ANALYSIS OF COMMUNICATION AND DISSEMINATION CHANNELS INFLUENCING UPTAKE OF INTEGRATED SOIL FERTILITY MANAGEMENT AMONG SMALLHOLDER FARMERS IN WESTERN KENYA

IVAN ADOLWA SOLOMON (A56/71745/2008)

THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE MASTER OF SCIENCE DEGREE IN AGRICULTURAL INFORMATION AND COMMUNICATION MANAGEMENT

DEPARTMENT OF AGRICULTURAL ECONOMICS, UNIVERSITY OF NAIROBI

2011

DECLARATION

I, Ivan Adolwa Solomon, declare that this thesis is my original work and has not been presented for a degree in any other university or any other award.

Ivan Adolwa Solomon

Signature _____ Date 11/07/2011

This thesis has been submitted with our approval as supervisors

Supervisors:

1) Dr. Mbithi R. Mulwa (University of Nairobi)

Signature _____ Date 11/07/2011

2) Dr. Peter Okoth (TSBF-CIAT)

Signature _____ Date 12/07/2011

3) Dr. Anthony O. Esilaba (Kenya Agricultural Research Institute)

Signature _____ Date 13/07/2011

DEDICATION

This work is dedicated to my parents David and Janet Adolwa who have always encouraged and supported me. Secondly, to my Aunt Rose who believed and invested in me. Lastly, to my younger brothers - Justin, Joe and Dan - who look upon me and whom I hope to inspire.

ACKNOWLEDGEMENTS

I take this opportunity to thank TSBF-CIAT through objective 5 of the African Soil Information Service (AfSIS) project for funding this research. Many thanks also go to my supervisors Dr. Mulwa, Dr. Okoth and Dr. Esilaba for their guidance and input. I am very grateful to Dr. Okoth, the principal investigator of objective 5, who was very instrumental in enabling me to obtain the requisite funding for this study. My gratitude also goes to CIAT for lending support to my studies through the Human Resource Development Fund (FDRH). I sincerely thank Helen for bringing to my attention the existence of this course and all my other colleagues namely Boaz, Mairura, and Liz for whatever support they may have lent me in the course of my studies. Special thanks also go to Mugambi who greatly assisted in the sampling process. I am also appreciative of the work carried out by the enumerators namely Gideon, Albert, Isaac and Odhiambo, and the cooperation received from the farmers.

ABSTRACT

Lack of access to timely and accurate information has been identified as a major impediment to the development of rural agriculture in Kenya impacting negatively on agricultural producers resulting in high poverty levels. Nyanza and Western provinces in western Kenya are among the poorest with poverty levels of 65% and 61%, respectively. This study was carried out to evaluate the existing information/knowledge communication and dissemination channels, and assess the influence of these channels on uptake of Integrated Soil Fertility Management (ISFM) knowledge among smallholder farmers in western Kenya. Structured questionnaires were administered to 120 farmers from Vihiga and Siaya districts. In Vihiga, farmers were sampled in a systematic random manner from available lists of participant and non-participant farmers, whereas in Siaya, farmers were selected based on randomly selected diagnostic trial sites of the Africa Soil Information Service (AfSIS) project. Community-based channels were found to be significantly advantageous. Farmers' preferred information source, channel and knowledge source were own experience, farmer field days and farmer groups respectively. A probit regression indicated that off-farm income, education level, distance from nearest information centre, livestock value, and district of residence were the socio-economic variables that significantly influenced farmer access and uptake of ISFM knowledge. In conclusion, farmer field days and farmer groups should continue to be promoted as vehicles of information dissemination and communication. Investing in education and information centres as well as using ICTs to complement community-based channels will bolster farmer access to ISFM information and knowledge.

Keywords: ISFM, information, knowledge, dissemination, communication, channels

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS AND ACRONYMS

AfNet	African Network for Soil Biology and Fertility
AfSIS	Africa Soil Information Service
ANOVA	Analysis of Variance
CBOs	Community-based organizations
CDF	Cumulative Distribution Function
EASSy	East African Submarine Cable System
FFS	Farmer Field Schools
IARCs	International Agricultural Research Centres
ICRAF	International Centre for Research in Agroforestry
ICTs	Information Communication Technologies
ISFM	Integrated Soil Fertility Management
KARI	Kenya Agricultural Research Institute
MICs	Market Information Centres
N	Nitrogen
NARES	National Agricultural Research and Extension Systems
NGOs	non-governmental organizations
P	Phosphorus
RKCs	Rural Knowledge Centres
SSA	sub Saharan Africa
TSBF-CIAT	Tropical Soil Biology and Fertility Institute of the International Centre for Tropical Agriculture

CHAPTER 1

INTRODUCTION

1.1 Background Information

Agriculture is the backbone of the economies of most sub-Saharan (SSA) countries and constitutes about 60% of the total labour force, 20% of the total exports and 17% of the Gross Domestic Product (Asaba *et.al.,* 2006). In Kenya, the agricultural sector accounts for 26% of the Gross Domestic Product (GDP) and 60% of export earnings with 80% of the population depending directly or indirectly on it (Brooks *et.al.,* 2009; Kledal *et.al.,* 2009).

However, agricultural production particularly among smallholder farmers has been severely curtailed by a number of factors. Key among them is the problem of poor soil fertility, which has long affected the productivity and livelihoods of smallholder farmers in Africa.

Although agricultural production over the last 50 years in SSA countries has been on the rise, this growth has been very slow compared to other developing regions of the world i.e. Latin American & Carribean (LAC) and Asia (Figure 1.1).

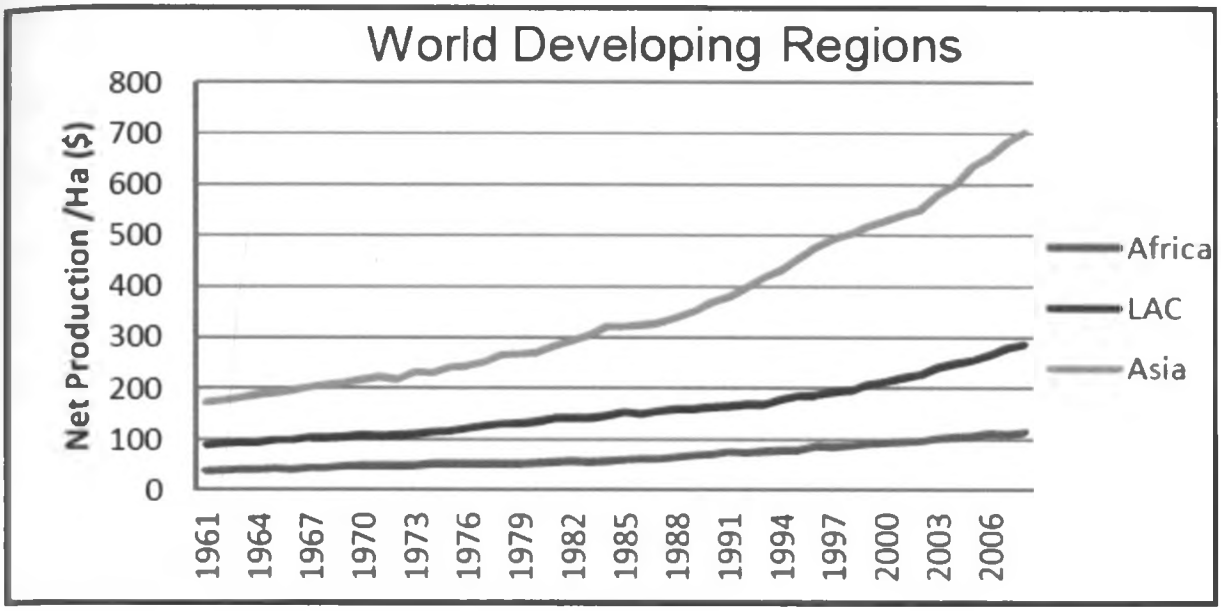

Figure 1.1 Net production in developing regions (Livingston *et.al.*, 2011)

Agriculture productivity in Kenya has been increasing steadily albeit slowly but this is still inadequate considering that production in Malawi has been increasing at a very rapid rate (Figure 1.2).

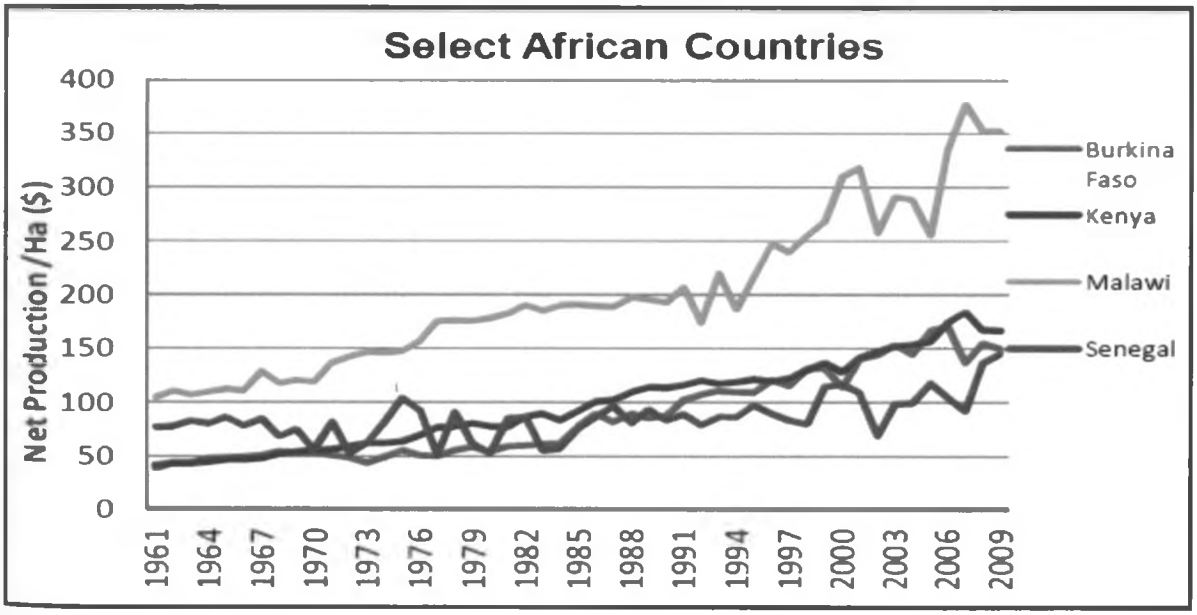

Figure 1.2 Net production in selected African countries (Livingston *et.al.*, 2011)

The decline of soil fertility in smallholder farming systems of SSA and western Kenya in particular, is the greatest biophysical constraint to increasing agricultural productivity and a major threat to food security (Kiptot, 2008; Okeyo *et.al.,* 2006; Odendo *et.al.,* 2006; Sanchez *et.al.,* 2009). Maize is one of the crops of interest to food security as it is the main staple food for most Kenyan households (Mulwa *et.al.,* 2009). Per capita food production in Africa has been declining over the past two decades, contrary to the global trend, with the annual cereal deficit in sub-Saharan Africa (SSA) amounting to 100 million tonnes (Bationo *et.al.,* 2007). Kiptot (2008) reported that 89.5% of farmers in western Kenya had food deficiency and only 8.9% were food secure. Depletion of soil fertility is one of the major causes of low per capita food production and food insecurity in smallholder farms in Africa (Sanchez *et.al.,* 2009). Consequently, various actors in the agricultural sector have come up with an array of strategies aimed at disseminating and communicating soil fertility technologies developed over the years.

Integrated Soil Fertility Management (ISFM) technologies have been promoted by research agencies such as the Tropical Soil Biology and Fertility Institute of the International Centre for Tropical Agriculture (TSBF-CIAT), Kenya Agricultural Research Institute (KARI) and the International Centre for Research in Agro-forestry (ICRAF), to address the problem of soil fertility in western Kenya. ISFM entails the judicious use of fertilizer, organic inputs and improved germplasm, combined with the knowledge on how to adapt these practices to local conditions to maximize agronomic use efficiency of the applied inputs (Vanlauwe *et.al.,* 2010).

