of farmers at all stages of planning, implementation and evaluation through farmer-led approaches to ensure the programme sustainability (Axinn, 1998).

Onyango (1987) indicated that Training and visit (T & V) system of agricultural extension was introduced in Kenya in 1982. Its basic goal was to build professional extension service that was capable of assisting farmers in raising agricultural production and/or income and providing appropriate support to agricultural development. However, the extension approaches failed in delivering extension services to farmers due to its limited farmer involvement in the technology transfer which was a top-down extension delivery system. In 1984, the strategy shifted from a centralized focus, to a more decentralized system where most of the work was done at the district level, thus the District Focus for Rural Development, which was based on a complimentary relationship between districts with the aim of encouraging local initiative in order to improve problem identification, resource mobilization and project implementation (Kibbet, Omunyinyi & Muchiri, 2005).

The participatory approaches emerged in the late 1980s after it was realized that most technologies developed by researchers alone were inappropriate for smallholder farmers (Jurgen *et al*., 2000). In their study in Northern India, Feder and Slade (1986) found that three-quarters of the farmers cited other farmers as their main sources of knowledge. Birkhaeuser, Evenson and Feder (1991) found that farmers sought for information on new technologies from their neighbours. Working on Potato farming in India, Foster and Rosenzweig (1995) noted that information from neighbours on new technologies was as important as knowledge acquired from government extension services. These experiences serve to show that diffusion of technologies is enhanced by informal approaches of dissemination especially from farmer-to-farmer (Sinja, Karugia, Waithaka, Miano, Baltenweck, Franzel, Nyikal & Romney, 2004).

Since 2000, the Swedish International Development Agency (SIDA) supported National Agricultural and Livestock Extension Programme (Republic of Kenya, 2010a). The key pillars of the NALEP were participatory, demand-driven, and pluralism in provision of extension and transparency and accountability in the management of resources. Being a top-

down extension model coupled with its high demand on human and capital resources limited the success of NALEP in extension service delivery.

The National Agricultural Extension Policy (NAEP) addressed these weaknesses by articulating the importance of clientele participation and demand-driven extension system; recognizing the role of the private sector in pluralistic extension; and setting out modalities for commercialization and privatization of extensions services. The implementation of NAEP was less successful than initially anticipated due to inadequate institutional arrangements, narrow ownership, and lack of a legal frame-work, lack of goodwill and commitment among some of the top managers, and slow flow of resources. These, coupled with the need to bring on board emerging issues articulated in the Strategy for Revitalizing Agriculture (SRA), justified the need to review NAEP (Ministry of Agriculture, 2012).

The National Agricultural Sector Extension Policy (NASEP) aims to guide and harmonize management and delivery of extension services in the country (Republic of Kenya, 2010a). The policy advocates demand-driven extension services and preparation of other players in the delivery of extension services. In fact, it recognizes the need to diversify, decentralize and strengthen the provision of extra services with a view to increase access to quality extension services from the best providers and attain higher productivity, increased incomes and improved standard of living. Extension services are mainly provided by the public sector (central and county governments, parastatals, and research and training institutions) and private and civil society sector operators (companies, Non-Governmental Organizations, faith-based organizations, cooperatives and community-based organizations).

2.3 Conventional Extension Approaches

As is in other developing countries, several extension approaches have been used in Kenya (Byerlee, 1994) without much success. These include Transfer of Technology (ToT) and Training and Visit (T&V). Conventional extension often fails due to incorrect recommendations being provided to farmers, causing a lack of trust between farmers and the extension worker. Rural extension staffs are generally not capable of dealing with the full spectrum of complex problems that farmers experience (Braun, 2006).

2.3.1 Transfer of Technology (TOT) Extension Approach

This extension approach dominated research and extension during the 1950s and 1960s (Anderson & Feder, 2004). where the technologies were developed in research stations and often in environments different from those of the farming communities. During this time the prevailing view was that scientific knowledge applied to problems of rural poverty in developing countries would provide the necessary impetus needed to transform rural people's lives and increase their welfare (Diemijenyo, 2011).

Information transfer was one way from agricultural extension to farmers with little or no direct feedback from rural farmers to research and development. There was lack of two-way flow of information between extension workers and farmers. This extension approach was mainly regulatory and characterized by some level of coercion that was aimed at compelling the native farmers to produce raw materials for the colonial industries. Technology transfer did not facilitate farmer participation in technology development and dissemination. It was characterized with weak linkages to research. The approach was criticized because it ignored the farmers' social and economic situation, projects did not work at all and the recommendations and technologies passed to farmers were not appropriate to their circumstances (Asiabaka, 1999).

The extension agents were assigned other duties apart from transfer of knowledge to farmers. The focus was mainly on individual crops or livestock rather than the entire household economy. Transfer of technology approach used mainly face-to-face communication with little use of mass media. The extension workers were insufficiently educated and supervised and had no organized system of communicating feedback from farmers to researchers (Piccioto & Anderson, 1997).

2.3.2 Training and Visit (T&V) Extension Approach

Training and Visit extension approach was used in technology dissemination with focus on a better deployment of extension field workers, and designed to be a management system for energizing extension staff, turning desk-bound and poorly motivated field staff into effective extension agents (Hakiza, Odogola, Mugisha, Semana, Nalukwago, Okoth & Adipala, 2002). It was introduced in Kenya by the World Bank during the 1980s and 1990s. Its main objective was to increase agricultural production. It assumed that farmers lacked adequate

knowledge that inhibited production increases. It tended to focus on identifying useful messages and diffusing them to farmers.

Although the flow of communication between extension and research units was improved, flow of communication from farmers to extension staff and especially from mixed enterprise producers was lacking. Contact farmers were used to disseminate information to their respective communities (Ministry of Agriculture & MoLFD, 2004). To improve feedback mechanism, T&V was designed to transfer information and technology from researchers to contact farmers via the front line extension workers with a feedback mechanism from farmers to researchers using the same channel (WB-OED, 1999). Research-Extension-Farmer linkages and communication flow between extension and research centres was improved. The extension activities followed a rigid schedule with little input from farmers with the result that programmes tended to lack relevance to local farm problems.

Evaluation studies done on T&V approach in Kenya found it neither effective nor sustainable for over the nearly twenty years of its existence (WB-OED, 1999). Ultimately, the T&V was dropped as a preferred public system extension approach. Due to those weaknesses; the impact of T&V was low knowledge and poor production skills of the farmers about the available technologies. Subsequently adoption and use of agricultural technologies in the smallholder farming systems remained limited (Gautam & Anderson, 2000).

In general, conventional extension approaches (ToT and T&V) were Government controlled with top-down strategy in transferring agricultural technologies aimed at solving production constraints. They were supply driven and externally initiated without the involvement of the target farmers, hence not farmer-problem oriented (LDG, 2004). Farmers were insufficiently involved in identifying own production problems, selecting, testing and evaluating the possible solutions. These approaches involved extension staff using group techniques like meetings, field days, demonstrations, and tours (Maunder, 1973). The linkages between research, extension and farmers were weak, treating farmers as passive recipients.

The conventional approaches adopted learning process through instruction rather than facilitation. Farmers were seen as end users who relied on uniform technologies and followed blanket recommendations of the extension instructors. The model did not embrace the use of collaborative effort of researchers, extension service, educators and farmers in the generation

and dissemination of new agricultural knowledge and skills. It was a one-directional approach to technology transfer without the provisions for stakeholders' participation (LDG, 2004).

The successes of these approaches are reportedly low in disseminating agricultural knowledge and skills to smallholder coffee farmers (Wambugu, 1999). Evaluations of these extension approaches have concluded that they have been ineffective in disseminating the necessary agricultural knowledge and skills (LDG, 2004). Consequently, the Government is reducing their support (Ministry of Agriculture & MoLFD, 2004) for alternative approaches of disseminating agricultural technologies to farmers, necessitating the change to participatory approaches in extension services (Asiabaka, 1999).

2.4 Farmers Field Schools (FFS)

Alternative participatory and more interactive extension strategies were developed to address the weaknesses associated with conventional extension. These approaches emerged after it was realized that most technologies developed by researchers alone were not appropriate for smallholder farmers (Axinn, 1998). Farmer field schools approach was used as a participatory training and information dissemination tool for the adoption of best agricultural practices coffee by smallholder coffee farmers.

The Farmer Field Schools approach was developed by FAO in South East Asia as a way for small-scale rice farmers to investigate, and learn, for themselves the skills required for, and benefits to be obtained from, adopting on practices in their paddy fields. Farmer field school is a participatory approach of learning, technology development, and dissemination based on adult-learning principles such as experiential learning (Braun, Janice, Niels, Henk, & Paulsnijders, 2006). Famer field schools are platforms and "schools without walls" for improving decision-making capacity of farming communities and stimulating local innovation for sustainable agriculture (Axinn, 1998). FFS provides a forum where farmers make regular field observations, relate their observations to the ecosystem and apply their previous experience and any new information to make crop or livestock management decisions under the guidance of a facilitator. Key learning tools such as discovery-based exercises, group trials and experimentation, Agro-Ecological System Analysis are carried out in the FFS as a mean of enhancing learning, and as an aid for the facilitators to ensure participation, dialogues and joint learning (Gallagher 2000).

In Farmer Field Schools, farmers share their knowledge with other farmers and are trained to teach the courses by themselves in a participatory manner. The dissemination of innovations develops spontaneously when one farmer has successfully tested a new practice or technology, attracting the interest of other farmers. It creates conditions for optimal farmer learning and informed decision making abilities. Farmers consequently perceive themselves as experts in, and managers of, their own fields. Through FFS, farmers take charge of organizing experiments, leading discussions, making plans and accomplishing tasks previously considered too complex for the average farmer to apply (Hakiza, Odogola, Mugisha, Semana, Nalukwago, Okoth & Adipala, 2002).

According to Mweri (2001), the FFS is a step-wise process involving ground working, training of facilitators, and establishment of FFS, FFS field days, graduation, and farmer run FFS and FFS follow-up activities by facilitators. Experimentation allows the knowledge gained from FFS to be replicated in farmers' environment in subsequent seasons, which implies that; knowledge is dynamic and adjusts itself to certain environmental stresses. Rola (1998) in his study entitled "Making farmers better decision makers through FFS", found that FFS approach increased farmer effectiveness in farmer training. Bartlett (2002) found that one of the best criteria for evaluation of technologies under FFS was based on behavioral changes in farmers i.e. how they approach problems in their fields, regardless of whether they were dealing with insect pests, diseases, weeds, water or fertilizers (Duveskog, 2006).

The Farmer Field Schools were introduced in East Africa, with support from Food and Agriculture Organization in 1995 following the successes in Asia during the 1990s (Sones & Duveskog, 2003). FAO initiated an FFS special Programme for food security on maize based farming systems with only four FFS schools in Kakamega District, Western Province. The number has since risen to over 400 FFS spread over in Bungoma, Kakamega and Busia District. The Programme has diversified to other crops and also includes livestock production. It has spread to other parts of the country, being funded by various development agencies, and at varying degrees of scale and level of institutionalization (Danida, 2011).

Farmer Field Schools relies heavily on farmer-to-farmer spread of knowledge to accelerate the acquisition of skills and subsequent diffusion of new ideas. All farmers participate actively in the learning process. Extension workers acquire and use facilitation skills. Learning is directly related to daily farming experiences and problems. Farmers are expected

to practically participate in all the FFS steps. Participation of farmers in the on-farm experimentation enables them to develop competency hence they can try the technologies on their own farms. At the on-set of FFS, farmers holistically identify their problems and map out resources available as a basis of selecting the relevant inclusions in the season-long training (Okoth *et al*., 2002). FFS has since been adapted to work with other crops and diseases and has spread rapidly across Asia, Africa and Latin America (Godtland, Sadoulet, Janvry, Murgai & Ortiz, 2004) It is being implemented in Kenya on a fairly wide scale but mainly on crops and soil management where it has been successful (Minjauw, Muriuki & Romney, 2002).

The Farmer Field Schools are innovative, participatory and interactive model for farmer education (Dilts, 1983). The approach has been used with a wide range of crops and has subsequently expanded to topics such as livestock, community forestry, water conservation, soil fertility management, food security and nutrition. The aim of FFS is to build farmers' capacity to analyze their production systems, identify problems, test possible solutions and eventually adapt the practices most suitable to their farming system. The knowledge acquired during the learning process enables farmers to adapt their existing technologies to be more productive, profitable, and responsive to changing conditions, or to test and adopt new technologies (Braun, 2006).

Famer Field Schools offer community-based, non-formal education to groups of 20-25 farmers through self-discovery and participatory learning principles. Some authors advocate for group sizes of 25-50 **(**Matata & Okech, 1998**)**. The learning process is based on agro ecological principles covering a cropping cycle. The school brings together farmers who live in the same village/catchment and thus, are sharing the same ecological settings and socioeconomic and political situation. The foundation of FFS approach is "farmers first" philosophy, a concept which is essential to empower farmers to learn, experimentation and technology generation and decision making. The FFS extension approach has been replicated in a variety of settings beyond IPM. The FARM Programme (FAO/UNDP), for example, sought to adapt the FFS approach to tackle problems related to integrated soil fertility management in the Philippines, Vietnam and China. Subsequently the FFS approach has been extended to several countries in Africa and Latin American. At the same time there has been a shift from IPM for rice based systems towards other annual crops, vegetables etc and

the curriculum has been enriched with other crop management aspects (Godtland *et al.*, 2004).

Through the FFS, farmers gain technical competencies concerning crops and livestock. Technical competence of farmers is increased by hands-on learning about agro-ecosystem concepts, experiential learning in small groups where group members observe the happenings on the field, reflect together, decide together, and observe the results during later meetings. Social competences of farmers are fostered by group discussion and reflection processes, presenting and explaining small group decisions to a larger audience and energizing exercises for group building (Braun, 2006).

2.4.1 Typical Coffee FFS Process in Kenya

With very slight modifications from one FFS to another, the key learning processes obtained from coffee FFS were very similar. The coffee FFS class started with an opening prayer followed by a roll-call. The chairpersons and facilitators of each FFS would make brief remarks highlighting the day's proceedings followed by the group splitting into groups of 5 for the Agro-Ecological Systems Analysis (AESA). The field observations would then be followed by discussions and reporting of major observations which were wrapped up by the facilitator. The discussions and facilitator backstopping led to simple experimentation to provide answers to questions whose answers were not apparent from the observations made during the class discussion. Experimentation was then followed by a group dynamic activity, which could take the form of local songs, dances, riddles, poems, proverbs and parables. Group dynamics were a variety of team building exercises employed during the FFS sessions meant to create an environment in which participants feel free to express and interact with each other during the sessions in order to learn effectively. This was followed by a special topic from the facilitator or member of the group, generated from the raising needs of the farmers, AESA presentations or from the implementation of the on-going discussions. Review of the day's activities and planning for next week's session followed. The coffee FFS activities for the day would end with announcements, roll-call and closing prayer as depicted in Table 1.