ISFM practices have been disseminated and communicated in western Kenya using various approaches. In 2001 TSBF-CIAT initiated the Strengthening "Folk Ecology" (SFE) project that promoted community-based learning approaches and farmer-led experimentations to communicate and disseminate ISFM practices, aimed at reducing communication gaps between

scientists and farmers (Ramisch *et.al.,* 2006). This entailed the use of community-based channels like Farmer Field Schools (FFS) and use of participatory demonstration plots. FFS methodologies were used in Vihiga, Busia, and Teso districts of western Kenya to demonstrate some ISFM technologies such as the use of organic/inorganic fertilizers (Ramisch, 2004). Since then, other community-based channels like farmer groups and field days have been used by TSBF-CIAT to promote ISFM practises. Field days, farmer groups, and cross-site visits were utilized in Vihiga and Busia districts to disseminate and communicate the use of improved soybean varieties e.g. TGX 1831-32E, improved maize varieties (e.g. IR), biomass transfer, and best-bet legume rotations and intercrops using mucuna, soybean and yellow grams (Vanlauwe *et. al.,* 2004). Local interpersonal channels such as the use of songs and poems were also utilized. Songs and poems have been written on the management of nitrogen, phosphorus and *Striga* as well as the use of organic resources (Vanlauwe *et.al.,* 2004). These efforts, however, did not lead to widespread adoption of ISFM due to the following reasons: i) FFS were thought to be too curricula-based hence in-effective in building farmers' understanding of ISFM; ii) unsustainable production of dynamic expertise itself; iii) downplaying of the experimentation process in farmer-to-farmer instruction; iv) inavailability of new knowledge, resources, and contacts with outsiders; v) the necessity to go beyond comparing technologies from demonstration plots and; vi) enhanced in-group morale and cohesion had limited impact on wide-scale adoption of ISFM (Ramisch *et.al.,* 2006; Tittonnel *et.al.*, 2008).

Hence, so far little attention has been given to farmer preference for certain channels of receiving ISFM information and knowledge, and socio-economic factors influencing access to information/knowledge. Yet this is important if these farmers are to be empowered to make their own choices and decisions in relation to the adoption and use of ISFM practices.

1.2 Statement of the Problem

The communication and dissemination of information on knowledge-intensive ISFM technologies has proved challenging as transfer of technical knowledge from scientists to farmers is difficult. Thus there exists a considerable amount of information from research activities in Western Kenya but this is not easily available, and in most cases its outdated and unreliable (Rege, 2006; Sanginga and Woomer, 2009). Indeed low adoption of ISFM has been attributed to lack of awareness of the technologies exacerbated by the wide communication gaps between researchers and farmers (Damisa and Igonoh, 2007; Odendo *et.al.,* 2006) Consequently, ISFM knowledge has not been optimally used to solve soil fertility management problems.

Poor communication as a result of uncoordinated channels of information delivery to farmers has been a major deterrence to information flow between researchers and farmers (Rees *et.al.*, 2000). Existing channels have not been used in context with social system through which ISFM is supposed to diffuse or spread thus rendering them in-effective. The channels have also not been carefully assessed for strengths and weaknesses so that they are more appropriately utilized. This has led to low farmer awareness of ISFM practices, resulting in soil degradation and low agricultural productivity. Hence, the prevailing situation whereby farmers do not access accurate ISFM information relevant to their needs has been one of the causes of food insecurity. This study seeks to assess communication and dissemination channels and factors influencing farmer access to ISFM information/knowledge and its uptake.

1.3 Purpose and Objectives

1.3.1 Purpose

The purpose of this study is to evaluate the existing communication and dissemination channels, and assess the influence of these channels on uptake of ISFM knowledge among smallholder farmers in western Kenya.

1.3.2 Specific Objectives

The specific objectives are:

- To evaluate the existing ISFM communication and dissemination channels with a view to analyzing their strengths or weaknesses.
- To identify preferred sources and channels of ISFM information and knowledge among smallholder farmers in western Kenya.
- To determine how a farmer's socio-economic disposition affects his/her information access, utilization and the eventual implementation of ISFM practices.
- To evaluate the role of extension agents and researchers in disseminating and communicating ISFM knowledge to smallholder farmers.

1.4 Research Questions

i. Are the existing communication and dissemination channels effective in imparting ISFM knowledge?

ii. Which sources and channels do smallholder farmers prefer to use in acquiring information on ISFM?

iii. Does a farmer's socio-economic disposition affect his/her access to ISFM information, its usage and how they implement ISFM practices?

iv. What is the role of extension agents and researchers in disseminating and communicating ISFM information/ knowledge to smallholder farmers?

1.5 Research Hypotheses

The following hypotheses were tested:

- Existing communication and dissemination channels are not adequate and effective in imparting ISFM technologies.
- Farmers only prefer traditional, local (or localite) interpersonal channels of ISFM information and knowledge.
- Socio-economic factors have no influence on farmers' access to ISFM information and knowledge and its uptake.

1.6 Significance of the Study

The results emanating from this study provide useful insights to agricultural stakeholders in the country on how to implement effective communication strategies. The study sheds light on the communication gaps existing between researchers and extension agents on one hand and farmers on the other. Hence, this study aids in providing information on appropriate dissemination and communication channels that can be utilized by extension agents and researchers to disseminate and communicate ISFM information. Additionally, smallholder farmers in Western Kenya stand to benefit when these communication gaps are dealt with consequently enabling them to utilize ISFM knowledge in addressing various soil fertility management problems.

1.7 Scope and Limitations of the Study

The study covers two counties or districts located in the western region of Kenya. Therefore, the information collected reflected attributes that may be unique to the region covered. For instance, socio-economic characteristics of farmers from central Kenya may differ from those of the western region.

CHAPTER 2

LITERATURE REVIEW

2.1 Overview of ISFM

ISFM has been defined as a set of soil fertility management practices that include the use of fertilizer, organic inputs and improved germplasm, combined with the knowledge on how to adapt these practices to local conditions (Vanlauwe *et.al.*, 2010). The practices are aimed at maximizing agronomic use efficiency of the applied nutrients and improving crop productivity, and all inputs need to be managed in accordance with sound agronomic principles (Vanlauwe *et.al.*, 2010).

Figure 2.1 graphically presents this definition by showing the relationship between agronomic efficiency of fertilizer and organic resources (i.e. animal manure, mulching, green manures), complemented with the application of various components of ISFM that leads to the eventual adoption of 'the complete ISFM' paradigm. In this paradigm; improved germplasms, mineral fertilizers, organic resources and their management are utilized in conjunction with local adaptation. Current practice is taken to mean the use of the current average fertilizer application rate in SSA of 8 kg fertilizer nutrients ha^{-1} (Alley and Vanlauwe., 2009).

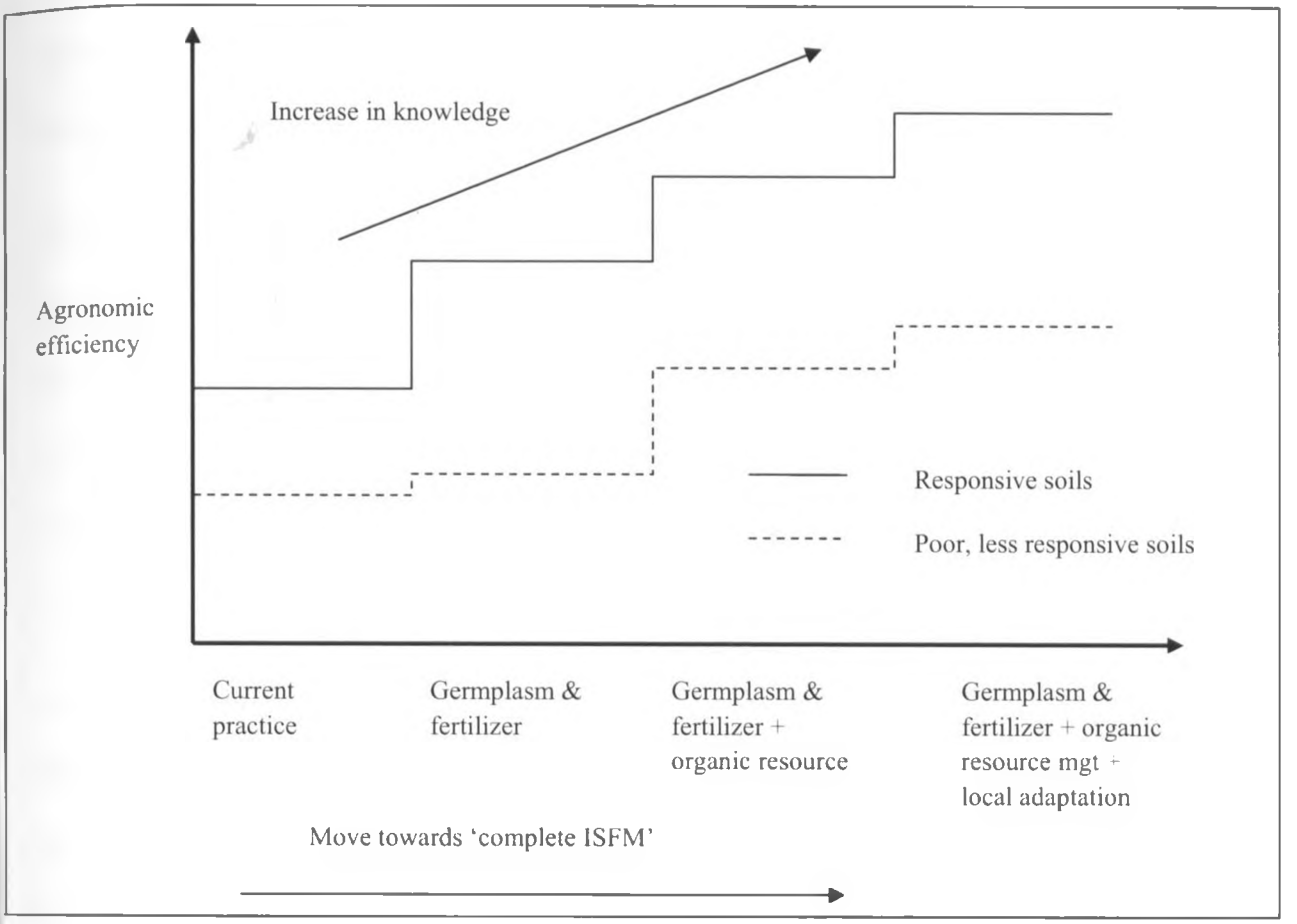

Figure 2.3 Conceptual relationship between agronomic efficiency and the different components of ISFM (adopted from Vanlauwe *et.al.*, 2010)

Central to the ISFM paradigm is the realization that no single component of soil fertility management can on its own lead to sustainable soil fertility management (Vanlauwe, 2004; Marenya & Barrett, 2007). The ISFM concept is knowledge-driven rather than being input-intensive and is aimed at raising both soil and crop productivities with the added benefit of maintaining the natural resource base (Tittonnel *et.al.*, 2008). ISFM aims to a) replenish soil nutrient pools, b) maximise on-farm recycling of nutrients, c) reduce nutrient losses to the

environment, d) improve the efficiency of external inputs, e) to make use of local, traditional and scientific knowledge, and integrating these into technologies that enable sustainable natural resource management.

According to Place et al. (2003), ISFM is about expanding the choice set of farmers by increasing their awareness of the variety of options available and how they may complement or substitute each other. ISFM has been adopted by the Tropical Soil Biology and Fertility Institute of CIAT (TSBF-CIAT), its African Network (AfNet), and various other organizations as the paradigm for tropical soil fertility management research and development (Vanlauwe, 2004).

Vanlauwe *et.al.* (2004) have outlined various ISFM practices developed, evaluated, disseminated and communicated by TSBF-CIAT and its partners in western Kenya. They include: 1) screening of dual-purpose promiscuous soybean varieties in Emunyonyi, Vihiga District, for the effect of phosphorus fertilizer on their nodulation, biomass production and grain yield; 2) quantifying the contribution of legumes (soybean, pigeon pea, groundnut, beans, lablab) to a subsequent maize crop in Vihiga, Kakamega and Bondo districts; 3) quantifying the contribution of tillage (conventional and minimum), legume rotations and intercrops, and crop residue management to crop production and soil fertility status in Nyabeda, Siaya district and; 4) demonstrating best-bet legume rotations and biomass transfer to farming communities in Muyafwa, Busia district and Emunyonyi. These and other ISFM technologies have been developed and disseminated in western Kenya (Figure 2.4).

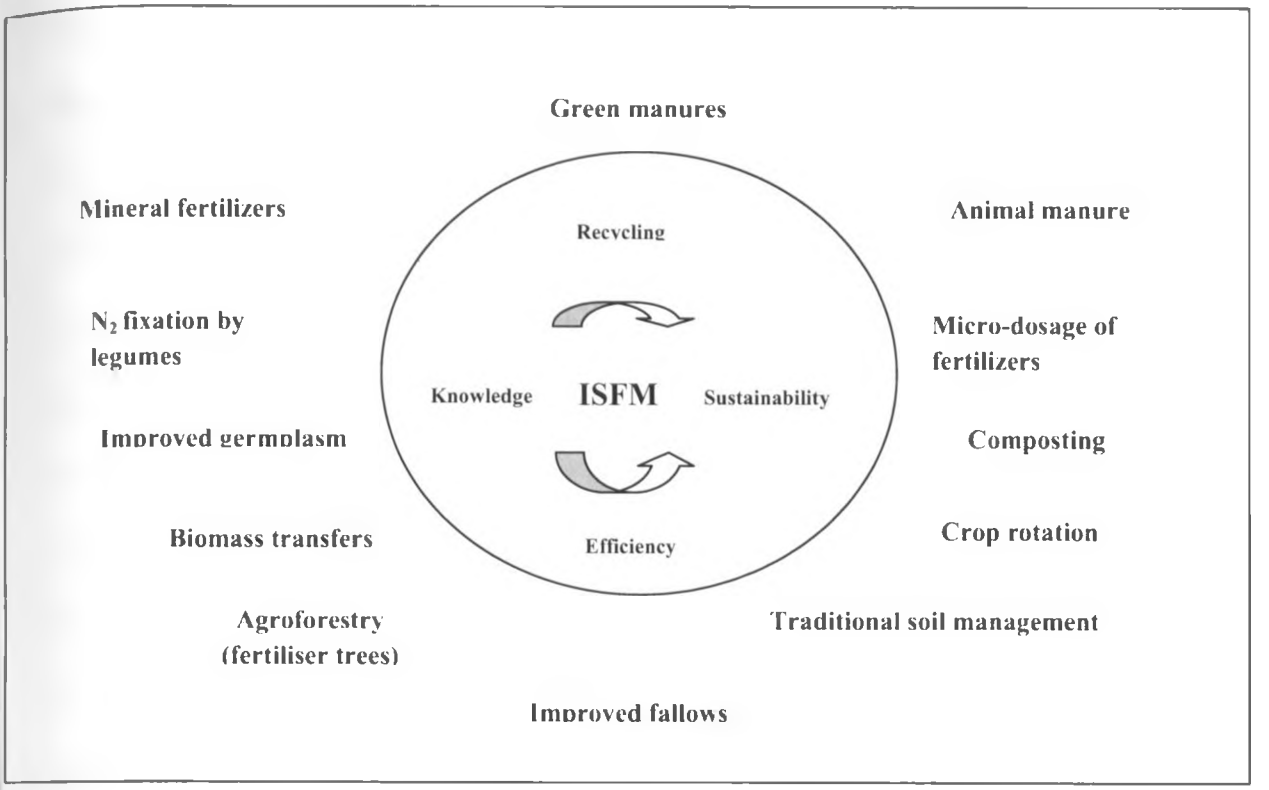

Figure 2.4 Examples of ISFM technologies (Adopted from Tittonnel *et.al.*, 2008)

2.2 Communication and Dissemination of ISFM

The ISFM paradigm has been promoted by various agencies for some time now and as a result there is a wide body of information and knowledge pertaining to it. This section first distinguishes between the terms information and knowledge before addressing their sources and the various channels through which they are disseminated and/or communicated to farmers. An examination of the various strategies employed in disseminating and communicating ISFM is made. The influence of socio-economic factors on channels used by farmers is reviewed as well as methodologies used for similar studies and finally knowledge gaps are identified.

2.2.1 ISFM information/knowledge sources and channels

The terms information and knowledge are inter-related and are often used synonymously; however there is a clear distinction between them. A hierarchical structure that starts with data, proceeds to information and then culminates in knowledge defines the inter-relationship between these components. What this implies is that: data is a set of symbols with little or no meaning to a recipient; information is a set of symbols that does have a meaning or significance to the recipient and; knowledge is the accumulation and integration of information received and processed by a recipient (Rasmussen, 2001). Thus data builds into information and information builds into knowledge.

Information has also been described as one or more statements, facts or news received by a human that have some form of worth to the recipient, and is necessarily accurate, timely and new (Floridi, 2005; Losee, 1997). Knowledge has be defined as information that is meaningfully aggregated into a reservoir of facts and concepts that can be applied or as information that is organized or processed (Asenso-Okyere and Davis, 2009; Rasmussen, 2001). Thus one can have knowledge about a topic or subject, knowledge about how to do something or knowledge about how to find information.

Likewise a distinction should be made between information/knowledge sources and channels. According to Tucker and Napier (2002), sources provide the content or expertise of interest to the information seeker while channels refer to the methods or vehicles by which information is transferred or received. Channels can be broadly grouped into disseminative or communicative. Dissemination is distinct from communication as the former entails the uni-directional (or one-way) flow of messages, information or knowledge from source to recipient. Robinson *et.al.* (2005) describes dissemination as a one-way active transfer process from resource to user groups.

Conversely, communication is the multi-directional (or two-way) flow of information/knowledge between source and recipient and thus necessitates feedback. Rogers (2003) defines communication as the process by which participants create and share information/knowledge with each other with the aim of reaching a mutual understanding.

Mass media channels are all those means of transmitting messages that entail mass medium such as radio, television, newspapers and magazines, which enable one or few individuals to reach a large audience whereas interpersonal channels involve a face-to-face exchange between two or more individuals (Rogers, 2003). Interpersonal channels could be either local or cosmopolite while mass media channels are entirely cosmopolite. According to Rogers (2003), cosmopolite communication channels are those linking an individual with sources outside the social system. Local (or localite) interpersonal channels are traditional in nature and include songs, poems, and exchange with neighbours, relatives and friends or peers (Dutta, 2009; Rogers, 2003). Information conveyed through these channels cannot be transmitted over long distances and often remains within the borders of a particular community rendering it inaccessible (Etebu, 2009).

Cosmopolite interpersonal channels involve face-to-face exchange but the sources of information are from outside the social system. These include community-based channels such as farmer field days, workshops, seminars, on-farm demonstrations, farm-to-farm visits, agricultural shows and public community meetings. Other channels of communication include print-based (books, posters, billboards, brochures), and ICT-based (internet, mobile phones, DVD/CD players, faxes) channels. Sanginga and Woomer (2009) describe a number of channels available for communicating and disseminating ISFM practices among small-scale farmers, each with associated costs and audiences. These were segregated into community-based (demonstration and field days, farmer field schools, farmer-to-farmer training), print-based (extension brochures,

booklets), mass media (radio programs) and ICT-based audio-visual systems (video documentaries, CD video documentaries).

Agricultural research institutions, whether they are International Agricultural Research Centres (IARCs) or National Agricultural Research and Extension Systems (NARES), as well as learning institutions (universities, colleges, polytechnics, schools etc) are vital sources of ISFM information. IARCs such as TSBF-CIAT and ICRAF, as well as KARI that is under the NARES umbrella are mentioned as important sources of ISFM information (Noordin *et.al.*, 2007). Community-based organizations (CBOs), non-governmental organizations (NGOs), churches, agricultural companies, extension workers (public or private), input dealers, farmer training centres are major sources of ISFM information among farmers in western Kenya (Muruli *et.al.*, 1999; Rees *et.al.*, 2000). Others sources include; farmers' own experience, development workers, outreach services, cooperatives, and faith-based organizations.

Extension services, agricultural institutions of learning and/or research, farmer unions or cooperatives, input dealers or stockists, mass media, ICTs (internet, mobile telephony, faxes), as well as the community-based and print-based channels employed by extension agents and researchers have been described as modern sources and channels of information (Boz and Ozcatalbas, 2010; Dutta, 2009). On the other hand, traditional sources and channels appertain to information emanating from farmers' own experiences, own family members and friends, farmers' neighbours, folklore, poems, songs and skits (Boz and Ozcatalbas, 2010; Dutta, 2009).

2.2.2 ISFM communication and dissemination strategies

Various strategies have been used to disseminate ISFM technologies and communicate ISFM knowledge over the years. TSBF-CIAT, having developed the ISFM paradigm, has played a very

prominent role to this end as outlined in the following sub-section. Other agricultural players have also been involved in this process in one way or the other.

2.2.2.1 Farmer Field Schools (FFS)

Farmer Field School (FFS) is a group extension method based on adult education methods and is characterized by learning-by-doing, learning-by-using, experimentation and peer learning (Rusike *et.al.,* 2004). In 2001, TSBF-CIAT began to promote FFS methodologies in Vihiga, Busia, and Teso districts of western Kenya with the aim of enriching local knowledge on soil ecology and disseminating ISFM concepts (Ramisch, 2004). The channels used by FFS entailed tests and demonstrations of some ISFM technologies such as the use of organic/inorganic fertilizers. FFS provided farmers the opportunity to learn about useful ISFM concepts.

The FFS approach has benefits such as increased productivity, knowledge gain among farmers and empowerment, but questions still abound on its overall impact and financial sustainability (Davis, 2008). These benefits have generally been confined to the most directly-engaged farmers and have demonstrated little capacity for scaling up for greater impact. In addition, studies have shown that FFS have limited or no effect on farmer-to-farmer dissemination of information and technologies (Davis, 2008). Furthermore, FFS strategies have been criticized for being curricula-based thus building farmers' understanding of science as a replacement for simply following scientific recommendations (Ramisch *et.al.,* 2006).

2.2.2.2 Local interpersonal channels

One of the channels for disseminating and communicating knowledge about improved soil management has been the use of songs and poems. Songs and poems have been written on the management of nitrogen, phosphorus and *Striga* as well as the use of organic resources (Vanlauwe *et.al.,* 2004). However, much as these activities have been important for building in-

group morale and solidarity, their role in raising interest and awareness in the broader communities has usually only come as a second priority (Ramisch *et.al.*, 2006).

2.2.2.3 Demonstration trials

Misiko and Ramisch (2007) report on the use of participatory demonstration trials as a channel to communicate ISFM technologies (e.g. biomass transfer, cereal-legume rotations, and organic-inorganic fertilizer combinations) in western Kenya. However, these channels are not entirely effective mainly because ISFM technologies are knowledge-intensive and their adaptations as well as applications are diverse. For instance, an ISFM concept like biomass transfer (e.g. application of *Tithonia*) demands a reasonable level of understanding to be applied unlike for simpler technologies that involve the dissemination of tangible things (e.g. seeds). Tittonnel *et.al.* (2008) points out the ineffectiveness of this communication strategy by recommending that there is need to go beyond comparing technologies from demonstration plots.

2.2.2.4 Community-based approaches

Through the Strengthening "Folk Ecology" (SFE) project, TSBF-CIAT, has promoted community-based learning approaches and farmer-led experimentations that aim to reduce communication gaps between scientists and farmers thus enabling them jointly develop dynamic expertise in ISFM concepts (Ramisch *et.al.*, 2006). Unfortunately, this approach has been faced with challenges mitigating widespread dissemination of ISFM technologies thus reducing impact. Ramisch *et.al.* (2006) attribute this failure to unsustainable production of dynamic expertise itself, downplaying of the experimentation process in farmer-to-farmer instruction, and the fact that overall success depended on availability of new knowledge, resources, and contacts with outsiders.

TSBF-CIAT has also made attempts to communicate and disseminate ISFM technologies through farmer-to-farmer interaction in Vihiga and Busia districts in western Kenya. This entails the organization of farmers around farmer research groups whereby these groups interact with other farmers through activities such as field days and cross-site visits (Vanlauwe *et. al.,* 2004). Field days, farmer groups, and cross-site visits were utilized in Vihiga and Busia districts to disseminate and communicate the use of improved soybean varieties e.g. TGX 1831-32E, improved maize varieties (e.g. IR), biomass transfer, and best-bet legume rotations and intercrops using mucuna, soybean and yellow grams (Vanlauwe *et. al.,* 2004).

Another analogous approach utilized in western Kenya to disseminate and communicate information on ISFM is the village committee approach, which promotes farmers as the principal agents of change in their communities thus increasing their capacity to innovate, make better decisions and provide feedback to the researchers (Franzel *et.al.,* 2001). This approach works on the assumption that the farmer delegates would facilitate further spread of knowledge in their social networks thereby generating sustainable processes and practices (Kiptot *et.al.,* 2006). According to Noordin *et.al.* (2001), the method relies on using existing village organisational structures such as church groups, women and youth self-help groups, and clan and sub-clan organisations which are common in western Kenya villages. Noordin *et.al.* (2001), noted that this approach is advantageous as it creates awareness in the form of mass campaigns, using channels such as public gatherings and farm-to-farm visits. But on the other hand, they cited some handicaps in the approach, the major one being inactivity of the village committees especially where follow up from project officers was lacking.

2.2.2.5 Agricultural extension

Ajayi and Gunn (2009) define agricultural extension as an out of school education for rural people and an extension agent as the person charged with providing knowledge and information on particular innovations to farmers. Extension services enhance the knowledge base of farmers through various ways, such as demonstrations, model plots, specific training and group meetings. The exposure of farmers to such activities is aimed at increasing their ability to optimize the use of their resources and ultimately increase crops yields (Muyanga & Jayne, 2006). Moreover, ideal extension service provides feedback mechanism from the farmers to the research centres. Extension services, if properly designed and implemented, improve agricultural productivity (Romani, 2003).