Table 1: Typical Time Table for Coffee FFS Training Session

Time	Activity	Responsible
08:00-08:05	Prayer/ Roll call	Host team
08:05-08:15	Brief Recap of the last session	Host team
08:15 -08:45	AESA taking	All
08:45 -09:15	AESA processing	All
09:15 -10:45	AESA presentation	All / Host team
10:45 -11:05	Group dynamic activity	Host team
11 :05 -12:05	Today's topic	Facilitator
12:05 -12:10	Review of the day's activities	Host team
12:10 -12:20	Planning of the next week's session	Host team
12:20 -12:25	Announcements	Host team
12:25 -12:30	Roll Call/ Prayer	Host team

Coffee Research Institute established five pilot Farmer Field Schools (FFS) in Bungoma, Kisii, Machakos, Meru and Murang'a counties as participatory learning approaches of information dissemination on best agricultural practices to the smallholder coffee farmers in Kenya. The FFS classes were undertaken during the 2010/2011, 2011/2012 and 2012/2013 coffee years. Farmer field schools as an extension approach was one of the activities under the Common Fund for Commodities' (CFC) funded project entitled increasing the resilience of coffee production to leaf rust and other diseases in India and four African countries. Centre for Agriculture and Bioscience International (CABI) and Coffee Research Institute were the administrating and implementing agencies respectively. The Bungoma, Machakos, Meru and Murang'a FFS classes were purposively chosen for this study. The Kisii FFS class was dropped owing to high dropout rate of the member farmers.

During the FFS class learning, farmers met after every other month for the three coffee years. They learnt through conducting Agro-Ecological Systems Analysis (AESA) in small groups of five members, then presenting individual group findings to the whole class. The facilitator would then guide the farmers through their presentations to come up with viable recommended practices for the various problems elicited by the learners. During the day's topic, learners had hands-on crop husbandry practices ranging from coffee establishment to selective picking of the red-ripe cherry. The topics focused on best agricultural practices in coffee husbandry; use of certified planting materials, coffee establishment protocol, soil and

moisture conservation techniques, weed management strategies, use of cover crops, soil nutrient management practices, canopy management practices, use of shade trees in coffee, top-working traditional varieties into disease resistant varieties (varietal conversion), pests and disease management strategies and timely selective picking of the red-ripe cherry for processing (CRF, 2014).

2.5 Uptake of Best Agricultural Practices by Smallholder Coffee Farmers

Knowledge occurs when an individual is exposed to innovation's existence and gains some understanding on how it functions (Rogers & Shoemaker, 1995). Field observation in coffee growing counties in Kenya indicates extension contact, field days and FFS as the main sources of information to coffee farmers. Collaborative research with farmers and research driven by farmers has brought a shift from previous perceptions where farmers were seen mainly as 'adopters' or 'rejecters'' of technologies but not as providers of knowledge and improved practices (Chambers, 1993).

Many studies have shown the ability among farmers to innovate and develop their own solutions to problems through FFSs, there by being part of the innovation system rather than just recipients (Scarborough & Kiloug, 1997).

2.6 Coffee Cherry Production Levels for Smallholder Coffee Farmers

Kenya coffee has been grown for over a century now, since 1893 when it was first introduced in Kenya. Karanja and Nyoro (2002) noted that the decline in production was mainly due to differences in intensity of input applications, and availability and use of best practices such as soil nutrient management, canopy management, use of shade in coffee and optimum inputs usage. Other contributing factors to the declining production trend include high prices on farm inputs, low levels of innovation adoption, lack of access to credit and low coffee payments due to high processing and marketing costs. Published research indicates substantial impacts of FFS in terms of increases in coffee productivity, reducing farmers' use of pesticides and improved farming knowledge (Rola, Quison, Jamais, Paunlagai & Provido, 2005).

A study by Evenson, Robert and Germano (1996) examined the effectiveness of agricultural extension on farm productivity in Kenya controlling for other determinants of crop yields, such as labor and fertilizer inputs, soil fertility and the agro-ecological conditions. They

found out that increased agricultural productivity was attributable to enhanced unobserved productive attributes of the farmers such as crop managerial abilities. Aguilar (1988) obtained negative productivity effects of schooling among Kenyan smallholders in Nyanza province but found positive effects in Central province. Data from FAO FFS models in the East Africa region show great impact of the extension model on crop productivity (FAO, 2011).

2.7 Sharing of Knowledge Learnt During the FFS

A key source of information for farmers is other farmers, because it is readily available and its utilization does not impose high transaction costs. This is confirmed by survey data showing that farmers cite other farmers as their main source of information regarding agricultural practices (Rees, Momanyi & Musembi, 2000). However, the data indicate that on technical matters entailing greater complexity or high cost, farmers have preferences for first-hand, or specialized sources of information such as extension experts (Feder & Slade, 1984).

A review of the FFS approach by Rolings (2002) had noted that while the traditional technology transfer paradigm seeks to transfer knowledge through demonstrations and lectures, the FFS uses adult education which is self-directed and which energizes discovery learning. Rolings hypothesized that complex lessons learned in the FFS do not easily diffuse on their own.

A study by Quizon, Rola, and James (2002) in Indonesia and the Philippines found that while there was very little diffusion of FFS knowledge from school graduates to other community members, graduates were retaining their FFS acquired knowledge. Feder, Murgai and Quizon (2004) found that there was no significant diffusion of knowledge to other farmers who resided in the same village. In relative contrast, Simpson and Owens (2002) have estimated high farmer-to-farmer communication in many African countries which conducted the FFS. Several types of information sharing occurred such as between immediate family members, among secondary contacts outside of the immediate family, in small group meetings and with non-participants.

More recently, Nederlof and Okdonkor (2007) provided evidence among Cowpea Farmer Field Schools in Ghana. They discovered that the FFS was used as a tool to transfer messages rather than foster experiential learning among farmers. These messages were about

technologies that work without the traditional top-down ‘order’ from facilitators and extension officers. In so doing the technologies were acceptable and appropriate to farmers.

The FAO team that developed the FFS approach recognized farmer-to-farmer diffusion as instrumental to the scaling up process and critical for making the approach most cost effective and sustainable (Diemijenyo, 2011). Therefore, an important assumption of FFS is that participants will informally share the knowledge acquired in FFS with non-participants (David, Agordorku, Bassanaga, Cowloud, Kumi, Okuku, & Wandi, 2006). In spite of this, there has been more concern on the sharing of knowledge between FFS farmers and other farmers. According to Rola, Quizon, Jamais, Paunlagai and Provido (2005), there was no significant transfer of knowledge by farmer field school graduates to other farmers in a study carried out in Phillipines. Similar result was reported in Indonesia by Quizon, Gershon and Rinku (2001).

In contrast to these, however, studies conducted on Kenya farmer field schools by IFAD (1998) and by sustainable Tree Crops Programme (STCP); Nigeria (2006), in Cross River State, Nigeria, reported that there were some knowledge sharing of information by farmer field school graduates to other farmers. The issue of knowledge sharing is very crucial as it is one of the yardsticks of assessing the effectiveness of FFS as an agricultural extension approach (Mutandwa & Mpangwa, 2004).

2.8 Theoretical Framework

This study was informed by the Experiential Learning Theory propounded by David Kolb (1984). Experiential learning is fundamental to the FFS approach, and assumes that learning is always rooted in prior experience. Any attempt to promote new learning must take previous experiences into account. Experiential learning theory involves learning from experience. According to Kolb (1984), this type of learning can be defined as "the process whereby knowledge is created through the transformation of experience. Knowledge results from the combinations of grasping and transforming the experience." A connection must be made between what one has experienced and what one comes to learn. This process often involves disorientation and surprise and occurs when individuals reconsider their existing knowledge and experience (Malinen 2000) in what is generally referred to as second-order learning.

Mezirow (2000) argued that critical self-reflections is a central element of adult learning and development, where experiential learning is being applied to correct political and social factors limiting a learner's development. Kolb (1984), views learning as a four-stage continuous process where the participant acquires knowledge from each new experience. His theory treats learning as a holistic process where one continuously creates and implements ideas for improvement. According to Kolb, effective learning can only take place when an individual completes a cycle of the four stages: concrete experience, reflective observation, abstract conceptualization and active experimentation.

Concrete Experience (feeling-1) occurs when a person has an experience that serves as the basis for observation. The individual encounters a new experience that creates an opportunity for learning. According to Kolb's theory, a person cannot learn by simply observing or reading. Reflective Observation (watching-2) is when the individual reflects on the experience before making any judgments. Particular notice is paid to any inconsistencies between experience and understanding. The goal is for the individual to review the situation and find meaning behind the experience**.** Abstract Conceptualization (thinking-3) involves the individual developing theories to explain their experience. This analysis often gives rise to a new idea or changes a pre-existing concept. In this stage, the individual identifies recurring problems that will help them with new learning experiences. The goal is to create concepts that they can apply in the future. Active Experimentation (doing-4) occurs when individuals apply what they learned in the experience to another situation. They use their theories to solve problems, make decisions and influence people. The learner takes risks and implements theories to see what will result (experimentation). The goal is to test the concepts in different and new situations to discover ways to improve. This is illustrated in Figure 1 on Kolb's Learning Cycle.

Experiential learning is highly relevant for agricultural extension, since it provides means to work with groups to find their own solutions to problems through testing and experimentation of ideas and practices, Malinen (2000). Through exercises such as the Agro-Ecological Systems Analysis (AESA), group session practical exercises and the trial plots the facilitator helps the group make use of actual real life situations, as opposed to simulated experiences. All of these exercises apply Kolbs learning cycle (Kolb 1984) in the way that farmers use concrete observations to reflect on experiences and from there conceptualize the learning points on which actions are defined. In the case of the season- long trials farmers go into

active experimentation which in turn will lead to another cycle of experiences and observations, Kolb (1984).

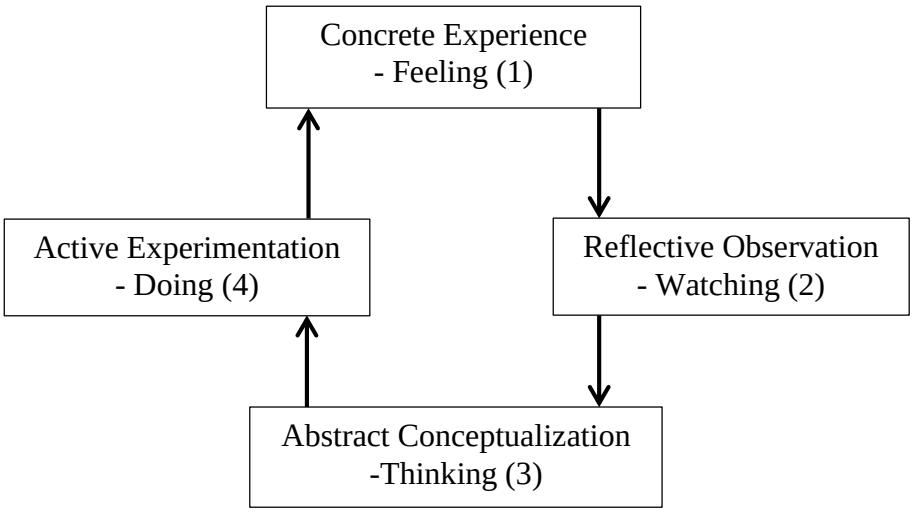


Figure 1: Kolb's Learning Cycle (source: adapted from, Kolb 1984)

The long term empowerment goals of FFS seek to enable graduates to continue to expand their knowledge and to help others learn and to organize activities within their communities to institutionalize different practices. What differs FFS approach from other extension methods is that, the role of extension worker is very much that of a facilitator rather than a conventional teacher. This frame work forms the basis of this study that seeks to determine the effectiveness of FFS in promoting adoption of best agricultural practices by smallholder coffee farmers in Kenya.

2.9 Conceptual Framework of the Study

The conceptual framework shows the relationship between the dependent and independent variables. The independent variable of the study was the farmer field schools (FFS). The dependent variable was the adoption of best agricultural practices whose indicators were uptake of best agricultural practices, increase in coffee yields and sharing of knowledge. The effect of Independent variable on the adoption of best agricultural practices were affected by the moderator variables (Socio-Economic factors: age, education level and gender) based on the assumption that FFS effect on uptake of best agricultural practices, sharing of knowledge and practices and coffee yields are interrelated. The effects of moderator variables were controlled by random sampling and taking a large sample of the respondents to give all participants equal chances. The interactions between the variables are illustrated in Figure 2.

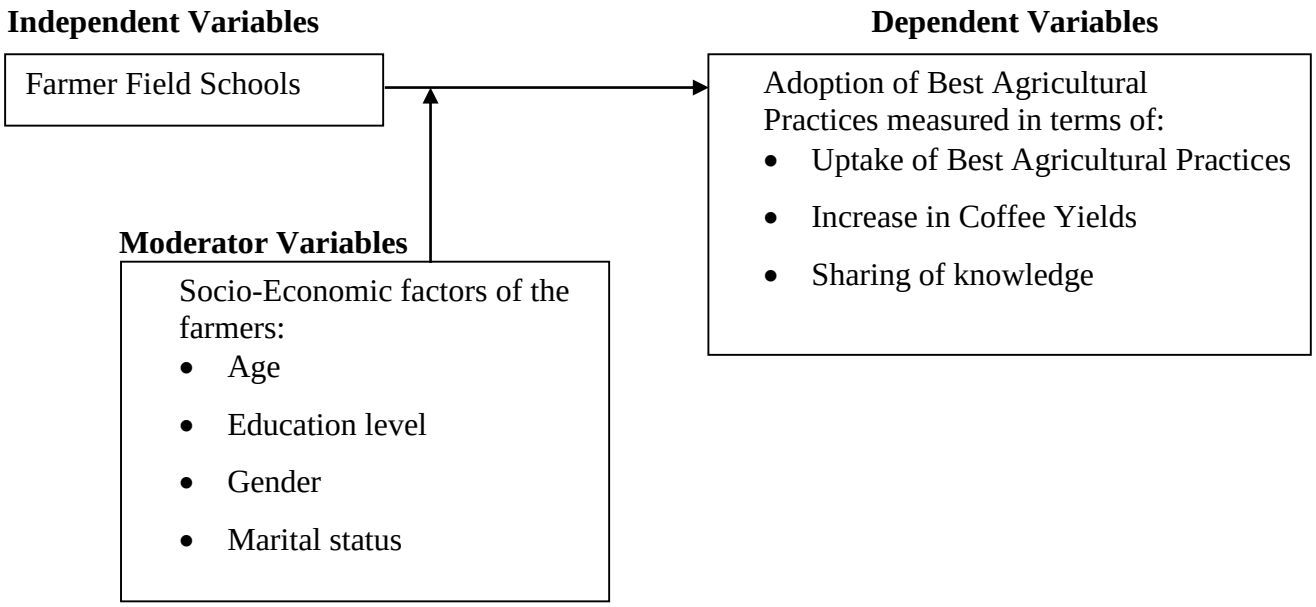


Figure 1: Conceptual Frame Work Showing the Relationship Among the Study variables

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

This chapter outlines the research methodology that was used. It describes the research design, the location of the study, the target population, sampling procedure and sample size, instrumentation, validity, reliability, data collection and data analysis.

3.2 Research Design

A descriptive survey research design was used for this study. This design was appropriate as it allowed collection of information and description of population from a sample. The design was useful in making accurate assessment of inferences and relationship of phenomenon (Edwards, 2006). Surveys are important in research as they allow economical collection of a large data from a sizable population (O'connor, 2002) and are useful in describing the characteristic of a population (Kathuri & Pals, 1999).

3.3 Location of the Study Area

The study locations were Bungoma, Machakos, Meru and Muranga Counties (Appendix B) where Coffee Research Institute initiated pilot coffee Farmer Field Schools under the Common Fund for Commodities funded project: increasing the resilience of coffee production to leaf rust and other diseases in India and four African countries. The activity was implemented during the 2010/2011, 2011/2012 and 2012/2013 coffee years.

Bungoma County is situated on the slopes and foothills of Mt. Elgon, and its natural potential is partly related to the natural potential of the districts in Central and East Kenya, characterized by fertile volcanic soils and enough water. The average annual rainfall in the County ranges from 1000 to 1800 mm. Agricultural land mainly supports sugar cane, cotton, tea, coffee and dairy farming on commercial basis (CBS, 2000; Jaetzold & Schmidt, 1995).

Machakos County experiences rainfall regionally very different, with total annual averages ranging between 500 and 1300 mm. The main coffee zone *(UM 2)* gets enough rains, which become marginal in the rain-shadowed slopes (*Marginal Coffee Zone UM 3).* Machakos County has a total area of 6,281.4 km^2, out of which 1982 km^2 are suitable for agricultural production (arable land). According to the 1999 Housing and Population Census, the County

had a population density of 144 persons/ km^2, translating to 3.37 ha per household (CBS, 2000; Jaetzold & Schmidt, 1995).

Most soils in Meru County are volcanic with moderate to high fertility; although many years of cultivation without fertilizing and manure application are exhausting the soils. Areas suitable for coffee are undulating with hills and gentle slopes. Annual average rainfall falls between 1000 to 1600 mm. (CBS, 2000; Jaetzold & Schmidt, 1995).

Muranga County has a bimodal rainfall pattern and the average rainfall received varies from 700 to 2000 mm per year depending on location and altitude. The soils are inherently fertile, but continuous cropping with poor management of organic and inorganic sources of nutrients has resulted in declining soil fertility. A greater part of the County has well-drained, extremely deep, dark reddish to brown, friable clay soils. Cropping land is dedicated to coffee and tea as cash crops, which are both grown under estates and also under small-scale sector. Horticultural activities are found in the high altitude wetter parts of the District (CBS, 2000; Jaetzold & Schmidt, 1995).

3.4 Target Population

The target population was the smallholder coffee farmers in the CRI's FFS pilot project numbering 4802. This number was constituted by the active members registered with the four societies where FFS was promoted during the 2010/2011, 2011/2012 and 2012/2013 coffee years. Out of a total active membership of 4802, only 117 participated in FFS while the rest, 4685 were assumed to have been exposed to conventional extension approaches. Table 2 shows the distribution of sample respondents in the respective societies.

3.5 Sampling Procedure and Sample Size

Four coffee societies were purposively selected since they implemented the farmer field schools in coffee. All the 117 farmers who trained and graduated in FFS were used owing to their small size. Proportionate random sampling technique was applied to the societies to obtain a sample of 100 farmers who did not learn through FFS. This is in line with Kathuri and Pals (1999), who recommend that, for descriptive studies, a minimum of 100 subjects are required. A total sample size of 217 was thus obtained as summarized in Table 2. The sample determination formula was:

Sample size* = (Non-FFS farmers) / (Total farmers) X 100. Example for Kikai FCS has been computed:

Sample size for Kikai FCS = (2060) / (4685) X100 = 43.97, rounded off to **44*.**

Table 2: **Distribution of Sample Respondents in the Study Area**

FFS School (FCS)	Active Society members	FFS farmers trained and graduated	Non-FFS farmers	Sample size for Non-FFS farmers*	**Total sample size**
Kikai	2092	32	2060	44*	**76**
Muvuti	775	26	749	16	**42**
Mukiria	1094	28	1066	23	**51**
Kabati	841	31	810	17	**47**
Total	4802	117	4685	100	**217**

3.6 Instrumentation

An interview schedule was used to collect data from the respondents. The items of the instrument were constructed based on the research objectives. The instrument was chosen because of its ease in administering besides the results being readily analyzed. Mugenda and Mugenda (2003) indicate that an interview will yield a higher response rate and also give an opportunity for clarification of items after they are presented by the respondent.

3.6.1 Validity

Validity is the degree to which results obtained from the analysis of data actually represent the phenomenon under study (Mugenda & Mugenda, 2003). Validity ensures that the instrument used to collect data actually measures what it is intended to measure. To ensure the items of the interview schedule measured what it was intended for, the instrument was subjected to scrutiny by the university supervisors, who also reviewed the face validity of the instrument. Face validity addressed the format of the instrument and aspects such as clarity of printing, font size and shape, adequacy of workspace and appropriateness of language. Content validity dwelt with the representativeness and adequateness of items designed to measure the various variables of the study (Mugenda & Mugenda, 2003). This procedure assisted in developing items that covered all the objectives in the study.

3.6.2 Reliability

Pre-testing the data collection instrument enabled the researcher to assess the reliability of the instrument and its use. Burns (2000) explain that pre-testing allows errors to be discovered before the actual collection of data. This involved filling in the interview schedule for 30 farmers from Kiambu County who were not part of the study group. According to Mugenda and Mugenda (2003), the pilot test sample should be between 1% and 10% of the calculated sample. The collected data was coded, entered into computer and analyzed using Statistical Package for Social Sciences (SPSS) Version 22 for windows. According to Fraenkel and Wallen, (2000) a reliability co-efficient threshold of above 0.70 is recommended for survey research. In this study, data reliability was computed using the Cronbach alpha coefficient, where an index of 0.936 was obtained.

3.7 Data Collection Procedure

Prior to data collection, approval was sought from the Graduate School, Egerton University. The researcher then sought a research permit from the National Commission on Science, Technology and Innovations (NACOSTI) in the Ministry of Education, Science and Technology. Pre-study visits were made to the study areas to meet the respective coffee society chief executive officers and the frontline extension staff who assisted to draw schedule of visits to the respondents' homes. Where the expected household respondent was not present for the interview, the interview day was rescheduled to an appropriate time.

The researcher visited and interviewed the respondents at their home. Secondary data was collected to supplement the primary data through review of publications, books, academic journals and official reports kept at the coffee societies' offices. Internet search approach was also employed to access data stored via websites.

3.8 Data Analysis

Data collected was organized into ordinal, nominal, interval and ratio scales. The data was coded, entered into computer and analyzed using Statistical Package for Social Sciences (SPSS) Version 22 for windows. Descriptive statistics (mean, mode and standard deviation) was used to summarize gathered data while inferential statistics was used to test the effect of farmer field schools in promoting adoption of best agricultural practices by smallholder coffee farmers in Kenya. The level of significance was tested at $\alpha \leq 0.05$.

CHAPTER FOUR
RESULTS AND DISCUSSION

4.1 Introduction

The study determined and documented the effectiveness of Farmer Field Schools in promoting adoption of best agricultural practices by smallholder coffee farmers in Kenya. This chapter presents the results, interpretation and discussion of the findings of the study.

4.2 Characteristics of the Respondents

The study gathered respondents' personal attributes which encompassed gender, marital status, age and level of education.

4.2.1 Gender of the Respondents

Figure 3 represents gender composition of the respondents, with 47.1% and 52.9% for male and female farmers respectively. This implies that coffee farming related decisions such as attendance of farmer field school training in promoting adoption of best agricultural practices may not be dominated by any gender.

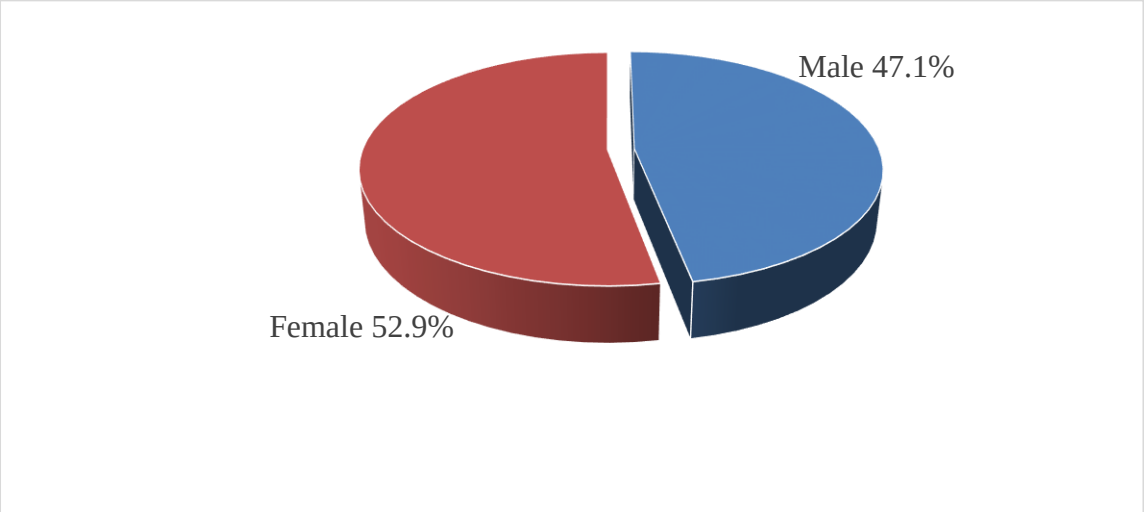


Figure 2. Gender of the Respondents

4.2.2 Age Brackets of the Respondents

This study comprised of farmers with different age brackets. Farmers within the age bracket of 36-55 were the majority, representing 34.0%. About 29.0% of the total respondents were in the age bracket below 35 years while 24.0% were in the age bracket 56-65 years. Respondents in the age 66 years and above constituted 13.0% of the sample as shown in Table 3.

Table 3: Age Brackets of the Respondents

Age bracket in years	Frequency	Percent	Cumulative Percent
Below 35 years	63	29.0%	29.0%
'36 - 55 years	74	34.0%	63.0%
'56 – 65 years	52	24.0%	87.0%
'66 years and above	28	13.0%	100.0%
Total	217	100.0%	

.

A cumulative percentage of 63.0% of the respondents were aged less than 56 years. This implies that coffee farming in the study area is popular among the young and middle aged persons. Most of the older and aged farmers in the age brackets 56-65 and above 66 years may have stopped the growing of the crop or may have transfered the ownership to younger generation. Age have an influence on farming productivity due to the effect of technology adoption. According to Khandker, Begum, Hasan, Sarker, Asaduzzaman and Bhuiyan (2014) young and middle aged farmers are generally receptive to adoption of new technologies in farming.

4.2.3 Marital Status of the Respondents

Majority (59.0%) of the respondents were married as depicted in Figure 4. Over 19% of the respondents were windowed while 17.1% were single. At least 4.3% of the farmers did not disclose their marital status. It can be deduced that coffee farming is a popular household enterprise among the married respondents.

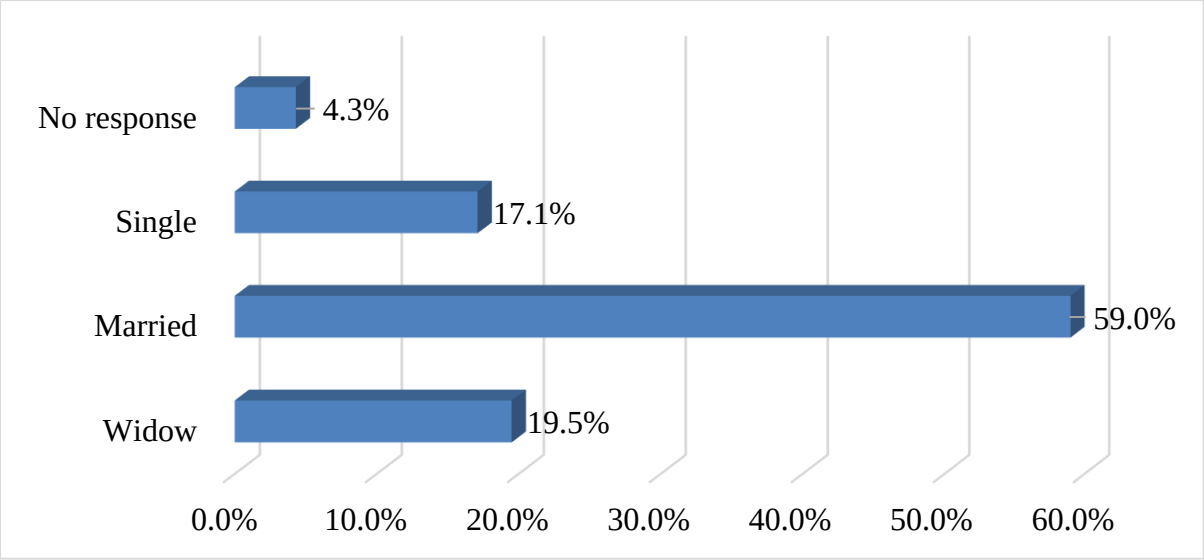


Figure 4. Marital Status of the Respondents

4.2.4 Respondents Level of Education

Most of the respondents, at 97.6% had less than tertiary level of education as shown in Figure 5. Majority of the respondents at 33.8% had secondary level of education. This was followed by respondents with upper primary level of education as represented by 27.1% of the total responses. About 26.7% of the respondents had no formal education while 10.0% had lower primary level of education. It was just 2.4% of the respondents who had tertiary level of education. These results imply that majority of the smallholder coffee farmers lack formal education necessary for better modern farming. In addition to this, the level of education of the household head can influence the kind of decision that may be made on behalf of the entire household with regard to coffee farming, attendance of trainings and adoption of new technologies. More educated farmers are likely to make better decisions, put more value on acquisition of new skills as well as quickly adopting new technologies in farming as compared to their less educated counterparts.