The Ministry of Agriculture has deployed agricultural extensionists up to divisional level. This means that each division has at least one or two extension workers charged with disseminating agricultural information and technology to farmers in that particular division. TSBF-CIAT and other research agencies have on various occasions partnered with extension agents to disseminate and communicate ISFM knowledge. However, these partnerships need to be continually strengthened for greater impacts to be achieved.

2.3 Influence of Socio-economic Factors on Channels Utilized by Farmers in Receiving Information on ISFM Practices

Socio-economic factors such as age, farm size, gender, income level, education level and years in farming cannot be overlooked as they play a major role in determining the media through which farmers are likely to receive information. For instance, a poor farmer who cannot afford to purchase a television set cannot be expected to benefit from agricultural documentaries aired on

television channels. Likewise, a farmer who is illiterate or semi-illiterate will definitely be unable to decipher information in a scientific journal or book. Sanginga and Woomer (2009) identified low levels of literacy among smallholder farmers in sub Saharan Africa (SSA) as a major constraint to effective communication and dissemination of soil fertility information. Conversely, a farmer endowed with resources and good education will certainly appreciate television and Information Communication Technologies (ICTs) as well as printed material, as viable media for receiving new information and insights. In support of this, Bationo *et.al.* (2004) reported that resource-poor farmers in western Kenya have no access to sources and media through which they could receive useful information on soil fertility interventions unlike wealthier farmers. Omosa (2000) concluded that success or failure of the use of communication channels depended heavily on socio-economic factors such as the level of literacy (education level) and wealth status as well as other factors like political environment. Similarly, Opara (2008) argued that apart from channels of information/knowledge meeting the minimum thresholds of credibility, reliability and accessibility they must be adapted to socio-economic environment of the recipient.

2.4 Overview of Methodologies used in Past Studies

Structured questionnaires have been the standard data collection instruments for studies of this nature (Riesenberg and Gor, 1989; Tucker and Napier, 2002). Riesenberg and Gor (1989) used Friedman's Two-way Analysis of Variance (ANOVA) to generate the mean rankings of farmers' preferences for methods of receiving agricultural information and knowledge. Tucker and Napier, (2002) applied factor analysis and regression modelling to determine farmers' preferred sources and channels for agricultural information. Opara (2008) simply used desprictive statistics involving frequency counts and percentages in assessing farmers' preferred sources and channels of agricultural information.

Probit and logit models have been used in studies where the dependent or response variable is dichotomous (or binary) in nature thus taking a 1or 0 value. According to Allison (1999) they are the standard methods of analysis for binary dependent variables. For instance, when testing the adoption of a hybrid maize seed variety by farmers as a function of independent variables such as age, education, or income, a farmer will either adopt or fail adopt the seed variety. Amudavi *et. al.* (2009) applied the logit model to analyze factors influencing likelihood of farmers participating in push-pull technology field days whereby binary dependent variables were analyzed. Nkamleu and Adesina (2000) utilized a bivariate probit model to test the influence of socio-economic variables on farmer adoption of chemical inputs.

2.5 Knowledge Gaps in ISFM Communication and Dissemination

While communication and dissemination of ISFM technologies (knowledge) has been carried out by various agencies, the efficacy and impact of this process remains doubtful as intimated by some literature sources (e.g. Odendo *et.al.,* 2006). Although a study carried out by Muruli *et.al.* (1999) over ten years ago in western Kenya had attempted to answer queries concerning the channels by which farmers acquire soil fertility management information, socio-economic aspects influencing farmer access to information were not dealt with adequately. In addition, new communication channels or media have since emerged, case in point being ICT-based mobile phones and internet with the former rapidly gaining in popularity in the rural areas. In light of this new development there was a need to assess the viability of these media as channels for ISFM dissemination and communication.

Thus knowledge gaps exist, more so on issues concerning diffusion of innovations aspects such as the communication channels the farmers use in receiving information and their accompanying

preferences, and the social system in which the innovations diffuse. There is a scarcity of literature on the channels preferred by farmers for receiving ISFM information, the merits or demerits of these channels, and the socio-economic aspects affecting access to these types of information and knowledge.

A social system as defined by Roger (2003) is a set of interrelated units that are engaged in joint problem solving to accomplish a common goal and constitutes a boundary within which an innovation diffuses. In this case, the social system constitutes farmers located in Vihiga and Siaya districts of western Kenya. The different members of a social system may have variable characteristics e.g. social, economic, perceptions, attitude, innovativeness that influences adoption of an innovation. This study intends to identify socio-economic variables influencing farmer access to ISFM knowledge and information, and consequently its adoption. Likewise, the role of change agents in the diffusion of innovations are also assessed and presented.

Kiptot *et.al.* (2006) reported that approaches utilized so far do not eliminate ambiguity on farm and farmer characteristics likely to influence knowledge dissemination, whether the dissemination of the technologies is accompanied with the associated knowledge and on what is disseminated and to whom. This justifies an in-depth analysis of the influence of communication and dissemination channels on farmer uptake of ISFM technologies.

CHAPTER 3

METHODOLOGY

This section gives a description of the data collection and analysis for the study. It commences with the analytical framework encompassing the theoretical and conceptual frameworks. Data needs and sources, sampling and data collection, data analysis, and description of study area are described in detail.

3.1 Analytical Framework

This consists of the theoretical and conceptual frameworks. The theoretical framework outlines the theoretical approach that informs the study and the conceptual framework links the various components of the study thus presenting the preferred approach to evolving ideas and giving coherence to the inquiry.

3.1.1 Theoretical framework

The theoretical approach that informed this study was drawn from three theories: 1) the diffusion of innovations theory, 2) adoption theory, and 3) the uses and gratification theory. These theories aided in the understanding of farmers' information use habits and preferences as well as the process of adoption of an innovation and its diffusion in a social system.

Adoption theory examines the individual and the choices an individual makes to accept or reject a particular innovation and is a micro-perspective on change, focusing not on the whole but rather the pieces that make up the whole (Straub, 2009). Information reduces uncertainty and hence is critical in the decision a person may take in choosing to accept or reject an innovation. Conversely, the diffusion of innovation theory takes a macro-perspective on the spread of an innovation across time as it describes how an innovation spreads through a population (Straub,

2009). According to Rogers (2003), diffusion is the process by which an innovation is communicated through certain channels over time among members of a social system. Its primary components are: a) the innovation, b) communication channels, c) social system, and d) time.

The uses and gratifications theory originated from the functionalist perspective on mass media communication and was first developed in research on the effectiveness of the radio medium in the 1940s (Luo, 2002). Its approach puts the function of linking needs gratification and media choice undoubtedly with audience members. Thus implying that peoples' needs influence what media they would choose, how they use certain media and what gratifications the media gives them. This theory aided in understanding as to why farmers preferred one media choice as opposed to the other, based on the assumption that peoples' needs influence what media they choose, how they use certain media and what gratifications the media gives them.

3.1.2 Conceptual framework

The conceptual framework used in this study is shown in Figure 3.5. The diffusions of innovations theory informs of the innovation-decision process through which an individual progresses from first knowledge of an innovation, to forming an attitude towards an innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision (Rogers, 2003). These stages in the innovation-decision process aid in understanding the role of different communication channels. Knowledge is initiated or generated by researchers who together with extension agents create awareness of this knowledge among farmers through various communication and dissemination channels. In the knowledge stage the farmer should gain an understanding of how the innovation functions.

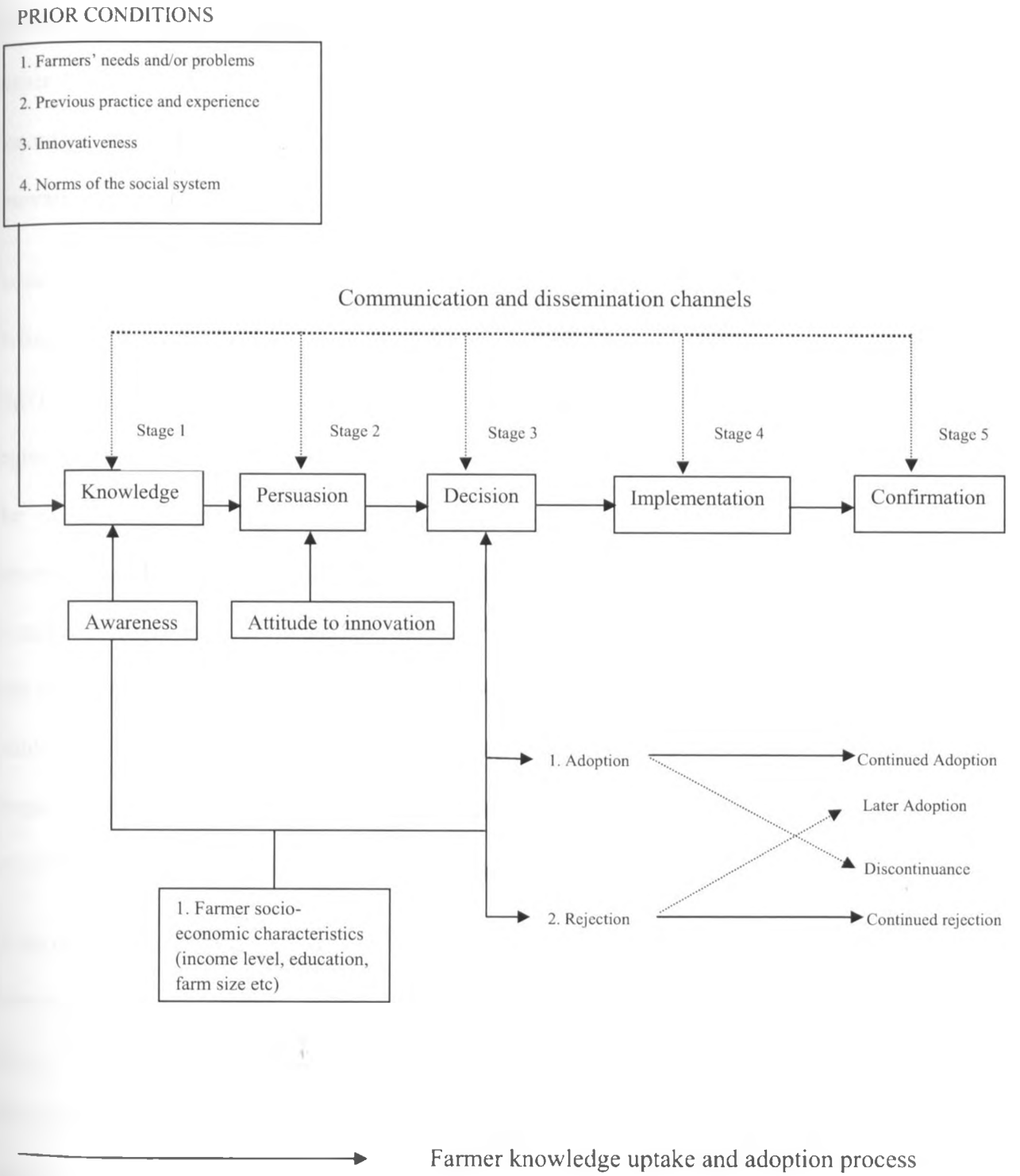

Figure 3.5 Conceptual framework (Adapted from Rogers, 2003)

In the persuasion stage, the farmer forms a favourable or unfavourable attitude to the innovation (ISFM). Persuasion in this case is taken to mean attitude formation and change on the part of farmer but not necessarily as a consequence of researcher and/or extension agent influence. According to Rogers (2003), individuals at this stage actively seek for information on an innovation and their attitudes are determined by their perception of messages received.

Farmers require information in order to be in a position to decide whether innovations have attributes that suit their needs and circumstances, and are therefore worth adopting (persuasion stage). According to Rogers (2003) innovations have five attributes: 1) relative advantage (the degree to which an innovation is perceived as better than the idea it supersedes); 2) compatibility (the degree to which an innovation is perceived as consistent with existing values, past experiences and needs; 3) complexity (the degree to which an innovation is perceived as difficult to understand and use); 4) trialability (the degree to which an innovation may be experimented with on a limited basis); and 5) observability (the degree to which the results of an innovation are visible to others). Rogers (2003) postulates that mass media and/or cosmopolite channels are comparatively more important at the knowledge stage and interpersonal and/or localite channels are relatively more important at the persuasion stage in the innovation-decision process.

At the decision stage, a farmer engages in activities that would lead to rejection or adoption of the innovation. Researchers and extension agents often work towards quickening the decision-making process by employing strategies such as demonstration trials. By the time a farmer is implementing the new idea, he or she has already put it into practice and the role of the extension agent at this stage is to provide technical support. Even after adoption or rejection, a farmer may receive information that may lead to discontinuance or later adoption of the innovation. Thus in the confirmation stage, the farmer or individual seeks to reinforce the new idea and erase any

form of uncertainty. The farmer will continually require information throughout this entire process leading to him/her acquiring knowledge and adopting the innovation. He/she will receive this information through various channels. However, it is important to note that the decision to adopt is not only dependent on access to information via the requisite channels but on other important factors such as innovativeness, socio-economic conditions, cultural practices and so on. Communication and dissemination channels preferred by farmers during these stages were investigated.