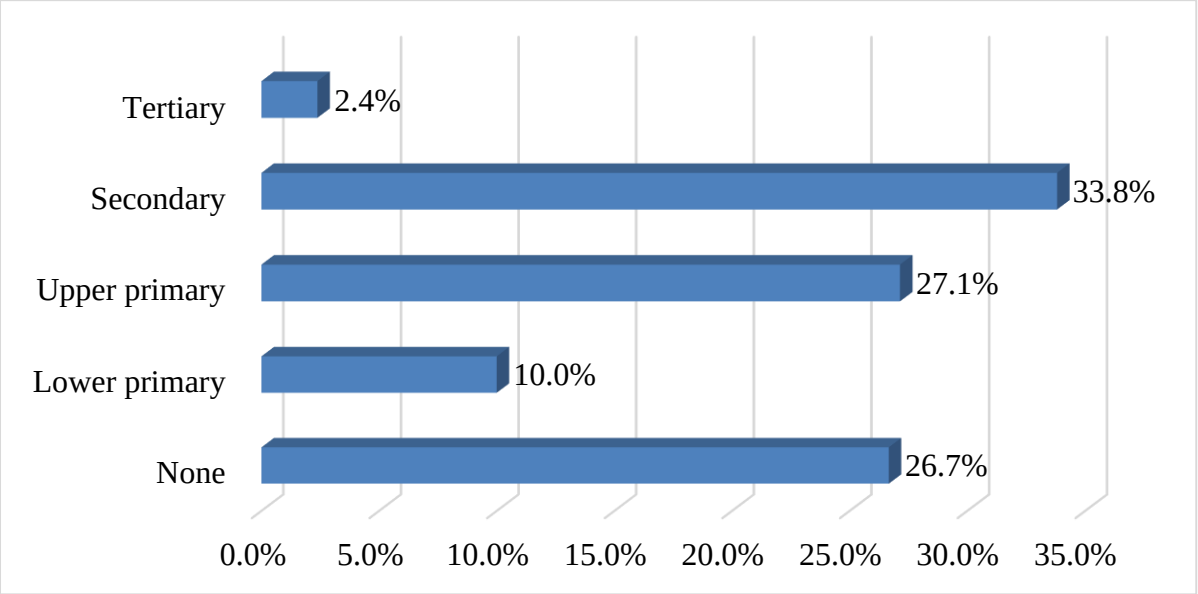


Figure 5. Respondents' Level of Education

According to Mugwe (2014), education level of the small scale farmers influence their average coffee production per tree at 0.01 level of significance where the level of education of the small scale farmer was associated with 32.4% increase in yield per tree. Studies by Max (2015) ascertained that the level of education of the household head affected uptake of technology, which in turn affect productivity. Level of education is hypothesized to influence positively on the dependent variables. Old farmers had less knowledge of different

technologies as compared to young farmers attributable to their low level of education (Shinde, Bhople & Valeker, 2000).

4.3 Respondents' Membership to Farmer Field Schools

Most of the farmers in the sample were found to belong to FFS classes, 55.7%. About 44.3% of the farmers did not belong to any FFS class as shown in figure 6.

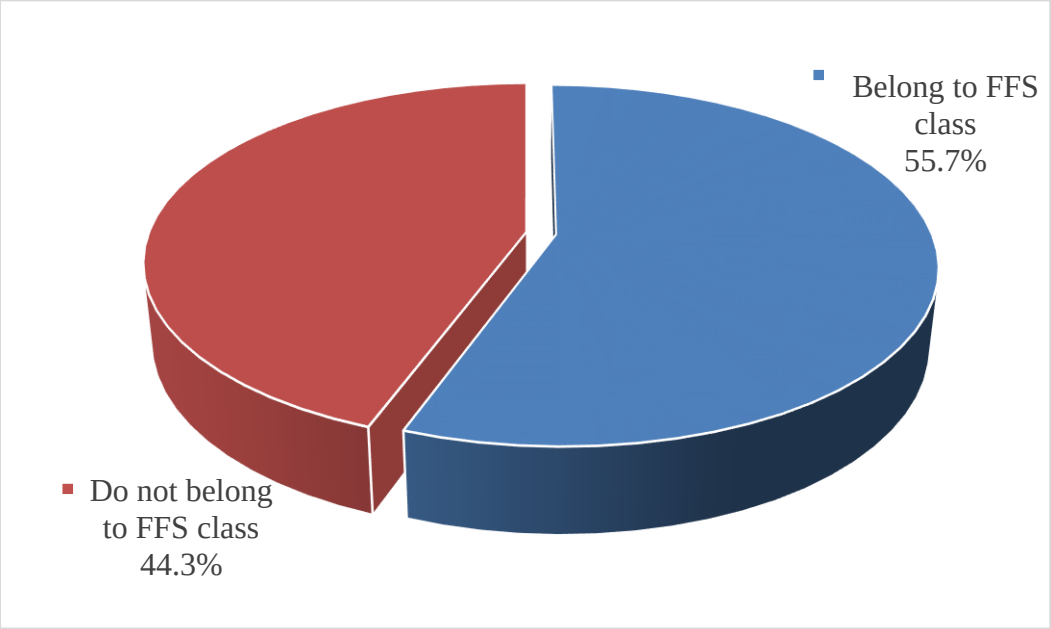


Figure 3. Membership to FFS Classes

Farmers belonged to various Farmer Field Schools in order to share knowledge on coffee farming for their common good. If one is a member of an FFS class, he/she was expected to access training on uptake of best agricultural practices and enhance farming knowledge and hence positively impact on coffee yields.

According to Frias and Rolling (2005), FFS classes are channels through which new technologies and approaches of production are transferred to farmers. They are also the main source of information for not only the best agricultural practices but also input and output markets. Membership to FFS classes is crucial in building up necessary networks required either in production or marketing of one's farm produce. In a bid to improve his/her understanding of the production techniques, most farmers join FFS classes so that they can share knowledge and experiences involved and help solve problems facing their colleagues (Hakiza et al., 2002). In addition to the educational opportunities available to farmers through

FFS classes, participation within the classes leads to initiative, innovation and improvements (Bebe et al., 2003).

Table 4: Main Occupation of the Respondents

Occupation	Frequency	Percent
Farming	173	80.0
Salaried employment	25	11.3
Non-farm businesses	14	6.4
Casual labour	3	1.3
Others	2	1.0
Total	**217**	**100.0**

N= 217

Majority of the respondents had farming as their main occupation as represented by 80.0% of the total responses as represented in Table 4. About 11.3% were in salaried employment while 6.4% operated non-farm businesses. Other types of occupations were represented by only 1.0% of the total responses. This implies that farming is the main economic activity in Kenya.

4.5 Respondents' Main Source of Income

Table 5: Major Source of Income of the Respondents

Source of income	Frequency	Percent
Off-farm employment	9	4.0
Farming	208	96.0
Total	**217**	**100.0**

N=217

Since farming was the main economic activity in the study area, most of the respondents indicated that their main source of income was farming as represented by 96.0% of the total responses (Table 5). It was just 4.0% of the respondents who indicated that their major source of income was from non-farm employment.

4.6 Effectiveness of Farmer Field Schools in Enhancing Uptake of Best Agricultural Practices Amongst Smallholder Coffee Farmers in Kenya.

The first objective in this study sought to determine the effectiveness of Farmer Field Schools in enhancing uptake of best agricultural practices amongst smallholder coffee farmers in Kenya. In meeting this objective, a null hypothesis, "Farmer Field Schools have statistically no significant effect on enhancing uptake of best agricultural practices amongst smallholder coffee farmers in Kenya" was formulated and analyzed using descriptive statistics (frequencies) and inferential statistics (Chi-square).

Uptake of Best Agricultural Practices

This study sought to describe the uptake of best agricultural practices in the study area. The results are shown in Table 6.

Table 6: Uptake of Best Agricultural Practices

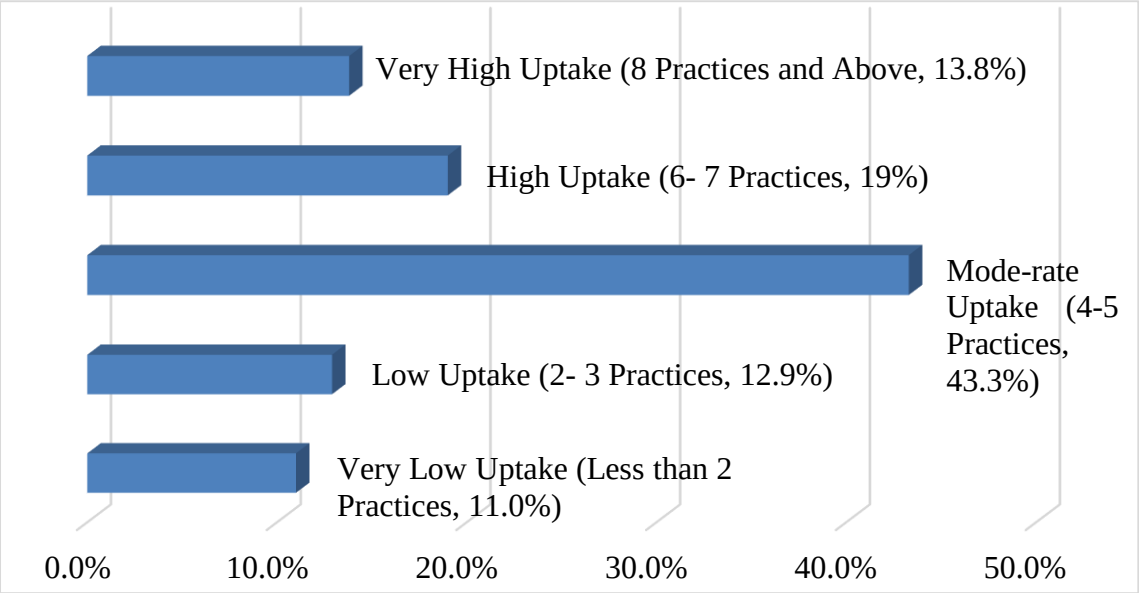
Uptake of Best Agricultural Practices				
	Yes		**No**	
Practice learned from coffee FFS	Frequency	%	Frequency	%
Proper field preparation and coffee establishment	125	65.2	67	34.8
Application of weed management strategies	117	56.2	91	43.8
Application of fertilizers and organic manures for improved production and quality	131	61.4	82	38.6
Proper canopy management to maintain the growth vigor	87	58.6	61	41.4
Use of certified planting materials (seedlings)	96	47.1	108	52.9
Use of mulch and shade trees for soil and moisture conservation among others	113	58.1	81	41.9
Application of Integrated Pest Management (IPM) strategies in the control of coffee insect pests	108	61	69	39
Application of cultural management strategies for control of Coffee Berry Disease & Coffee Leaf Rust	89	53.3	81	46.7
Top-working traditional varieties (SL) into disease resistant varieties (Ruiru 11 and Batian)	102	54.8	84	45.2
Timely and selective picking of red-ripe cherry	96	48.3	103	56.2

N= 217

Majority of the respondents at 65.2% indicated uptake of proper field preparation and coffee establishment, with 34.8% indicating non-uptake of the practice. 56.2% of the respondents indicated uptake of weed management strategies while 43.8% indicated non uptake of the practice. As far as uptake of the application of fertilizers and organic manures for improved production and quality was concerned, majority of the respondents at 61.4% indicated to have had an uptake, with only 38.6% not embracing the practice. 58.6% of the respondents implemented proper canopy management practices to maintain the growth vigor of the coffee plant. Similarly, 58.1% of the respondents implemented the use of mulch and shade trees for soil and moisture conservation, with 41.9% indicating non uptake. 61.0% of the respondents implemented the application of Integrated Pest Management (IPM) strategies in the control of coffee insect pests, with 39.0% not embracing the practice. Application of cultural management strategies for control of Coffee Berry Disease and Coffee Leaf Rust was represented by a remarkable uptake of 53.3% with just 46.7% of the farmers reporting non-uptake. Majority of the respondents at 54.8% indicated to have implemented top-working traditional varieties (SL) into disease resistant varieties (Ruiru 11 and Batian), with only 45.2% reporting non uptake.

However, only 47.1% of the respondents embraced the use of certified planting materials, with 52.9% of the respondents not embracing the practice. Likewise, 43.8% of the respondents indicated uptake of timely and selective picking of red-ripe cherry, with 56.2% indicating non-uptake of the practice.

Figure 7 shows a categorization of farmers depending on the number of Best Agricultural Practices (BAPs) adopted, out of a possible maximum of 10 practices. Very high uptake applied to farmers who adopted 8 and more practices, and they constituted 13.8%. High uptake (19%) comprised of farmers who adopted 6-7 BAPs. The category on moderate uptake (4-5 practices) had the highest number of farmers, at 43.3%. Low uptake (2-3 practices) and very low uptake (Less than 2) constituted 12.9% and 11.0% respectively.



NB: Minimum = 0, Maximum = 10, Mean = 6.595, Standard Deviation = 4.537

Figure 4. Coffee Farmers' level of Uptake of Best Agricultural Practices

Use of Chi-square was employed to determine whether Farmer Field Schools had any statistically significant effect on enhancing uptake of best agricultural practices amongst smallholder coffee farmers in Kenya. The results are shown in Table 7.

Table 7: Chi-square Results for the Relationship between Membership to FFS and Uptake of Best Agricultural Practices

	Membership to FFS		
Extent of uptake of BAP	**Belong to FFS**	**Does not belong to FFS**	**Totals**
Very Low Uptake (≤ 2 practices)	2 (1.7%)	15 (15.0%)	17 (7.8%)
Low Uptake (2 - 3 practices)	6 (5.1%)	42 (42.0%)	48 (22.1%)
Moderate Uptake (4 - 5 practices)	36 (30.8%)	28 (28.0%)	64 (29.5%)
High Uptake (6 – 7 practices)	53 (45.3%)	12 (12.0%)	65 (30.0%)
Very High Uptake (≥8 practices)	20 (17.1%)	3 (3.0%)	23 (10.6%)
Total	**117 (100.0%)**	**100 (100.0%)**	**217 (100.0%)**

Chi-square = 85.34, df= 4, P-value < 0.001, N= 217

Chi-square test was run to help determine the relationship between extent of uptake of BAP and membership to FFS classes. A calculated chi-square value of 222.941 (significant at 5%

level since p-value = 0.001 at 4 degrees of freedom) implies that there is a significant statistical relationship between these two variables.

Greater uptake of BAP is associated with membership to FFS as opposed to non-membership to FFS. The results in Table 8 shows that majority of the respondents who belonged to FFS had high uptake of BAP as represented by 45.3% of the total responses. About 30.8% of the respondents who belonged to FFS had moderate uptake of BAP while 17.1% had very high uptake of the BAP. It was only 5.1% and 1.7% of the respondents who belonged to FFS who had low and very low uptake of BAP, respectively. On the other hand, majority of the respondents who were not members of FFS had low uptake of BAP as represented by 42.2% of the total responses. About 28.0% of the respondents who did not belong to any FFS had moderate uptake of BAP while 15.0% had very low uptake of the BAP. It was just 12.0% and 3.0% of the respondents who did not belong to FFS who had high and very high uptake of BAP, respectively.