The uses and gratifications theory informs us that peoples' needs influence what media they would choose, how they use certain media and what gratifications the media gives them. It is noteworthy that human needs such as information acquisition, tension release, escape, social interaction e.t.c. influence the media individuals are likely to utilize to serve their gratifications (Luo, 2002). Hence, the study determined how farmers' needs influenced the media or channels they prefer to utilize for receiving information.

It was necessary to analyse the socio-economic characteristics of farmers, for instance income level and education level that may affect the access they have to information/knowledge. Socio-economic characteristics influence the eventual adoption of the innovation. Individuals in a social system have different levels of innovativeness i.e. the degree to which an individual is relatively earlier in adopting new ideas than other members (Rogers, 2003). A higher level of innovativeness may portend the likelihood of characteristics (e.g. more education) that predispose a farmer to have more exposure to mass media and interpersonal communication channels. Conversely, a low level of innovativeness in a farmer is likely to suggest that he/she has less exposure to channels of communication.

3.2 Data Needs and Sources

Primary data, both qualitative and quantitative, was collected from farmers and key informants (e.g. extension agents). Secondary, qualitative data (literature review) was obtained from libraries and the internet. The data was required in order to evaluate farmers' access to information and knowledge sources as well as their preferred channels for receiving information and knowledge. In addition, the relationship between farmers' socio-economic status and information and knowledge access and the consequent uptake of ISFM was investigated. Data on the existing ISFM communication and dissemination channels in the study area were collated.

In order to understand the impact of the dissemination and communication channels they were placed into five broad categories regardless of whether they were disseminative or communicative in nature. These included: i) mass media channels such as radio, television, newspapers/magazines which are disseminative; ii) local (or localite) interpersonal channels e.g. neighbours, friends, and relatives which are communicative, and songs, poems, and dramas which are disseminative; iii) cosmopolite interpersonal or community-based channels such as farmer field days, workshops, seminars, on-farm demonstrations, farm-to-farm visits, public gatherings, which are all communicative; iv) print-based channels e.g. books, posters, billboards, and brochures that are disseminative; and v) ICT-based audio-visual and data transmission systems such as the internet, mobile phones, DVD/CD players, and faxes, which are both communicative and disseminative. Dissemination and communication channels were evaluated on the basis of their accessibility to farmers as well as their reliability, informativeness and comprehensiveness.

Respondents were asked to evaluate the ISFM information and knowledge sources as well as channels in terms of preferences and indicate the needs influencing their choices. Channels were

segregated into mass media, local interpersonal and cosmopolite interpersonal and whether they were either traditional or modern. In addition, farmer socio-economic characteristics including age, off-farm income, education level, farm size, wealth status or asset endowment, distance to nearest information centre, and off-farm income were utilized as independent variables whereas access and uptake of ISFM information and knowledge were used as dependent variables.

3.3 Sampling and Data Collection

The following formula was used to determine sample size (Israel, 1992).

$SS = Z^{2*}(p)*(1-p)/C^2$

Whereby:

SS= sample size

Z = Z value (in this case 1.96 for 95% confidence level)

p = estimated proportion of an attribute that is present in a population. The variability of a large population that will adopt ISFM and access information/knowledge is not known thus assume maximum variability i.e. p=0.5

c = confidence interval (or the desired level of precision), expressed as decimal, in this case 0.0895

$SS = (1.96)^2 (0.5) (0.5)/ (0.0895)^2 = 120$

Thus the sample size of the study for both Vihiga and Siaya districts was 120 farmers. Farmers from Vihiga were sampled in a systematic random manner from available lists of participant and non-participant farmers compiled by TSBF and other organizations that have worked in the area previously.

In Siaya, farmers were selected based on randomly selected diagnostic trial sites of the Africa Soil Information Service (AfSIS) project. Sixteen clusters were randomly generated from the centre coordinates of the TSBF Nyabeda site, with 15 farmers being identified per cluster out of which 4 farmers per cluster were selected for the study. However, four of these farmers were not utilized as they fell outside the district.

The survey instrument deployed was the structured questionnaire which was administered to the 120 farmers. Informal interview sessions with farmers and extension agents took place in order to gain additional information. To address objective one and two, structured questionnaires were administered to the farmers. Structured questionnaires were also used to address objective three. To extract additional information, informal interviews with farmers and observation comprehensively tackled these objectives. Lastly, rapid desk study/literature review and informant interviews in addition to structured questionnaires addressed objective four.

3.3 Data Analysis

Data collected was entered into the excel software application (Microsoft Windows version 2003) and then analyzed. To test the first and second hypotheses that existing communication and dissemination channels are not adequate and effective in imparting ISFM technologies and farmers only prefer traditional, local (or localite) interpersonal channels of ISFM information and knowledge, respectively, GenStat (discovery edition 3) application was utilized. With this application, it was possible to use analysis of variance (ANOVA) to test significance of the accessibility, reliability, informativeness, comprehensibility and preference of communication and dissemination channels among farmers at least significance difference of means (LSD) level of 5 ($P \leq 0.05$). STATA (10) application was used to test the null hypothesis that socio-economic factors have no influence on farmers' access to ISFM information and knowledge and its uptake.

This application enabled probit regression modeling to determine the effect of selected socio-economic variables on farmer access to ISFM information and knowledge, and uptake of ISFM practices.

Excel and SPSS (12.0) applications were used to generate, descriptive statistics that included frequency counts and percentages. Excel application was also utilized for single factor (or one-way independent) ANOVA analysis that was used to test the effect of farmers' access to ISFM knowledge and its application on crop production specifically maize and beans.

3.4 Empirical Model

Probit and logit models have been used in several empirical studies to try and capture the influence of socio-economic variables on adoption decisions (Nkamleu and Adesina, 2000). Although probit and logit models give similar results qualitatively they are slightly different (Greene, 2002). For instance, Greene (2002), postulates that the logistic distribution is similar to the normal one except that the former has heavier tails that approach x axis faster. Probits are the "natural" units for the unit normal cumulative distribution function (CDF), the "normal" ogive, whereas logits are the "natural" unit for the logistic ogive. For this study, a probit model was preferred because it uses the normal CDF (normal ogive) which many statisticians identify with.

The probit model was used to analyze factors influencing likelihood of farmer access to ISFM information and knowledge, and subsequent uptake of ISFM practices. The dependent variables in the model used were: a) farmer access to ISFM information and knowledge and, b) farmer uptake of ISFM.

A latent variable Y_i*, which is unobserved, is the underlying utility function which ranks the preference of the 'th farmer and is assumed to be a function of farmer-specific attributes, "X" (e.g.

age, education level, farm size, etc.) and a disturbance term having a zero mean. It is determined by the following model:

$$Y_i^* = \beta_0 + \beta_1 X_i + u_i$$

The observed variable Y_i (the dependent variable) is linked to Y_i^* as:

$$Y_i = 0 \quad \text{if} \quad Y^* < 0$$

$$Y_i = 1 \quad \text{if} \quad Y^* \geq 0$$

Thus the probability of observing $Y_i = 1$ is:

$$p_i = P(Y_i = 1) = P(Y^* \geq 0)$$

$$= P(\beta_0 + \beta_1 X_i + u_i \geq 0)$$

$$= P(u_i \geq -\beta_0 - \beta_1 X_i)$$

$$= 1 - F_u(-\beta_0 - \beta_1 X_i)$$

Where F_u is the cumulative distribution function of the random variable u.

For probit model, the error term – u is normal and thus the model is given as:

$$P_i = 1 - \Phi(-\beta_0 - \beta_1 X_i) = \Phi(\beta_0 + \beta_1 X_i)$$

The null hypothesis was set at $H_0 = 0$, that is, the probability of a farmer accessing and applying ISFM information and knowledge was independent of each of the independent variable X. The main independent variables were; age, level of education, off-farm income, livestock value,

distance from the nearest information centre, farm size, district farmer resides in and extension visits (Table 3.1).

Table 3.1 Description of dependent and independent variables

Variable	Description	Expected sign
Access	Farmer access to ISFM information and knowledge	
Appisfm	Farmer application of ISFM	
Age	Age	-
Educ	Education level	+
Offinco	Off-farm income	+
Livestval	Livestock value	+
Distinfo	Distance from nearest information centre	-
Farmsize	Farm size	+
Extension	Extension visits (1=Yes, 0=None)	+
Dist	District (1=Vihiga, 0=Siaya)	+

3.5 Description of Study Area

The study was undertaken in north-east Bunyore location in Vihiga district, and north Gem, north-west Gem, east Gem and south Ugenya locations in Siaya district. Vihiga and Siaya districts are situated in the Lake Victoria Basin of western Kenya. Some key characteristics of the districts are shown in Table 3.2. The location in Vihiga district was selected because it is the site of various ISFM projects conducted by TSBF. The locations in Siaya district were randomly selected from the centre coordinate of the TSBF Nyabeda site where ISFM interventions have been tested. All these locations, especially north-east Bunyore, are densely populated and have diverse farming practices and land use.

Table 3.2 Key characteristics of Vihiga and Siaya districts (Source: Jaetzold *et.al.*, 2005; Mango, 1999)

	Vihiga	Siaya
Annual precipitation (mm)	1900	800-2000
Altitude (m)	1650 – 2650	1140-1500
Soils	Dystric CAMBISOLS[1], LITHOSOLS[2], dystric & dystro-mollic NITISOLS[3], FERRALSOLS[4], ferralo-orthic ACRISOLS[5]	FERRALSOLS[4], VERTISOLS[6]
Population (1999)	498, 883	493, 326
Population density(persons km^{-2}) (1999)	886	325
Area (km^2)	563	1520
Farm size (ha)	0.5	1

Various ISFM options have been tested in the two districts hence the rationale behind their selection. According to Kiptot *et.al.* (2006), both districts are faced with high poverty and low agricultural productivity due to nutrient deficiency. About 80% of farms in Vihiga and Siaya are severely deficient in Phosphorus (P) (<5 mg bicarbonate-extractable P kg^{-1} soil), and most are deficient in Nitrogen (N) when P deficiency is overcome (Sanchez *et.al.*, 1997). There is secure

[1] Well drained, moderately deep to deep, brown, friable to firm, fairly bouldrey and fairly rocky, gravely coarse sandy clay, on moderate slopes [2] Somewhat excessively drained, very shallow to shallow, brown, friable, bouldery and extremely rocky, gravely coarse sandy clay loam; in places with an acid top soil; on steep slopes [3] Well drained, extremely deep, dark red, friable clay, in places with a humic top soil [4] Well drained, extremely deep, dusky red to dark red, very friable clay [5] Well drained, very deep, dark reddish brown to yellowish red, friable clay [6] Churning heavy clay soils with high proportion of swelling clays

tenure of land and the farming system is characterized by a subsistence oriented mixed crop–livestock system with the major food crops being maize (*Zea mays*) intercropped with beans (*Phaseolus vulgaris*). Figure 3.6 shows a map of Vihiga and Siaya districts and the location of study sites.

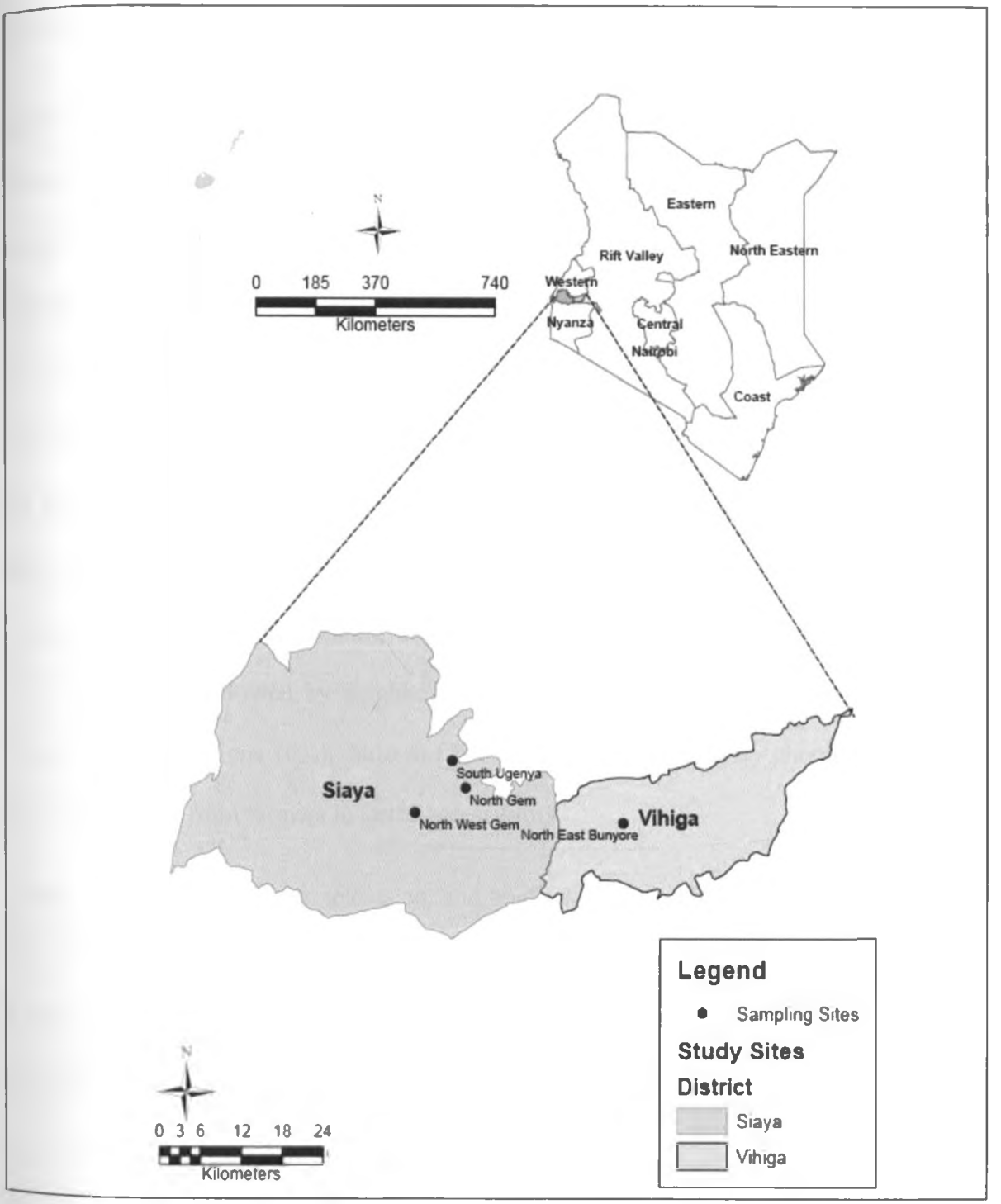

Figure 3.6 Location of sampling points in Siaya and Vihiga Districts, Western Kenya

CHAPTER 4

RESULTS AND DISCUSSION

This section presents the results of the study accompanied with a detailed discussion. A careful evaluation of communication and dissemination channels was made and farmer preferences with regards to ISFM information and knowledge determined. Needs influencing these preferences were investigated and, influence of socio-economic factors on farmer access and uptake of ISFM examined.

4.1 Evaluation of ISFM Communication and Dissemination Channels

Many of the farmers considered radio and farmer field days to be very accessible with 19% and 18% of them, respectively, ranking these channels very highly in terms of accessibility (Table 4.3). These were followed by neighbours/friends/relatives (12%), workshops/seminars (10%). On-farm demonstrations (8%), farm-to-farm visits (7%), and mobile phones (7%) elicited an average response from farmers in terms accessibility.

Public gatherings, brochures, television, and books were even less accessible with a response of 5%, 4%, 4% and 3%, respectively, while billboards, posters, newspapers and the internet elicited a response rate of only 1%. DVD/CD players and songs/poems were the least accessible channels and had a zero response rate.

Table 4.3 Farmers' assessment of the accessibility of various ISFM communication and dissemination channels. (Source: own data)

	Accessibility
ISFM channels	% Response
Radio	19
Farmer field days	18
Neighbors/friends/relatives	12
Workshops/Seminars	10
On-farm demonstrations	8
Farm-to-farm visits	7
Mobile phones	7
Public gatherings	5
Brochures	4
Television	4
Books	3
Newspapers/Magazines	1
Billboards/Posters	1
Internet	1
Songs/Poems	0
DVD/CD players	0
Total	100

Forty eight percent of the farmers considered community-based channels (i.e. farmer field days, workshops, seminars, on-farm demonstrations, farm-to-farm visits, public gatherings) to be very accessible followed by the mass media channels (i.e. radio, television and newspapers) at 24% (Figure 4.7). Only 12% of the farmers considered local interpersonal channels (i.e. neighbours, friends, relatives, songs and poems) to be accessible. ICT-based channels (i.e. mobile phones, internet and DVD/CD players) and print-based channels (i.e. brochures, books, and posters) were the least accessible with 8% and 7% response rate, respectively (Figure 4.7).

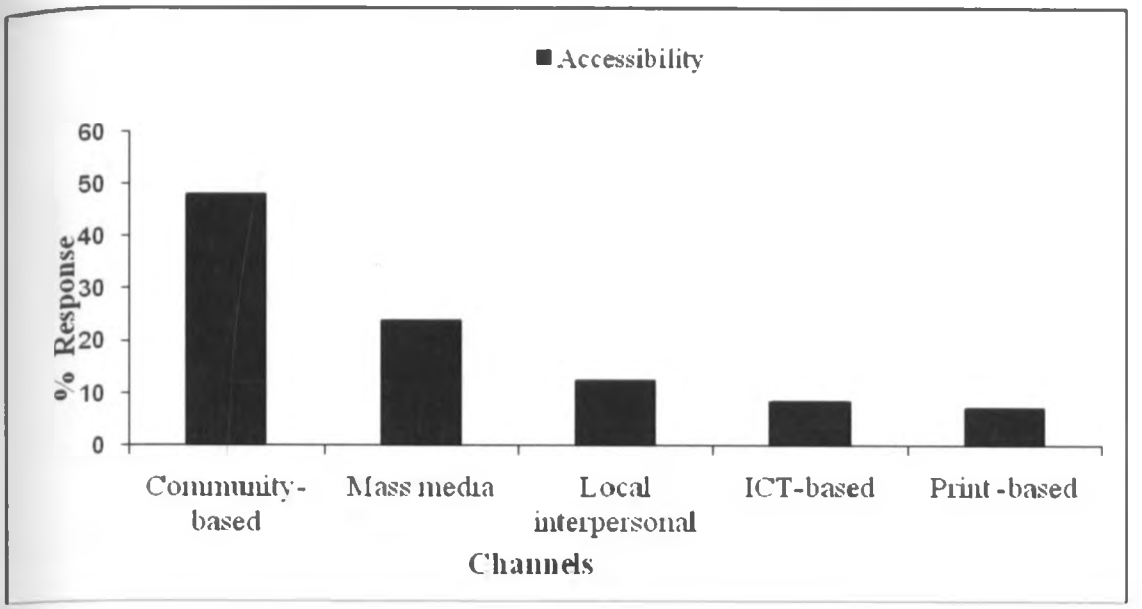

Figure 4.7 Farmers' assessment of the accessibility of ISFM channel categories

From the statistical analysis shown in Figure 4.8, although community-based channels were more accessible than mass media channels there was no significant difference between the two in terms of accessibility. However, community-based and mass media channels were significantly more accessible than ICT-based and print-based channels.

The ICT and print-based channels were the least accessible. Local interpersonal channels though not significantly different from the other channels were less accessible in comparison to community-based and mass media channels on one hand but more accessible when compared to ICT and print-based channels on the other.

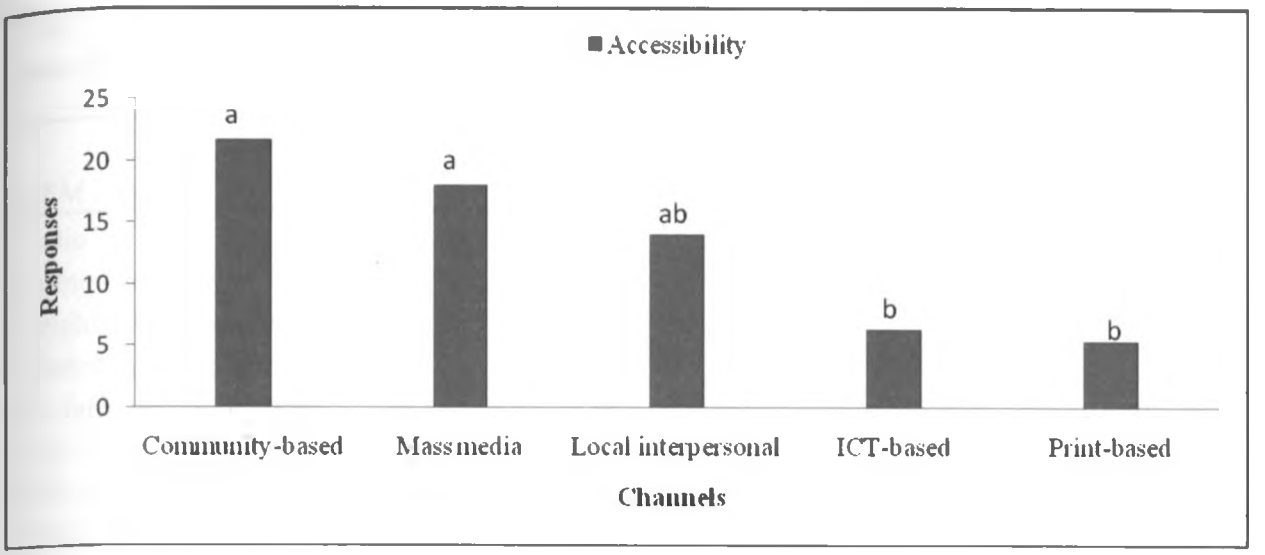

Figure 4.8 Accessibility of ISFM channel categories according to farmers P ≤ 0.05

Communication and dissemination channel categories with the same letters are not significantly different

Similarly, radio and farmer field days were ranked highly in terms of reliability, 19% and 18% of the responses, respectively (Table 4.4). These were followed by neighbours/friends/relatives at 12%. Workshops/seminars (9%), on-farm demonstrations (9%), mobile phones (8%), farm-to-farm visits (7%), and public gatherings (6%) elicited an average response from farmers in terms of reliability.

Television was even less reliable with a response of 4% while books, brochures, newspapers, billboards and posters elicited a response rate of only 2%. Again DVD/CD players and songs/poems were the least reliable channels and had zero response (Table 4.4).

Table 4.4 Farmers' assessment of the reliability of ISFM communication and dissemination channels (Source: own data)

	Reliability
ISFM channels	% Response
Radio	19
Farmer field days	18
Neighbors/friends/relatives	12
Workshops/Seminars	9
On-farm demonstrations	9
Mobile phones	8
Farm-to-farm visits	7
Public gatherings	6
Television	4
Books	2
Brochures	2
Newspapers/Magazines	2
Billboards/Posters	2
Internet	1
DVD/CD players	0
Songs/Poems	0
Total	100

Community-based channels (i.e. farmer field days, workshops, seminars, on-farm demonstrations, farm-to-farm visits, public gatherings) at 48% response rate were considered to be very reliable by farmers (Figure 4.9). Mass media channels (i.e. radio, television and newspapers) were the second most reliable channels at 25% response rate. Local interpersonal channels (i.e. neighbours, friends, relatives, songs and poems) followed with a response of 12%. ICT-based (i.e. mobile phones, internet and DVD/CD players) and print-based (i.e. brochures, books, and posters) channels were considered least reliable eliciting a response of 9% and 6%, respectively (Figure 4.9). Yet again both community-based (cosmopolite interpersonal) and mass

media channels were important with the former being viewed to be reliable by considerably more farmers.

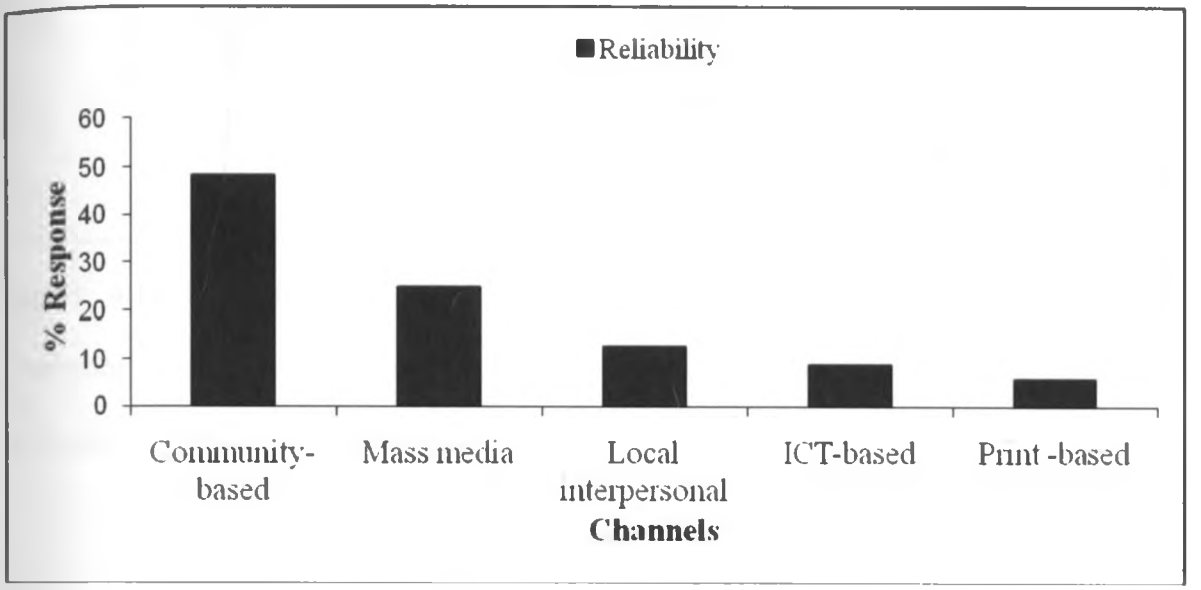

Figure 4.9 Farmers' assessment of the reliability of ISFM channel categories

As shown in Figure 4.10, although community-based channels were more reliable than mass media channels there were no significant differences between the two in terms of reliability. However, community-based and mass media channels were significantly more reliable than ICT-based and print-based channels.