The use of correlation coefficient analysis was employed in testing the null hypothesis, "Farmer Field Schools have no statistically significant effect on enhancing uptake of best agricultural practices amongst smallholder coffee farmers in Kenya". Table 8 shows the results for the test for effectiveness of Farmer Field Schools on uptake of best agricultural practices in coffee farming.

Table 8: Effectiveness of Farmer Field Schools on Uptake of BAP in Coffee Farming

		Membership to FFS	Extent of uptake of BAP
Membership to FFS	Pearson Correlation	1	.397
	Sig. (2-tailed)	.	.000
	N	217	217
Extent of uptake of BAP	Pearson Correlation	.397	1
	Sig. (2-tailed)	.000	.
	N	217	217

The correlation coefficient for the effectiveness of farmers' field school training on uptake of best agricultural practices in coffee farming was positive and significant at 5% level (r=.397,

$p<0.05$). Based on these results, the null hypothesis was rejected, thus belonging to FFS increased the farmers' uptake of BAPs.

This study is consistent with CRF (2014) that asserts that one of the effective ways of implementing various recommendations on coffee agronomic practices, aimed at enhancing coffee productivity is use of FFS. This study also agrees with World Bank (2010) that observed that FFS approach represents an important approach for the empowerment of the rural poor, improving their access to information, critical analysis and decision making, optimizing productivity, improving food and nutrition security, strengthening rural institutions and having a positive impact on the sustainable management of natural resources. All these aspects are particularly relevant for vulnerable groups and may contribute to social protection in terms of community empowerment/cohesion and its own social safety nets.

This finding is in line with Loevinsohn, Meijerink and Salasya (2000) who reported that eighty percent (80%) of what was learned on coffee management in the FFS was adopted showing farmers satisfaction with the technical options learned during the FFS sessions than their counterparts.

4.7 Effectiveness of FFS in Increasing Coffee Yields Amongst Smallholder Coffee Farmers in Kenya.

The second objective of this study was to determine the effectiveness of Farmer Field Schools in increasing coffee yields amongst smallholder coffee farmers in Kenya. In pursuing this objective, a null hypothesis, 'Farmer Field Schools have no statistically significant effect on increasing coffee yields amongst smallholder coffee farmers in Kenya' was formulated. Data was collected on cherry production per tree over the study period. The results in Table 9 summarized the production per tree in kilograms of cherry achieved by the respondents during the respective years.

Table 9: Cherry Production per Tree (Kilograms)

Coffee year	Minimum (Kg)	Maximum (Kg)	Mean (Kg)	Std. Deviation
2008/2009	0.92	11.40	2.96	2.31
2009/2010	0.90	10.25	2.82	3.01
2010/2011	0.64	11.09	2.49	2.13
2011/2012	0.39	10.01	2.17	2.15
2012/2013	0.44	11.72	2.45	3.77
2013/2014	0.40	11.18	2.34	3.45
Average	0.39	11.40	2.41	2.35

The highest production of coffee was realized in the year 2008/2009 when a mean of 2.96 kg/ tree with a standard deviation of 2.31 was achieved. This was followed by the year 2009/2010 with a mean of 2.82 and standard deviation of 3.01. In the year 2010/2011 a mean of 2.49 coffee yields in kg/ tree with a standard deviation of 2.13 was realized. The coffee year 2011/2012, 2012/2013 and 2013/2014 recorded the lowest yield of 2.17, 2.45 and 2.34 kg/ tree, respectively.

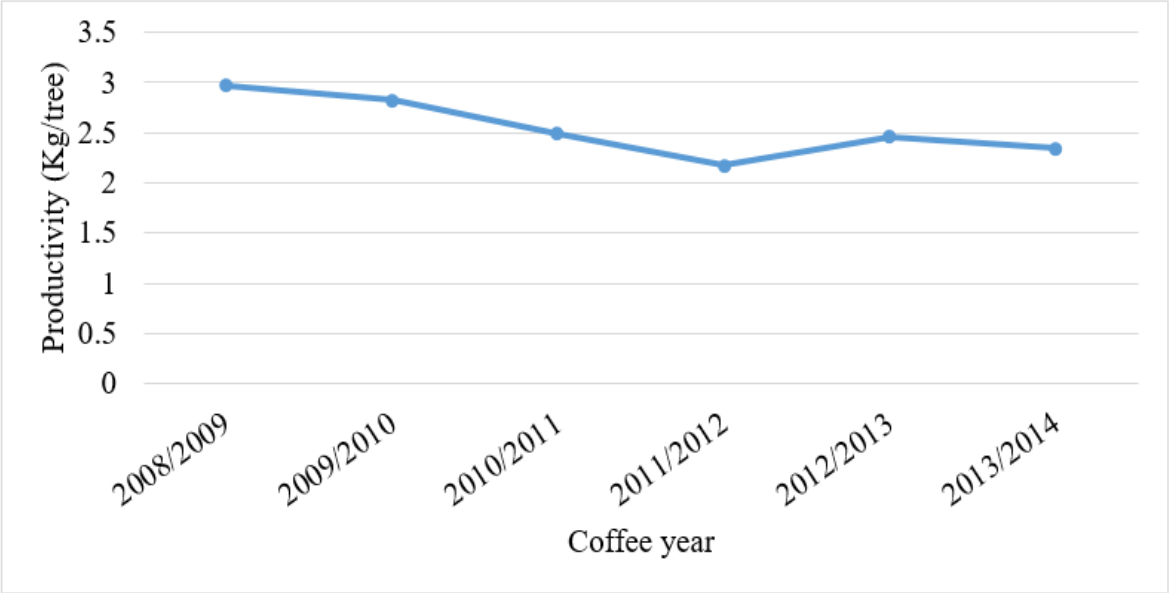


Figure 8. Cherry Production Trends for the Period 2008/2009 to 2013/2014.

The results in Figure 8 show that the average yield in kg/ tree for the study period ranging from 2008 – 2014 was calculated to be 2.41 with a standard deviation of 2.35. These results indicate a consistent decline in coffee productivity within the period between year 2008/2009

and 2013/2014. The results agree with Republic of Kenya (2016) that observed that coffee production in Kenya has been on the decline with its earnings declining from US$ 500 million in the 1990s to less than US$ 150 million in 2015 and its productivity dropping to as low as 2 Kgs per coffee tree against a potential of 30 Kgs per tree per year.

The use of correlation coefficient analysis was employed in testing the null hypothesis, "Farmer Field Schools have no statistically significant effect on increasing coffee yields amongst smallholder coffee farmers in Kenya''. Table 10 shows the results for the test of effect of belonging to farmer field schools on coffee yields amongst smallholder coffee farmers in Kenya.

Table 10: Effectiveness of FFS on Coffee Yields amongst Smallholder Coffee Farmers

		Membership to FFS	Coffee yields (kg/ tree)
Membership to FFS	Pearson Correlation	1	.218
	Sig. (2-tailed)	.	.003
	N	210	210
Coffee yields (kg/ tree)	Pearson Correlation	.218	1
	Sig. (2-tailed)	.003	.
	N	210	210

The Pearson's correlation coefficient for the effectiveness of farmers' field school training on coffee yields was positive and significant at 5% level ($r=.218$, $p<0.05$). Based on these results, the null hypothesis was rejected. This indicates that belonging to FFS increases the farmers' coffee yields.

A Chi-square analysis results for the relationship between coffee yield and attendance of Farmer Field School is shown in Table 11. The results indicate that there was a significant positive relationship between membership to FFS class and coffee yield.

Table 11: Relationship between Coffee Yield and Membership to Farmer Field School

	Coffee Yield			
FFS Membership	Low (< 3.0kg/ tree)	Medium (3.0-6.0kg/ tree)	High (> 6.0kg/ tree)	Totals
Belong	23 (19.7%)	55 (47.0%)	39 (33.3%)	117 (100.0%)
Does not belong	58 (62.4%)	27 (29.0%)	8 (8.6%)	93 (100.0%)
Total	81 (38.6%)	66 (31.4%)	63 (30.0%)	210 (100.0%)

Chi-Square = 48.33; Degrees of Freedom = 2; P-Value = 0.000

The chi-square value of 48.33 at 2 degrees of freedom with a P-value < 0.05 shows that coffee yield is related to belonging to FFS class. Majority of the farmers who belonged to FFS classes achieved medium (3.0-6.0kg/ tree) yield and high yield (more than 6.0kg/ tree) as represented by 47.0% and 33.3% of the total responses, respectively. It was only 19.7% of the respondents belonging to FFS class that realized low coffee yields at less than 3.0kg/ tree. On the other hand, most of the respondents who did not belong to FFS classes achieved low coffee yields (less than 3.0kg/ tree) as represented by 62.4% of the total responses. About 29.0% of respondents who did not belong to FFS classes realized medium (3.0-6.0kg/ tree) yield. It was only 8.6% of the respondents who did not belong to FFS classes that realized high coffee yield (more than 6.0kg/ tree).

This is an indication that higher yields were realized by farmers who attended FFS classes as opposed to those that did not attend the classes. To further confirm the difference in coffee yields achieved by farmers who had attended FFS classes as compared to those who did not attend the classes, this study conducted an independent samples t-test analysis and the results summarized in Table 12.

Table 12: t-Test Results for the Difference in Coffee Yields between Farmers Who Attended FFS Classes and Those Who Did Not.

Period	N	Mean	Std. Dev.	Std. Error Mean
Farmers belonging to FFS classes	117	2.71	0.643	.137
Farmers not belonging to FFS classes	93	2.18	0.482	.142

The results on Table 12 shows that an average farmer who had attended FFS classes got a mean of 2.71 kg/ tree for the production period between 2008/09 to 2013/14 while an average

of 2.18 kg/ tree yield was achieved by farmers who had not attended FFS classes for the production period between 2008/09 to 2013/14. The results further show that there was a mean difference in yield for the two groups (those who attended FFS classes and those who did not attend) computed as 0.53. This difference is significant at 5% level (T-value of 3.786 computed at 208 degrees of freedom has a probability value of 0.000). This implies that attendance in coffee farmers FFS classes significantly increases the likelihood of getting higher coffee yields.

This study is consistent with Duveskog (2006) who noted that farmers who have received training from FFS achieve a high production than non-participating farmers. According to FAO (2017), the farmer field school (FFS) approach developed by FAO and partners nearly 25 years ago in South East Asia as an alternative to the prevailing top-down extension approach of the Green Revolution, was found to effectively work in improving crop productivity, especially in situations where more complex and counter-intuitive problems existed, such as pesticide-induced pest outbreaks.

This study agrees with Evenson, Robert and Germano (1996) who in their study aimed at examining the effectiveness of agricultural extension on farm productivity in Kenya found that increased agricultural productivity was attributable to membership to forums such as FFS. This study is also consistent with FAO (2011) whose analysis of their established FFS models in the East Africa region showed great impact of the extension model on crop productivity.

This study agrees with Mwaura (2014) who noted that FFS helps achieving higher productivity in crop farming. In this field-based setting, farmers are able to investigate a wide range of topics, such as management of soil fertility and water resources; approaches of local varietal selection and issues of seed quality; risks associated with toxic pesticides and implementation of low-toxicity alternatives; development of marketing skills.

This study disagrees with Mwaura (2014) who concludes that membership to FFS does not necessarily lead to adoption of high yielding technologies (e.g. use of inorganic fertilizer) and increased productivity and that in fact, membership to FFS has detrimental effects on adoption of inorganic fertilizer and improved seeds. The results of this study disagree with

Aguilar (1988) who noted a negative productivity effect of farmers schooling among Kenyan smallholders in Nyanza province.

According to Adong, Mwaura and Okoboi (2013), despite the low rate of participation in FFS, which should concern policy makers, investment in agricultural extension through groups, considerably increase the ability of farmers to produce more. This implies that for improved agricultural production, strengthening of FFS classes is an important intervention.

4.8 Effectiveness of Farmer Field Schools in Enhancing Sharing of Knowledge Amongst Smallholder Coffee Farmers in Kenya

The third objective of this study was to determine the effectiveness of Farmer Field Schools in enhancing sharing of knowledge amongst smallholder coffee farmers in Kenya. In pursuing this objective, the respondents were asked questions in relation to sharing information regarding coffee best agricultural practices. A null hypothesis, ‘‘ Farmer Field Schools have no statistically significant effect on enhancing sharing of knowledge amongst smallholder coffee farmers in Kenya” was formulated.

The results in Figure 9 shows the proportions of respondents who were involved in sharing knowledge on coffee best agricultural practices with other farmers.

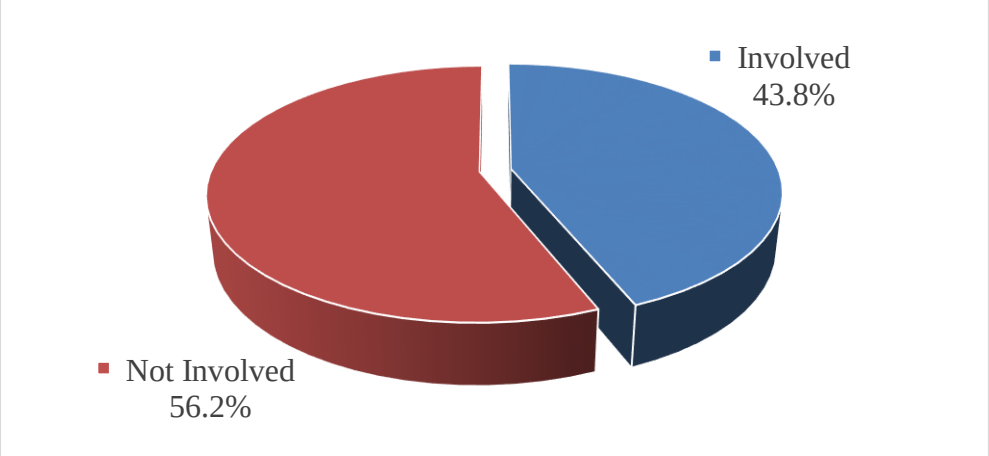


Figure 9. Involvement in Sharing of Knowledge on BAPs with Other Farmers

The results in Figure 9 shows that majority of the respondents were not involved in sharing of knowledge on coffee best agricultural practices with other farmers as represented by

56.2% of the total responses. A few respondents (43.8%) were however involved in sharing of knowledge amongst other smallholder farmers.

Respondents were requested to indicate the number of farmers with whom respective nature of knowledge was shared out. Table 12 summarizes the extent to which the major types of knowledge were shared by sampled farmers with their colleagues.

Table 13: Type of Knowledge Shared out by Farmers

Type of Knowledge Shared out	Mean	Std. Dev.
Proper field preparation and coffee establishment	6.749	3.904
Application of weed management strategies	3.820	4.162
Application of fertilizers and organic manures for improved coffee productivity and quality	5.920	2.817
Proper canopy management to maintain plant growth vigour	5.724	3.759
Use of certified planting materials (seedlings)	3.164	3.766
Use of mulch and shade trees for soil and moisture conservation	4.808	2.261
Application of Integrated Pest Management (IPM) Strategies in the control of coffee insect pests	5.313	3.631
Application of cultural practices in the management of Coffee Berry Disease & Coffee Leaf Rust	5.486	3.624
Top-working traditional Varieties (SL) into disease resistant Varieties (Ruiru 11 and Batian)	5.431	3.672
Timely and selective picking of red-ripe cherry	2.575	4.040

The results in Table 12 shows that respondents indicated to have shared knowledge on proper field preparation and coffee establishment with an average of 6.749 farmers with a standard deviation of 3.904. Respondents had shared knowledge on application of fertilizers and organic manures for improved coffee productivity and quality with a mean of 5.920 farmers with a standard deviation of 2.817. Knowledge on proper canopy management to maintain plant growth vigour was shared by a mean of 5.724 farmers with a standard deviation of 3.759. Respondents indicated to have shared knowledge on application of cultural practices in the management of Coffee Berry Disease & Coffee Leaf Rust with a mean of 5.486 farmers. Among the sampled respondents, knowledge on top-working traditional Varieties

(SL) into disease resistant Varieties (Ruiru 11 and Batian) was indicated to have been shared with a mean of 5.431 farmers. Knowledge on application of Integrated Pest Management (IPM) Strategies in the control of coffee insect pests was shared with 5.313 farmers.

However, application of weed management strategies, use of certified planting materials (seedlings), and use of mulch and shade trees for soil and moisture conservation and timely and selective picking of red-ripe cherry knowledge was found to have been shared with less than 5 farmers.

Through a computation of the number of farmers that respondents shared knowledge with, this study was able to quantify the extent of knowledge sharing among sampled farmers. During this quantification, the following classification criteria was adopted, "less than 2 farmers = Very low", "2 - 4 farmers = low", "5 – 6 farmers = moderate", "7 - 8 farmers = high", and "more than 8 farmers = very high". The results are shown in table 14.

Table14: Extent of Knowledge Sharing by Farmers

Extent	Frequency	Percent	Cumulative Percent
Very low	44	21.0	21.0
Low	115	54.8	75.7
Moderate	31	14.8	90.5
High	19	9.0	99.5
Very high	1	.5	100.0
Total	210	100.0	

The results in Table 13 show that over 75% of the respondents shared knowledge at low level. Only 9.5% of the respondents shared knowledge at a high level.

In order to determine the difference in extents of knowledge sharing among farmers who were members to FFS classes and those who did not belong, the use of independent samples t-test was employed. The results are shown in Table 14.

Table 15: t-Test Results for the Difference in Extents of Knowledge Sharing among Farmers Belonging to FFS Classes and Those not Belonging

Period	N	Mean	Std. Deviation	Std. Error Mean
Member to FFS class	117	4.684	2.186	.248
Non-Member to FFS class	93	2.064	2.317	.329

Mean Diff. = 2.620, Calc. T-value = 2.679, Critical T-value = 1.971, df= 208, Std Error = 0.978, p=0.000).

The results in Table 14 show that farmers who belonged to FFS classes had an average of 4.684 farmers whom they had shared knowledge with. Farmers who did not belong to FFS classes had shared their knowledge on coffee farming with an average of 2.064 farmers. In comparing farmers who belonged to FFS classes against those that did not, the results show a mean difference in number of farmers that knowledge was shared with was 2.620. This mean difference is significant at 5% level (computed t-value of 2.679 is higher than the critical values of 1.971). Additionally, the p-values of 0.000 is less than the 0.05 significance level and thus the null hypothesis was rejected, thus, Farmer Field Schools has a statistically significant effect on enhancing sharing of knowledge amongst smallholder coffee farmers in Kenya.

The findings of the study are in line with Solanki (2001) who reported that knowledge of dairy farmers in FFS with respect to activities such as breeding, feeding, health care and management practices of dairy animals was higher in enrolled farmers than non-enrolled farmers.

These findings were also similar with the findings of Bunyatta (2005) who found that about 50% of FFS farmers had acquired high to very high knowledge of the technologies disseminated while more than 80% of the non FFS farmers had acquired moderate to very low level of the technologies, highlighting a crucial difference in the level of knowledge acquisition among the FFS members and non-members.

This finding was also in agreement with Tsion (2008) that training kept the FFS trained farmers more informed and updated on extension packages disseminated by Agricultural Research Centers. However, farmers who did not participate in FFS classes also knew

something about coffee management practices due to different extension activities conducted in the locality, informal discussion with FFS members and from their life experience. But from the result obtained, it could be seen that coffee FFS kept the farmers more knowledgeable in promoting coffee management practices, especially with reference to coffee wilt disease.

This result also supported the findings of Rola and Jamias (2002) in Phillipines who reported that FFS graduates had generally higher knowledge scores than their non- counterparts. After actively participating in FFS sessions through group learning, coffee farmers gained knowledge about the life cycle of the disease, how to manage and prevent it. The study is consistent with Babur (2009) who calculated the mean score of knowledge of FFS members on coffee management practice and found it to be significantly higher with probability level of 1% than the mean score of non FFS members. The result confirmed that the FFS approach of coffee was effective in terms of improving knowledge of farmers as compared to the conventional extension approach.

The results of this study are also consistent with Quizon, Rola and James (2002) whom in their study in Indonesia and the Philippines found that although there was very little diffusion of FFS knowledge from school graduates to other community members, FFS acquired knowledge was observed to be significantly maintained by these graduates.

On the contrary, this study disagrees with Feder, Murgai and Quizon (2004) who found that there was no significant diffusion of FFS acquired knowledge to other farmers who resided in the same village. However, in relative contrast, Simpson and Owens (2002) estimated high farmer-to-farmer communication in many African countries which conducted the FFS with several types of information sharing occurring between immediate family members, among secondary contacts outside of the immediate family, at small group meetings and with non-participants.

This study agrees with Nederlof and Okdonkor (2007) who noted that knowledge was greatly shared among Cowpea farmer participating in field schools in Ghana. They discovered that the FFS did not just act as a tool to transfer messages but also to foster experiential learning among farmers.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents a summary of major findings, conclusions and recommendations of the study. It also highlights the suggestions for further related studies. The study aimed at determining and documenting the effectiveness of Farmer Field Schools in promoting adoption of best agricultural practices by smallholder coffee farmers in Kenya.

5.2 Summary of the Study

The following were the salient findings of this study.

5.2.1 Effectiveness of FFS in enhancing uptake of BAP

Majority of the respondents had implemented proper field preparation and coffee establishment, application of weed management strategies, application of fertilizers and organic manures for improved production and quality, proper canopy management practice to maintain the growth vigor of the coffee plant, use of mulch and shade trees practice for soil and moisture conservation, application of Integrated Pest Management (IPM) strategies in the control of coffee insect pests, application of cultural management strategies for control of Coffee Berry Disease and Coffee Leaf Rust and top-working traditional varieties (SL) into disease resistant varieties, Ruiru 11 and Batian. A few farmers implemented the use of certified planting materials (seedlings) and timely and selective picking of red-ripe cherry. Majority of the farmers had moderate uptake of best agricultural practices, adopting 4 – 5 practices representing 43.3% of the total responses. The Chi- square test results for the relationship between extent of uptake of BAP and belonging to FFS classes showed that there was a significant statistical relationship between these two variables. Higher uptake of BAP is associated with belonging to FFS as opposed to non-belonging to FFS. The correlation coefficient analysis was used to test the effect of farmers' field school training on uptake of best agricultural practices in coffee farming. Based on these results, the null hypothesis was rejected, thus belonging to FFS increased the farmers' uptake of BAPs.

5.2.2 Effectiveness of FFS in increasing coffee yields

The highest production of coffee was realized in the year 2008/2009 when a mean of 2.96 kg/ tree with a standard deviation of 2.31 was achieved. This was followed by the year 2009/2010 with a mean of 2.82 and standard deviation of 3.01. In the year 2010/2011 a mean

of 2.49 coffee yields in kg/ tree with a standard deviation of 2.13 was realized. The coffee year 2011/2012, 2012/2013 and 2013/2014 recorded the lowest yield of 2.17, 2.45 and 2.34 kg/ tree, respectively. There has been a consistent decline in coffee productivity within the period between years 2008/2009 to 2013/2014. The average yield in kg/ tree for the study period ranging from 2008 – 2014 was calculated to be 2.41 with a standard deviation of 2.35. The correlation coefficient for the effect of farmers' field school training on coffee yields was positive and significant at 5% level ($r=.218$, $p<0.05$). Based on these results, the null hypothesis was rejected, thus belonging to FFS increased the farmers' coffee yields. Coffee yield was found to be related to belonging to FFS class (chi-square value = 47.49, P-value < 0.05 at 2 df). Majority of the farmers who belonged to FFS class achieved medium (3.0-6.0kg/ tree) yield and high yield (more than 6.0kg/ tree) as represented by 47.0% and 33.3% of the total responses, respectively. On the other hand, most of the respondents who did not belong to FFS class achieved low coffee yield (less than 3.0kg/ tree) as represented by 62.4% of the total responses. An independent samples t-test analysis showed that an average farmer who had attended FFS classes got a mean of 2.71 kg/ tree for the production period between 2008/09 to 2013/14 while an average of 2.18 kg/ tree yield was achieved by farmers who had not attended FFS classes for the production period between 2008/09 to 2013/14. The mean difference in yield for the two groups (0.53) was significant at 5% level (t-value = 3.786, p-value <0.05). Therefore, attendance in coffee farmers FFS classes significantly increases the likelihood of getting higher coffee yields.

5.2.3 Effectiveness of FFS in enhancing sharing of knowledge

Majority of the respondents, at 56.2% were not involved in sharing of knowledge on coffee best agricultural practices with other farmers. About 43.8% were involved in sharing of knowledge amongst other smallholder farmers. Most farmers had shared knowledge on proper field preparation and coffee establishment, application of fertilizers and organic manures for improved coffee productivity and quality, proper canopy management to maintain plant growth vigour, application of cultural practices in the management of Coffee Berry Disease and Coffee Leaf Rust, application of Integrated Pest Management strategies in the control of coffee insect pests and top-working traditional Varieties (SL) into disease resistant Varieties Ruiru 11 and Batian. Majority of the respondents shared knowledge in a low extent as represented by 54.8% of the total responses. About 21.0% of the respondents shared knowledge in a very low extent while 14.8% shared knowledge in moderate extent. A few respondents had shared knowledge in high (9.0%) and very high (0.5%) extent. Farmers

who belonged to FFS classes had an average of 4.684 farmers whom they had shared knowledge with as compared to a mean of 2.064 for farmers who did not belong to FFS classes (a mean difference of 2.620 farmers). Farmer Field Schools has a statistically significant effect on enhancing sharing of knowledge amongst smallholder coffee farmers in Kenya ($t= 2.679$, $p< 0.05$).

5.3 Conclusions

The main conclusions for this study are as follows:

i) There was a significant relationship between extent of uptake of BAP and membership to FFS classes. Higher uptake of BAP was associated with belonging to FFS as opposed to non-belonging to FFS. The correlation coefficient analysis confirmed that belonging to FFS increased the farmers' uptake of BAPs.

ii) Belonging to coffee FFS class increased the farmers' coffee yields by 0.53 kg/ tree per year. Attendance in coffee farmers FFS classes significantly increases the likelihood of getting higher coffee yields.

iii) Farmers who belonged to FFS class had an average of 5 farmers whom they had shared knowledge with as compared to a mean of 2 for farmers who did not belong to FFS class. Farmer Field Schools has a statistically significant effect on enhancing sharing of knowledge amongst smallholder coffee farmers in Kenya.

5.4 Recommendations

Based on the findings of this study, the following recommendations are forwarded:

i) In order to enhance the uptake of BAP in coffee farming in Kenya, the National and County governments together with other stakeholders involved in extension services delivery should promote FFS in extension and agricultural advisory services systems. It is recommended that the County governments embrace FFS through refresher and short courses for all extension officers.

ii) Agricultural extension agents in Kenya should encourage farmers to join and actively participate in existing FFS classes for them to be able to enhance coffee productivity. Having demonstrated favorable results in its application, farmer training through FFS should be up-scaled in all the coffee growing regions. This could help to bridge the gap between the current low productivity of 2kg/ tree/year and the potential productivity of 30kg/ tree/year.

iii) It is recommended that the agricultural extension agents in Kenya should strengthen and support training through FFS in order to encourage and promote sharing of knowledge on BAPs by the smallholder coffee farmers.

5.5 Suggestions for Further Research

This study was not exhaustive and recommends further research on the following related areas:

i) Evaluation of factors affecting the effectiveness of Farmers Field Schools (FFS) in Kenya.

ii) Factors affecting the participation of coffee farmers in established Farmers Field Schools (FFSs) in Kenya.

REFERENCES

Adesina, A. A., & Zinnar, M. M. (1993). *Technology Characteristics, Farmers' Perceptions and Adoption Decisions*: A Tobit Model Application in Sierra Leone. Agric. Econ., 9: 297-311.

Adong, A., Mwaura, F., & Okoboi, G. (2013). What factors determine membership to farmer groups in Uganda? Evidence from the Uganda census of agriculture 2008/9. *Journal of Sustainable Development* 6(4):37-55.

Aguilar, R. (1988). *Efficiency in Production: Theory and Application on Kenyan Smallholders*, Economiska Studier, University of Gotenborg, Sweden.

Ajayi, M. T., & Okafor, C. (2006): "Extension Agents' perception of Participatory Agricultural Extension Approaches adopted by Agricultural Development Programme (ADP) in Ondo State, Nigeria." International Journal of Agricultural and Biological Sciences, 4(1): 20-25.

Anderson, J. R. (2007). "Agricultural Advisory Services", Background Paper for the World Development Report 2008.

Anderson, R. J. & Feder, G. (2004). Agricultural extension: good intentions and hard realities (English). *The World Bank research observer* 19(1): 41-60. Retrived from http://documents.worldbank.org/curated/en/473431468320670648/Agricultural-extension-good-intentions-and-hard-realities

Arega, M. (2009). Determinants of Intensity of Adoption of Old Coffee Stumping Technology in Dale Wereda, SNNPRS, Ethiopia. MSc. Thesis at Haramaya University Ethiopia. 123pp.

Ashenafi, G. (2007). Triticale Crop and Food Security, and Determinants Influencing the Adoption of Triticale: Example from the Amhara Region, Ethiopia. Utilization of Diversity in Land Use Systems: *Sustainable and Organic Approaches to Meet Human Needs*, University of Kassel, Germany Tropentag, October 9-11, Witzenhausen.

Asiabaka, C. C., & James, B. D. (1999). *Farmer Field Schools for Participatory Cassava Development in West Africa*, Margraf verlag.