The ICT and print-based channels were the least reliable. Local interpersonal channels though not significantly different from the other channels were less reliable in comparison to community-based and mass media channels on one hand but more reliable when compared to ICT and print-based channels on the other.

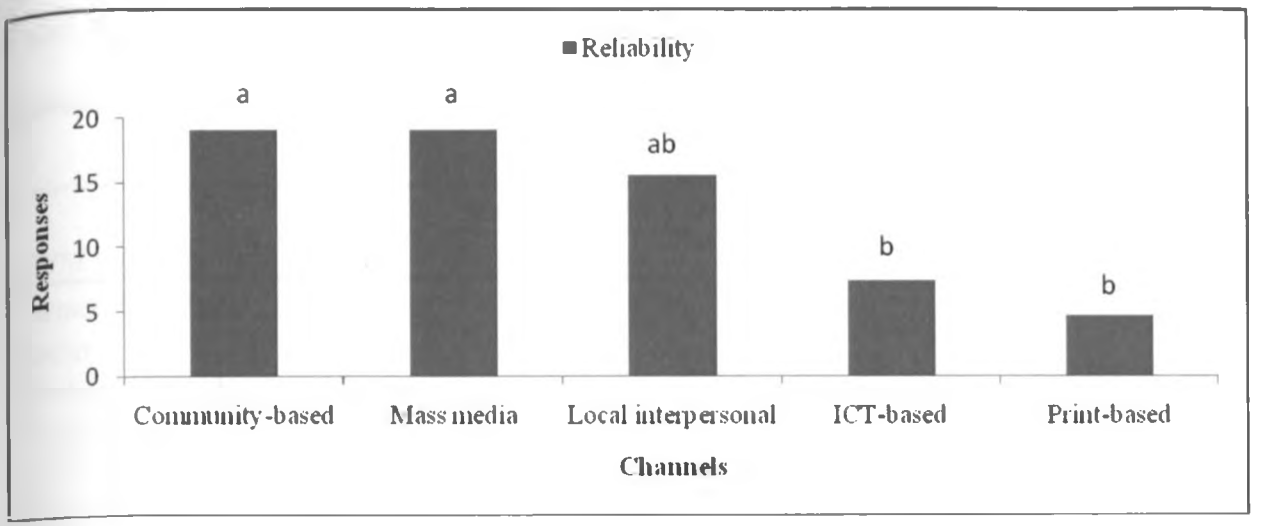

Figure 4.10 Reliability of ISFM channel categories according to farmers $P \leq 0.05$

Communication and dissemination channel categories with the same letters are not significantly different

The same trend persisted in terms of informativeness as farmers considered radio and farmer field days to be the most informative with a 16% response (Table 4.5). These channels were followed by neighbours/friends/relatives (11%), workshops/seminars (11%). On-farm demonstrations, public gatherings, farm-to-farm visits, television and mobile phones elicited a lower response from farmers in terms of informativeness with a response rate of 8%, 7%, 6% and 5%, respectively.

Channels such as billboards, posters, newspapers, and books had an even lower response of 3% while brochures had a response of 2%. Like in the other cases DVD/CD players, internet and songs/poems had the lowest response rate and were thus the least informative.

Table 4.5 Farmers' assessment of the informativeness of ISFM communication and dissemination channels (Source: own data)

	Informativeness
ISFM channels	% Response
Farmer field days	16
Radio	16
Workshops/Seminars	11
Neighbors/friends/relatives	11
On-farm demonstrations	8
Public gatherings	7
Farm-to-farm visits	6
Television	5
Mobile phones	5
Billboards/Posters	3
Newspapers/Magazines	3
Books	3
Brochures	2
Internet	1
DVD/CD players	1
Songs/Poems	1
Total	100

Lastly, in terms of comprehension farmers considered farmer field days and radio to be the most comprehensible with the former having a response of 16 % followed by the latter at 13 % (Table 4.6). These channels were followed by workshops/seminars (12%) and neighbours/friends/relatives (11%).

On-farm demonstrations, farm-to-farm visits, public gatherings, television and mobile phones elicited a lower response rate from farmers in terms of informativeness with a response rate of 8%, 7%, 6% and 5%, respectively. Channels such as brochures and posters had an even lower response of 4% followed by newspapers and books at 3%. Songs/poems were the second least

comprehensible channel with a response of 2%. DVD/CD players and the internet had the lowest response rate of 1% and were thus the least comprehensible.

Table 4.5 Farmers' assessment of their comprehension of ISFM communication and dissemination channels (Source: own data)

	Comprehension
ISFM channels	% Response
Farmer field days	16
Radio	13
Workshops/Seminars	12
Neighbors/friends/relatives	11
On-farm demonstrations	8
Farm-to-farm visits	7
Public gatherings	6
Television	5
Mobile phones	5
Brochures	4
Billboards/Posters	4
Newspapers/Magazines	3
Books	3
Songs/Poems/Skits	2
Internet	1
DVD/CD players	1
Total	100

Community-based channels (i.e. farmer field days, workshops, seminars, on-farm demonstrations, farm-to-farm visits, public gatherings) were the most informative at 48% response (Figure 4.11). These were followed by mass media (i.e. radio, television and newspapers) and local interpersonal (i.e. neighbours, friends, relatives, songs and poems) channels at 24% and 12% respectively. Print-based (i.e. brochures, books, and posters) and ICT-based (i.e. mobile phones, internet and DVD/CD players) channels were considered the least informative with a response of 8% and 7%, respectively.

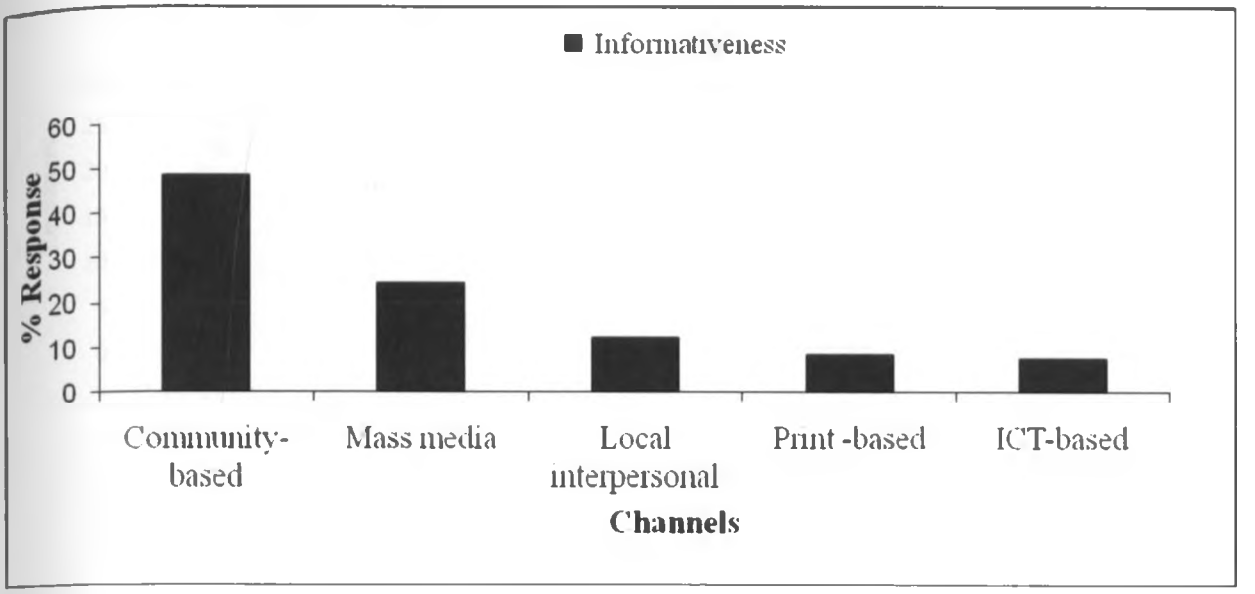

Figure 4.11 Farmers' assessment on the informativeness of ISFM channel categories

As indicated in Figure 4.12, although the community-based channels were more informative than the mass media channels there was no significant difference between the two in terms of informativeness. However, community-based and mass media channels were significantly more informative than ICT and print-based channels. The ICT and print-based channels were least informative.

Local interpersonal channels though not significantly different from the other channels were less informative in comparison to community-based and mass media channels on one hand but more informative when compared to ICT and print-based channels on the other.

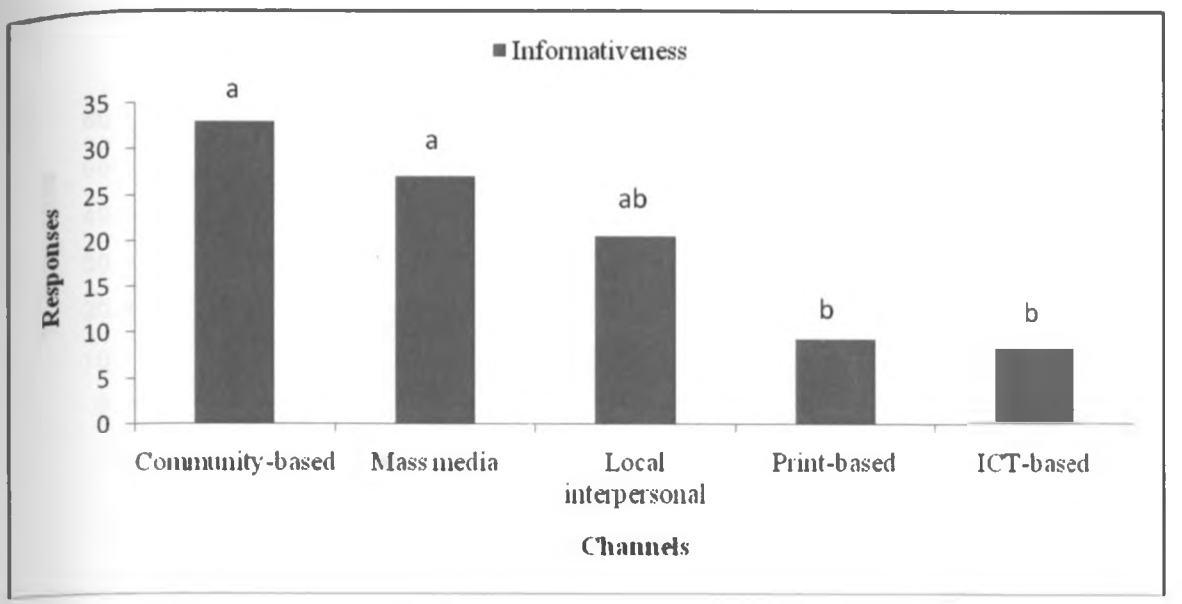

Figure 4.12 Informativeness of ISFM channel categories according to farmers $P \leq 0.05$

Communication and dissemination channel categories with the same letters are not significantly different

Figure 4.13 illustrates the sustained popularity of community-based channels (i.e. farmer field days, workshops, seminars, on-farm demonstrations, farm-to-farm visits, public gatherings) even in terms of comprehension as ICT-based channels continued to be ranked poorly.

Forty nine percent of the respondents considered community-based channels comprehensible followed by mass media (i.e. radio, television and newspapers) and interpersonal (i.e. neighbours, friends, relatives, songs and poems) channels at 21% and 12%, respectively. ICT (i.e. mobile phones, internet and DVD/CD players) and print-based (i.e. brochures, books, and posters) channels were considered least comprehensible with a response of only 10% and 7%, respectively.