Axinn, G. H. (1998). *Guide on alternative Extension Approaches*, FAO, Rome.

Babur D. E. (2009). Effectiveness of Farmer Field School in Promoting Coffee Management Practices: The Case of Jimma and Sidama Zones. Unpublished Masters Thesis. Haramaya University.

Baffes, J. (2003). Tanzania's Coffee Sector: Constraints and challenges in a Global Environment, Africa Regional Working Paper Series 56. World Bank. 57pp.

Bartlett, A. (2002). From Farmer Field School to Community IPM. Ten Years of IPM Training in Asia. FAO Community IPM Program, Jakarata.

Batz, F. J., Peter, K. J., & Janssen, W. (1999). The influence of technology characteristics on the rate and speed of adoption. *Agricultural Economics Journal* 21(2): 121-130.

Bebe, B. O., Udo, H. M. J., Rowlands, G. J., & Thorpe, W. (2003). Smallholder dairy systems in the Kenya highlands: Cattle population dynamics under increasing intensification. *Livestock Production Science,* 82: 211-221

Birkhaeuser, D., Evenson R., & Feder, G. (1991). "The Economic Impact of Agricultural Extension: a review." *Economic Development and Cultural Change*. 39(3).

Braun, A. & Duveskog, D. (2008). "*The Farmer Field School Approaches–History, Global Assessment and Success Stories*", background paper for the *IFAD Rural Poverty Report 2009*. Rome: IFAD.

Braun, A. (2006). *A Global survey and review of Farmer Field School experiences.* Wageningen, The Netherlands: Endelea.

Braun, A., Janice J., Niels R., Henk, V., & Paulsnijders, J. (2006). *Global Survey and Review of Farmer Field School Experiences:* Report prepared for the International Livestock Research Institute (ILRI), The Netherlands, Final Report June, 12.

Bunyatta, D. K. (2005). Farmer Field School as an Effective Approach for Disseminating Agricultural Technologies: Up-scaling Of Soil Management Technologies among Small-scale Farmers in Trans-Nzoia District, Kenya. Proceedings of the 21st Annual conference, San Antonio, TX, pages 515-525.

Byerlee, D. (1994). "*Technology Transfer Systems for Improved Crop Management*: Lessons for the Future". In J. Anderson, ed., Agricultural Technology: Policy Issues for International Community. Wallingford, UK: Cab International.

Central Bureau of Statistics. (2000). *The 1999 Population and housing Census volume 1*: Population distribution by administrative area and urban centres, Central Bureau of Statistics, Ministry of Finance and Planning, Nairobi, Kenya.

Chambers, R. (1993). *Rural development: Putting the last first*. London: Longman.

Chaves, B., & Riley, J. (2001). Determination of factors influencing integrated pest management adoption in coffee berry borer in Colombian farms. Agriculture, Ecosytems and Environment 87: 159-177.

Coffee Board of Kenya. (2001). Coffee Act, published by Kenya Government Printers, Nairobi.

Coffee Board of Kenya. (1998). *Coffee Market report,* published by Kenya Government Printers, Nairobi. *Nairobi*.

Coffee Directorate. (2015). Coffee Annual Report, published by Kenya Government Printers, Nairobi.

Coffee Research Foundation. (2014). Coffee Growers' Handbook. Minai, M.J. (ed).

Danida. (2011). *Evaluation of the farmer field school approaches in the agriculture sector programme support phase II, Bangladesh*. Evaluation Department, Ministry of Foreign Affairs of Denmark.

David, S., Agordorku, S., Bassanaga, S., Cowloud, J. Y., Kumi, M. A., Okuku, I. C., & Wandi, D. (2006). *A guide for conducting Farmer Field Schools in cocoa integrated crop and pest management*. Sustainable Tree Crop Pest Programme, International Institute of Tropical Agricultural. p. 102.

Diemijenyo, G. E. (2011). *Cocoa Farmers Assessment of the Perceived Costs/Benefits of Farmer Field School.*

Dilts, R. (1983). *Critical Theory*. *A Theoretical Foundation for Non- formal Education and Action Research*. Unpublished PhD. dissertation. Amherst (Mass): University of Massachusetts, Centre for Informal Education.

Doppler, W. (2001). Farming and rural systems approaches: lecturing material, University of Hohenheim. Stuttgart, Germany.

Duveskog, D. (2006). Theoretical Perspectives of the Learning Process in Farmer Field Schools. Food and Agricultural Organization of the United Nations. European Commission, December 2005.

Edwards, A.W. (2010). *Non Experimental Quantitative Research*. Columbus Ohio, USA.

Evenson, Robert, E., & Germano M. (1996). *Household Composition and Expenditures on Human Capital Formation in Kenya*, *Research in Population Economics*, 8, pp. 205-232.

FAO. (2017). Integrated Production and Pest Management Programme in Africa; Farmers Field School Approach. Retrieved from http://www.fao.org/agriculture/ippm/programme /ffs-approach/en/

FAO. (2011). *"Climate-Smart" Agriculture; Policies, Practices and Financing for Food Security, Adaptation and Mitigation.* FAO, Rome.

Feder, G., & Slade, R. (1984). The Acquisition of Information and the Adoption of New Technology, *American Journal of Agricultural Economics* (3):312-20.

Feder, G., Just, R. E., & Zilberman, D. (1984). *Adoption of agricultural innovations in developing countries: a survey.* Economic Development and Cultural Change 33 (2): 255-297.

Feder, G., Murgai, R., & Quizon, J. B. (2004). The acquisition and diffusion of knowledge: The case of pest management training in Farmer Field Schools. Indonesia. *Journal of Agricultural Economics, 55(2), 217-339.*

Fisher, D. K. (2000). *'Understanding technology adoption through system dynamics modelling: implication for agribusiness management'*, International Food and Agribusiness Management Review, vol. 3, no. 3, pp. 281-296.

Frankel, J. & Wallen, N. (2000). *How to design and evaluate research in education.* Boston, MA: McGraw-Hill Higher Education.

Free online dictionary. (2016). Retrieved from https://www.ldoceonline.com/dictionary/uptake. Accessed on 4 June 2016.

Frias, M., & Rolling, N. (2005). *Inventory and Evaluation of Farmer Field Schools in Zimbabwe*. Working Document. FAO Sub-Regional Office for Southern and East Africa. Harare, Zimbabwe.

Gall, M. D. & Borg, W. R. (2003). *Educational Research: An introduction 6th edition.* White Inc Plains NY:Longman.

Gallagher, K. (2000). *Community study programmes for integrated production and pest management: Farmer Field Schools.* FAO, Rome.

Gautam, M. & Anderson, J. (2000) "*Agricultural extension: the Kenya experience: An impact evaluation"*, Operations Evaluation Department, The World Bank, Washington, D.C.

Godtland. M. E., Sadoulet, de Janvry A., Murgai, R., & Ortiz, M. (2004). *The impact of Farmer Field School on Knowledge and Productivity: A study of Potato farmers in the Peruvian Andes*`.

Government of Kenya. (2010). *Agricultural Sector Development Strategy Medium-Term Investment Plan: 2010 –2015.* Government of Kenya, Nairobi.

Hakiza, J. J., Odogola, W., Mugisha J., Semana, A. R., Nalukwago J., Okoth, J., & Adipala, E. (2002). Challenges and Prospects of Disseminating Technologies through Farmer Field Schools: Lessons learned based on experience from Uganda. *Uganda Journal of Agricultural Sciences.*

International Food Policy Research Institute. (2005). *Women: The Key to Food Security: Looking into the Household.* Washington, DC: IFPRI. 2000. *Women: Still the Key to Food and Nutrition Security.* Report No. 3 3.Washington, DC: International Food Policy Research Institute.

International Fund for Agricultural and Development (IFAD). (1998). *International Fund for Agricultural and Development Report and Recommendation of the president on the Technical Assistance Grant to the FAO for East African sub-Regional pilot project for Farm Field School in Kenya.* Republic of Tanzania and Uganda, IFAD, Rome. p. 77.

Jaetzold, R., & Schmidt, H. (1995). *Farm Management Handbook of Kenya, Vol II. Natura Conditions and Farm Information Vol II/C.* Ministry Of Agriculture, Kenya and German Agricultural Team.

Jurgen, H., Chuma, E., Murwira, K., & Connolly, M. (2000). *Learning Together Through Participatory Extension.* A Guide to an Approaches Development in Harare: AGRITEX.

Karanja, A. M., & Nyoro J. K., (2002*). "Coffee Prices and Regulation and their Impact on Livelihoods of Rural Community in Kenya"*, Tegemeo Institute of Agricultural Policy and Development, Egerton University, Kenya.

Kathuri, N. J., & Pals, A.D. (1993). *Introduction to educational research*. Njoro; Kenya Egerton Education Media Centre.

Khandker, S., Begum, K., Hasan, N., Sarker, S. C. Asaduzzaman, M. & Bhuiyan, M. H. (2014). Adoption of Salt tolerant variety in the Coastal areas of Bangladesh. *App. Sci. Report.* 8 (1), 2014: 13-20

Kibbet, J. K., Omunyinyi, M. E., & Muchiri, J. (2005). Elements of Agricultural Extension Policy in Kenya. Challenges and Opportunities. African Crop Science Conference Proceedings. 7: 1491 - 1494.

Kolb, D. (1984). Experiential Learning. New Jersey, Prentice Hall, Inc.

Lattimore, D. (1986). *Water management: Problem and potential for communication in technology transfer in KC Nobe and RK Sampath* (Eds.). Irrigation management in developing countries: Current issues and approaches. Colorado, U.S.A: Westview press.

Livestock Development Group (LDG). (2004). *Receptors, end users and providers: The deconstruction of demand-led processes and knowledge transfer in Animal Health Research.* Livestock Development Group. School of Agriculture Policy and Development. The University of Reading, UK.

Loevinsohn, M., Meijerink, G., & Salasya, B. (2000). Integrated Pest Management in Smallholder Farming Systems in Kenya: evaluation of a pilot project. Global IPM Facility.

Long, N. (1986). *Encounters at the Inference: A perspective on Social Discontinuities in Rural Development.* Wageningen Agricultural University, The Netherlands.

Max, N. A. (2015). Effect of Farmers Socio-economic Towards Adoption Level of Agricultural
Technology in Sigi Regency Indonesia. *Journal of Applied Sciences*, 15: 826-830.

Madhur, G. (2000). *Agricultural Extension: The Kenya Experience, an Impact Evaluation.* Washington DC. The World Bank, February (1999).

Malinen, A. (2000). Towards the Essence of Adult Experiential Learning. Finland: SoPhi Academic Press.

Matata, J. B. W., & Okech, A. G. O. (1998). *Promising and New Approaches*. Draft Report on New and Adapted Field Approaches in Kenya.

Maunder, A. H. (1973). *Agricultural Extension*: Reference Manual. FAO: Rome.

Mezirow, J. (2000). ''Learning to think like an adult. Core concepts of transformation theory.'' In J. Mezirow and Associates (eds.), Learning as Transformation: Critical

Perspectives on a Theory in Progress (pp. 3–33). San Francisco, California: Jossey-Bass.

Minjauw, B., Muriuki, H.G,. & Romney, D. (2002). *Development of the Farmer Field School Approach for Smallholder Dairy Farmers in Kenya.* Paper presented at International Learning Workshop on Farmer Field Schools (FFS): Emerging Issues and Challenges, 21-25 October 2002, Yogyakarta, Indonesia.

Ministry of Agriculture. (2002). *National Agricultural Extension, policy of the republic of Kenya. Kilimo house.* Nairobi, Kenya.

Ministry of Agriculture. (2006). *Farm Management Hand book of Kenya Vol. II-Natural conditions and Farm management information, 2nd Edition, Central Province.* Kilimo House, Nairobi, Kenya.

Ministry of Agriculture. (2012). *National Agricultural Sector Extension Policy of the Republic of Kenya*. *Kilimo house.* Nairobi, Kenya.

Ministry of Agriculture and Livestock Development. (2004). *Strategy for Revitalizing Agriculture*. Ministry of Agriculture and Livestock Development. Agricultural Information Centre.

Ministry of Agriculture and Livestock Development. (2001). *National Agriculture and Livestock Extension Programme (NALEP).* An implementation framework, Kilimo House, Nairobi, Kenya.

Mugenda A. G., & Mugenda O.M. (2003). *Research Approaches, Quantitative and Qualitative approaches.* Acts Press, Nairobi.

Mugwe, J. W. (2014). Factors Influencing Coffee Production by Small Scale Farmers: A Case of Tetu Constituency, Kenya. Unpublished Masters Thesis. University of Nairobi, Kenya.

Mutandwa, E. & Mpangwa, J. (2004). *An Assessment of the impact of Farmer Field Schools on Integrated Pest Management Dissemination and use: Evidence from smallholder cotton farmers in the lowveld areas of Zimbabwe*. Journal of Sustainable Development in Africa, 6(2), 24-31.

Mwaura, F. (2014). Effect of Farmer Group Membership on Agricultural Technology Adoption and Crop Productivity in Uganda. African Crop Science Journal, Vol. 22, Issue Supplement s4, pp. 917 - 927

Mweri, A. (2001). Farmer field schools (FFS): Experience from Kenya. In P. Anandajayasekeram et al. (Eds.), Farmer field schools: Synthesis of experiences and lessons from FARMESA member countries. Harare, Zimbabwe: FARMESA.

Ndunguru, P. C. (2007). *Lectures on Research Approach for Social Sciences*; Research Information and Publications Department, Mzumbe University, Morogoro. 156pp.

Nederlof, S. & Odonkor, E. (2006). *Lessons from an experiential learning process: The case of cowpea Farmer Field Schools in Ghana.* The Journal of Agricultural Education and Extension 12(4): 249-271. DOI 10.1080/13892240601062447.

O'Connor, T. (2000). Research approaches. *Ncwe.educ/toconnor/308/308lect0.7htm.*Viewed on 6th October, 2015.

Ogunfiditimi, T.O., & Ewuola, S. O. (1995). *The Synthesis of Corporative Agricultural Extension Systems.* Emmi Press Ltd. Ibadan, Nigeria. pp 205.

Onyango, C. A. (1987). *Making extension effective in Kenya: The District Focus for Rural Development,* Egerton College,Njoro,Kenya.

Piccioto, R. T., & Anderson, J. (1997). "*Reconsidering Agricultural Extension*." World Bank Research Observer. 12(2).

Potinus, J., Dilts, R., & Bartlett, A.(Eds). (2002*). From Farmer Field School to Community IPM. Ten years of IPM training in Asia Bangkok,* FAO Regional office for Asia and the Pacific.

Quisumbing, A. L., Brown, H. S., Feldstein, L., Haddad & Pena, C. (1995). *Women: The Key to Food Security.* Report No. 21. Washington, DC: International Food Policy Research Institute.

Quizon, J.B., Rola, A. C., & Jamais, S. B. (2002). *Do farmer field school graduates retain and share what they learn? An investigation in Iloilo, Philippines.* Journal of International Agricultural Extension and Education, 9 (1), 65-74.

Rees, D., Momanyi, M. & Musembi, F. (2000). *Agricultural Knowledge and Information Systems in Kenya – Implications for Technology Dissemination and Development.* Overseas Development Institute, *AGREN Network Paper* No. 107, July.

Republic of Kenya. (2016). Report of the National Task Force on Coffee Sub-Sector Reforms. Nairobi. Government Printer.

Rice, R. (2003). *Coffee production in a time of crisis: Social and environmental connections. SAIS Review* 23(1):221–245.

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). New York: Free Press.

Rogers, E. M. & Shoemaker, F.F. (1995). *Communication of innovations: Across cultural approaches.* pp. 1-19. The Free Press. New York, USA.

Rola, A., & Jamias, S. (2002). Do Farmer Field School Graduates Retain and Share what they Learn? An Investigation in Iloilo, Philippines. *Journal of International Agricultural and Extension Education 9, 65-76.*

Rola, A. C., Quison, J. B., Jamais, S. B., Paunlagai, M. M., & Provido, Z. S. (2005). *An Evaluation of the IPM-FFS Knowledge Diffusion*. A case study of Iloilo. World Bank up Los Barrios Foundation, Inc. Los Barrios College, Laguna, Philippines. p. 54.

Rola, A. C. (1998). *Making farmers better decision makers through FFS.* Seasmeo Regional Centre for graduate study and Research in Agriculture. University of the Phillipines at Los Banos College,Inguna,Phillipines, 4031.

Rosenberg, N. (1995). *Inside the Black Box: Technology and Economics.* New York: Cambridge University Press.

Scarborough, V., & S. Kilough. (1997). *Farmer Led Extension: Concepts and Practices.*

Sen, A. (1990). "Gender and Cooperative Conflicts." In *Persistent Inequalities,* edited by I. Tinker, 123–150. New York: Oxford University Press.

Shinde, P.S., Bhople, P. P., & Valeker, R. B. (2000). Factors Associated with Knowledge Status of Rabi Jowar Growers. Number 12-13, *Rajasthan journal of Extension Education,* 2004-05, pp 37-41.

Simpson, B. M. (2001). *IPM Farmer Field Schools and Local Institutional Development: case studies of Ghana and Mali,* FAO, Rome.

Simpson, B. M. & Owens, M. (2002). *Farmer Field Schools and the future of agricultural extension in Africa.* Proceedings of the Annual Conference of the Association for International Agricultural Extension and Education, 18, 405-412.

Sinja, J., Karugia, J., Waithaka, M., Miano, D., Baltenweck, I., Franzel, S., Nyikal, R & Romney, D. (2004). Adoption of Fodder Legumes technology through Farmer-to-Farmer extension approaches. *Uganda Journal of Agricultural Sciences* No. 9.

Sustainable Tree Crops Programme, Nigeria. (STCP). (2006). *Cocoa Farming Communities lead Extension Delivery in Cross River State*. Retrieved from http://www.world cocoafoundation.org/difference/stcp.Nigeria Success-story.asp.

Swanson, B. E. & Claar, J. B. (1984). *The History of Development of Agricultural Extension.* A Reference Manual. FAO: Rome.

Tai, D. A. (2004). *Family Resources and their impact on Living Standard and Food Security of Farmers in the Mountainous Farming Systems in Northwest Vietnam:* Vol 53. Margraf Verlang Weikersheim.

Tsion Tesfaye. (2008). Effectiveness of Training Offered by Ethiopian Institute of Agricultural Research to Farmers: The Case of Holeta, Melkasa and Debrezeit Agricultural Research Centers. M.sc Theses Haramaya University of Agriculture, Haramaya.

Wai, K. L. (2009). *Cross-Cultural Challenges for Information Resources Management. Univer*-sity of Guam, Guam.

Wambugu, M. N. (1999). Extension *and its effects on dairy cow nutrition and productivity in smallholder dairy cow enterprise in Kiambu District*. MSc Thesis, University of Nairobi, Kenya.

World Bank Operations Evaluation Department (WB-OED). (1999). *The précis: Agricultural Extension. The Kenya Experience.* Number 198.

World Bank. (2008). *World Development Report 2008; Agriculture for Development. World Bank publications, 2007.* New York: Oxford University Press.

World Bank. (2010). Agricultural Technology and Agribusiness Advisory Services Project. Agriculture and Rural Development African Region. Kampala, Uganda.

APPENDICES

A. Interview Schedule for Farmers

Letter of Transmittal

Jonathan M Luusa,
Coffee Research Institute,
P.O. Box 4-00232, Ruiru.
Cell No: 0721 479961/ 0734721393
Email: j_luusa@yahoo.com

Dear Respondent,

I am a post-graduate student of Egerton University; currently conducting a research entitled "Effectiveness of Farmer Field Schools in Promoting Adoption of Best Agricultural Practices by Smallholder Coffee Farmers in Kenya". You have been selected to assist in providing the required information, as your views are considered important to this study.

I am therefore kindly requesting you to fill this interview schedule. Please note that all information provided will be treated with utmost confidentiality and will only be used for the purposes of this study.
Thank you.

Jonathan M Luusa.

Section A: .General information of the Respondent

(Tick appropriately)

1. Date of interview…….

2. Gender of respondent: Male ☐ 1 Female ☐ 2

3. Age of respondent in years: Below 35 ☐ 36-55 ☐ 56-65 ☐ Over 66 ☐

4. Marital status: Widow ☐ Married ☐ Single ☐ No response ☐

5. Highest educational level: None ☐ Lower primary ☐ Upper-primary ☐ Secondary ☐ Tertiary ☐

6. Do you belong to an FFS class? Yes ☐ No ☐

7. What is the name of your FFS class? Kikai ☐ Muvuti ☐ Mukiria ☐ Kabati ☐ None ☐

8. What is your main occupation? Farmer ☐ Teacher ☐ Civil servant ☐ Small business ☐ other ☐ (specify)…….

9. What is your major source of income? Off-farm employment ☐ Farming ☐ Other ☐ (specify) ……

Section B: Uptake of Best Agricultural Practices

(Tick appropriately against the options)

No.	Practice learned from coffee FFS	Uptake	Non-Uptake
10	Proper field preparation and coffee establishment		
11	Application of weed management strategies		
12	Application of fertilizers and organic manures for improved production and quality		
13	Proper canopy management to maintain the growth vigor of the coffee plant		
14	Use of certified planting materials (seedlings)		
15	Use of mulch and shade trees for soil and moisture conservation among others		
16	Application of Integrated Pest Management (IPM) strategies in the control of coffee insect pests		
17	Application of cultural management strategies for control of Coffee Berry Disease & Coffee Leaf Rust		
18	Top-working traditional varieties (SL) into disease resistant Varieties (Ruiru 11 and Batian)		
19	Timely and selective picking of red-ripe cherry		

Section C: Sharing of Knowledge

20. Have you been involved in sharing of knowledge on coffee Best Agricultural Practices with other farmers?

Yes ☐ No ☐

21. Please indicate the number of farmers with whom respective nature of knowledge was shared out.

No.	Nature of knowledge shared	No. of farmers knowledge shared with
22.	Proper field preparation and coffee establishment	
23.	Application of weed management strategies	
24.	Application of fertilizers and organic manures for improved coffee productivity and quality	
25.	Proper canopy management to maintain growth vigour	
	Use of certified planting materials (seedlings)	
27.	Use of mulch and shade trees for soil and moisture conservation	
28.	Application of Integrated Pest Management (IPM) Strategies in the control of coffee insect pests	
29.	Application of cultural practices in the management of Coffee Berry Disease & Coffee Leaf Rust	
30.	Top-working traditional Varieties (SL) into disease resistant Varieties (Ruiru 11 and Batian)	
31.	Timely and selective picking of red-ripe cherry	

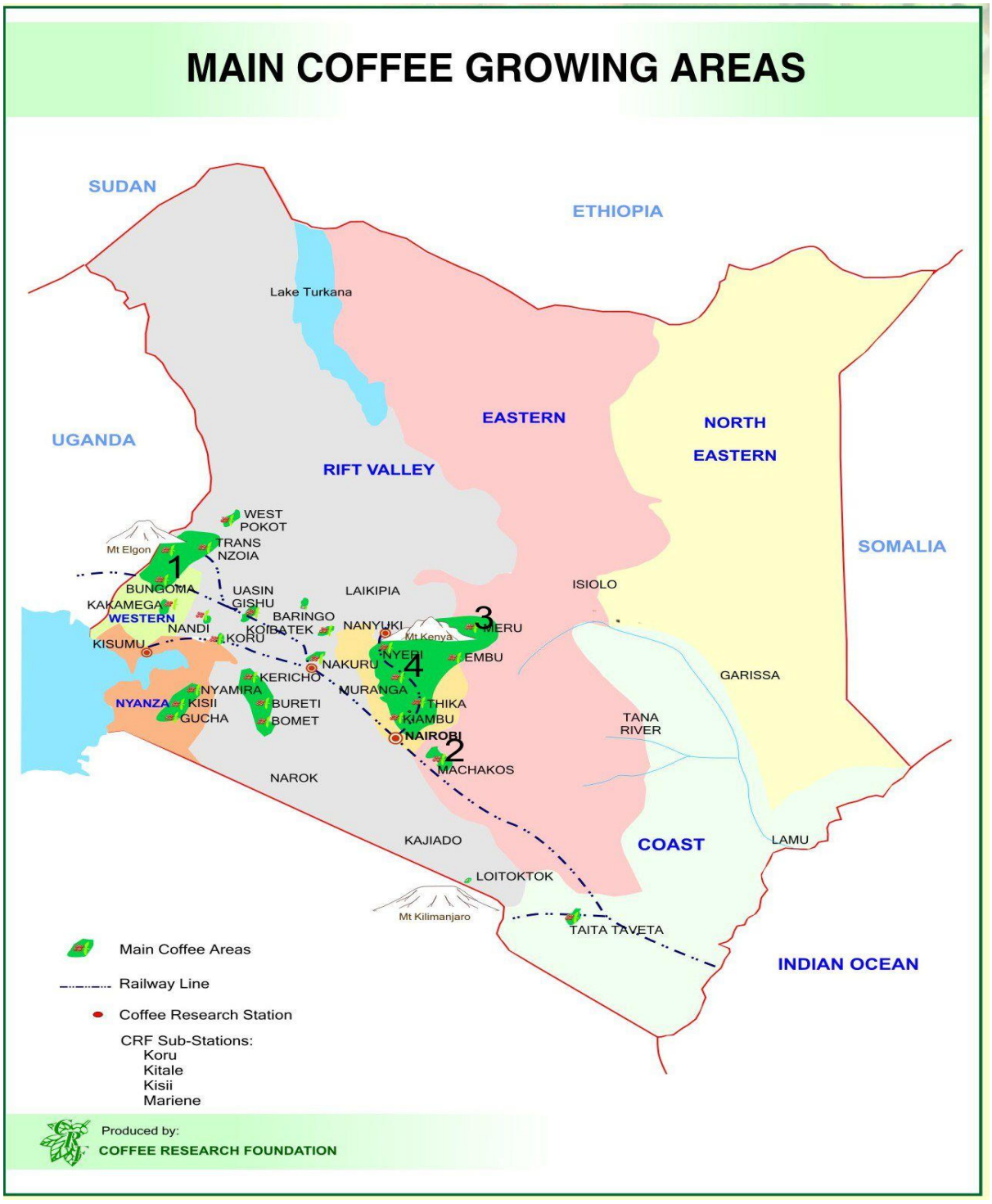
Section C: Coffee Yields

(Fill in the figures appropriately)

No	Coffee year	No. of mature coffee trees	Quantity of cherry (Kgs)	Production per tree (Kgs.)
32.	2008/2009			
33.	2009/2010			
34.	2010/2011			
35.	2011/2012			
36.	2012/2013			
37.	2013/2014			

I wish to thank you for finding time to respond to the questions. I wish you success in your farming activities.

B: Map of Kenya Showing the FFFS Pilot Project sites



Source: Coffee Research Foundation

Key:

1. Kikai FFS (Bungoma)
2. Muvuti FFS (Machakos)
3. Mukiria FFS (Meru)
4. Kabati FFS (Muranga)

C: NACOSTI Research Authorization

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone: 020 400 7000,
0713 788787,0735404245
Fax: +254-20-318245,318249
Email: dg@nacosti.go.ke
Website: www.nacosti.go.ke
When replying please quote

NACOSTI, Upper Kabete
Off Waiyaki Way
P.O. Box 30623-00100
NAIROBI-KENYA

Ref: No. **NACOSTI/P/18/80342/21157** Date: **20th February, 2018**

Jonathan Muisyo Luusa
Egerton University
P.O. Box 536-20115
EGERTON.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Effectiveness of farmer field school training in promoting adoption of best agricultural practices by smallholder coffee farmers in Kenya"*** I am pleased to inform you that you have been authorized to undertake research in **Bungoma, Machakos, Meru & Muranga Counties** for the period ending **20th February, 2019.**

You are advised to report to**, the County Commissioners and the County Directors of Education, Bungoma, Machakos, Meru & Muranga Counties** before embarking on the research project.

Kindly note that, as an applicant who has been licensed under the Science, Technology and Innovation Act, 2013 to conduct research in Kenya, you shall deposit **a copy** of the final research report to the Commission within **one year** of completion. The soft copy of the same should be submitted through the Online Research Information System.

GP Kalerwa
GODFREY P. KALERWA MSc., MBA, MKIM
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioners
Nakuru County.

The County Commissioners
Nakuru County.

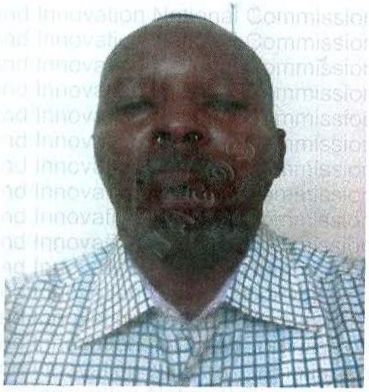
THIS IS TO CERTIFY THAT:
MR. JONATHAN MUISYO LUUSA
of EGERTON UNIVERSITY, 4-232 RUIRU,has been permitted to conduct research in *Bungoma , Machakos , Meru , Muranga Counties*

on the topic: *EFFECTIVENESS OF FARMER FIELD SCHOOL TRAINING IN PROMOTING ADOPTION OF BEST AGRICULTURAL PRACTICES BY SMALLHOLDER COFFEE FARMERS IN KENYA*

for the period ending:
20th February,2019

.....
Applicant's Signature

Permit No : NACOSTI/P/18/80342/21157
Date Of Issue : 20th February,2018
Fee Recieved :Ksh 1000



.....
Director General
National Commission for Science, Technology & Innovation