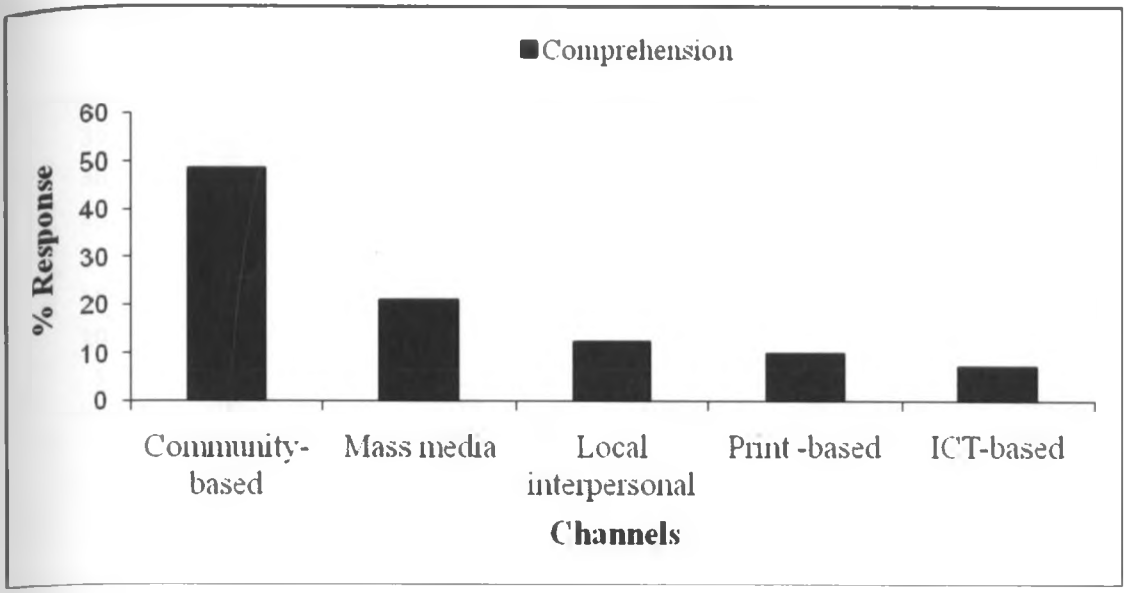

Figure 4.13 Farmers' assessment of the comprehensibility of ISFM channel categories

From the statistical analysis shown in Figure 4.14, community-based channels were significantly more comprehensible than local interpersonal, ICT-based and print-based channels. They were more comprehensible than mass media channels though not significantly so.

Although mass media channels were more comprehensible than local interpersonal ones there was no significant difference between them. However, mass media channels were significantly different from ICT-based and print-based channels though the latter sets of channels were least comprehensible.

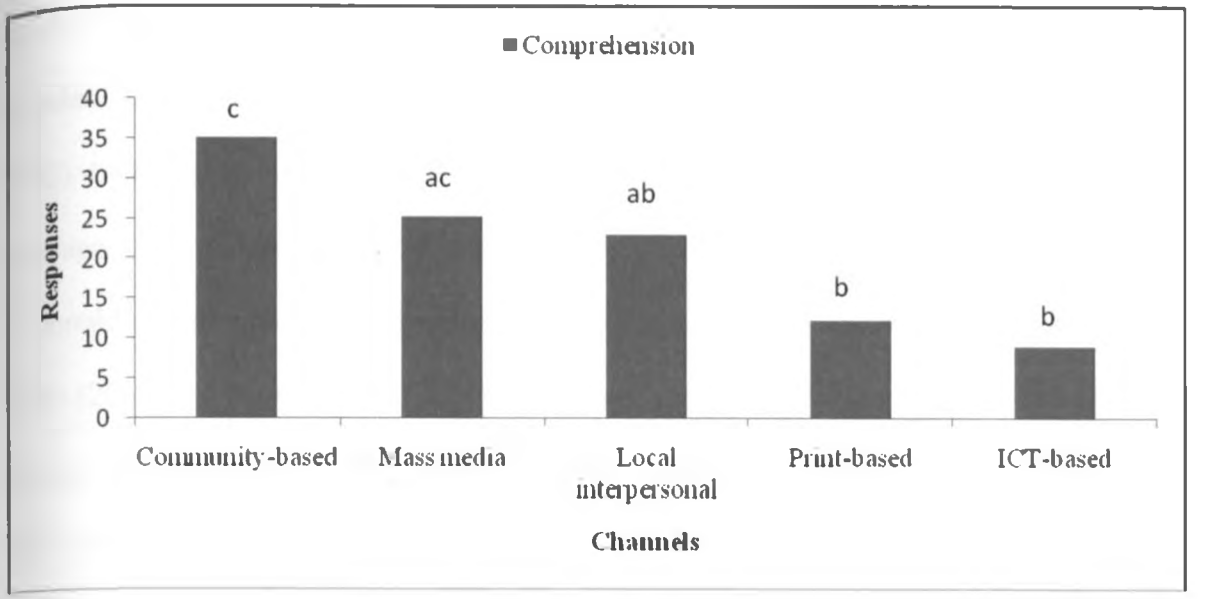

Figure 4.14 Comprehensiveness of ISFM channel categories according to farmers $P \leq 0.05$

Communication and dissemination channel categories with the same letters across are not significantly different

From these results, community-based (or cosmopolite interpersonal) channels were the most advantageous in terms of accessibility, reliability, informativeness and significantly so in terms of comprehensibility. Mass-media channels proffered the most advantages second only to community-based channels. For instance, farmer field days (a community-based channel) and radio (a mass media channel) were deemed advantageous by many farmers.

Thus they are the most suitable for the communication and dissemination of ISFM information/knowledge. On the other hand, ICT-based and print-based channels were significantly the least advantageous.

Mass media in general are not as interactive as community-based channels but radio as a channel has numerous advantages to the rural farmer and consequently considered favorably. Radio is

mentioned as the channel that is suitable for the dissemination of information among rural populations as many of them own radios making them easily accessible (Dutta, 2009; Momodu, 2002). Radio has many advantages, key among them are that it reaches a large audience, conveys messages or news very quickly, it is particularly effective in rural areas and non-literate cultures, is portable, it stimulates the imagination and carries authority (Norrish *et.al.,* 2001). However, Dutta (2009) and Norrish *et.al.* (2001) pointed out various limitations of radio such as bad timing, wrong language, poor quality of messages, and its unsuitability for imparting technical skills. This notwithstanding the proliferation and penetration of vernacular FM radio stations has boosted listenership as these stations air programs in the language that is most understood and preferred by the target groups (Makinen, 2007). Rogers (2003) observes that mass media channels like radio could be very important at the knowledge stage in the decision-innovation process of diffusion as it is the point that one first gains awareness of an innovation's existence and understanding of how it functions.

Other mass media such as television and newspapers are relatively more expensive. Makinen (2007) observed that only few Kenyans can afford to buy newspapers not to mention language barriers and illiteracy. In addition, due to their high cost television sets are owned by very few Kenyan households and thus have no impact in the rural areas (Makinen, 2007). As a result, the attractiveness of mass media channels as a whole reduces and that is why considerably more farmers were of the view that community-based or cosmopolite interpersonal channels were the most appropriate communication channels.

Community-based (cosmopolite interpersonal) channels that include farmer field days, on-farm demonstrations and workshops provide farmers with the opportunity to interact with each other as well as with other stakeholders. These communicative channels enable two-way flow between

sender and receiver thus providing opportunities for feed-back and enhanced interaction. According to Norrish *et.al.* (2001), these are the best channels for information/knowledge communication and dissemination as they elicit genuine participation, provide immediate feedback, and are effective in demonstrating a tangible technology or technique. Hence, it is not surprising that community-based channels were perceived to be very appropriate by a majority of the respondents in the study.

On the contrary, print-based channels such as brochures, books and even posters offered few advantages as far as farmers were concerned. These channels are disseminative in nature thus only allow one-way transmission of messages. Therefore, they do not provide opportunities for feedback and interaction between sender and receiver. In addition, print-based channels such as books are costly to farmers and also require some level of literacy for them to be effectively utilized. Socio-economic factors such as low education level and income have been mentioned as impediments to the utilization of print-based channels (Bationo *et.al.,* 2004; Sanginga and Woomer, 2009). Norrish *et.al.* (2001) mention some disadvantages of printed material that include difficulty of distribution, lack of impact especially where the target audience is not literate, fragility and susceptibility to wear and tear, and likelihood of being viewed as impersonal and thus be ignored. Therefore, it is understandable that rural farmers apparently are averse to seeking for agricultural information through printed material.

ICT-based channels such as DVD/CD videos, mobile phones and the internet also portended very minimal advantages to farmers a scenario that could be attributed to the relatively high costs of accessing them and complexity of use. The digital divide in Africa – a situation where there is a disparity in access to ICTs between rural and urban populations – has been a topic of discussion by many scholars (Oguya, 2006; Munyua, 2007; Sopazi and Andrew, 2005). High costs and

inadequate investment in infrastructure that can support internet services in rural areas has resulted in the failure of many poor and small-scale farmers to embrace the internet revolution thus the very low utilization of the internet. From observations, it was noted that there were very few cyber or internet cafes in the study area. There were also no recognized community resource centres or rural knowledge centres in Vihiga district whereas the other district had only two resource centres available to serve the farmers.

Mobile phones are in common use with approximately one member per every household in Kenya owning a mobile phone handset (Muriithi *et.al.*, 2009). However, mobile telephony has been underutilized as a tool for information acquisition largely due to the relatively high cost of airtime (recharge vouchers). Munyua (2007) comprehensively outlines various impediments to ICT development which include inadequate ICT infrastructure in terms of electricity and telecommunication facilities, high costs of ICTs and telecommunications due to poor infrastructure and presence of monopolies and oligopolies, low bandwidth leading to frustratingly low speeds, and weak or inadequate ICT policies. It is hoped that some of these problems will be overcome with the use of submarine and terrestrial cables that are being laid out in Africa. Among these is the East African Submarine Cable System (EASSy) fibre optic project that will connect Eastern Africa and part of Southern Africa to the rest of the world through the international fibre optic system hence enhancing high quality internet and international communication service (Echezona and Ugwuanyi, 2010; Munyua, 2007).

Thus, farmer field days and other community-based (cosmopolite interpersonal) channels which have been used extensively by stakeholders to communicate and disseminate ISFM information have significant advantages and should continue to be promoted. Therefore, the hypothesis that

existing communication and dissemination channels are not adequate and effective in imparting ISFM technologies was rejected.

4.2 Preference of ISFM information/knowledge sources and channels

Table 4.7 shows that many farmers (17%) preferred their own experience as an ISFM information source. Farmer groups and mass media followed closely at 14% and 12%, respectively. Information sources such as neighbours/friends had a preference rating of 9% while extension staff and research institutions had 7%. Churches and provincial administration had a preference rating of 6% and 4%, respectively. CBOs (3%), input suppliers (3%), learning institutions (3%) and NGOs (2%) were among information sources with few responses in terms of preference. Cooperatives were the least preferred information sources with a response of only 1%.

Table 4.7 Preference of ISFM information sources among farmers (Source: own data)

	Preference	
ISFM information sources	Type	% Response
Experience	Traditional	17
Farmer groups	Modern	14
Mass media	Modern	12
Ministry of Agriculture	Modern	9
Neighbors/friends/relatives	Traditional	9
Extension staff	Modern	7
Research institutions	Modern	7
Churches	Traditional	6
Provincial Administration	Modern	4
CBOs	Modern	3
Input suppliers	Modern	3
Learning institutions	Modern	3
NGOs	Modern	2
Agricultural companies	Modern	1
Other cooperatives	Modern	1
Farmer cooperatives	Modern	1
Total		100

Table 4.8 indicates that the most preferred knowledge sources were farmer groups and farmer field schools with 12% and 10% of the respondents, respectively, ranking them very highly. These were followed by documentary radio (9%), churches (8%) and brochures (8%). Provincial administration, researchers and seminars elicited a response of 7% while extension agents and NGOs elicited a response of 6%. These were followed by newspapers (5%), published papers, books and CBOs all at 4%, and farmer magazines (3%).The least preferred knowledge sources were websites eliciting a response of only 1%.

Table 4.8 Preference of ISFM knowledge sources among farmers (Source: own data)

		Preference
ISFM knowledge sources	Type	% Response
Farmer groups	Modern	12
Farmer Field Schools	Modern	10
Documentary radio	Modern	9
Churches	Traditional	8
Newsletters/Brochures	Modern	8
Provincial Administration	Modern	7
Researchers	Modern	7
Local training seminar	Modern	7
Extension agents	Modern	6
NGOs	Modern	6
Newspapers	Modern	5
Published papers	Modern	4
Books	Modern	4
CBOs	Modern	4
Farmer magazines	Modern	3
Websites	Modern	1
Total		100

Table 4.9 shows that farmer field days were the most preferred communication channel at 17% response followed closely by radio at 15%. Workshops and neighbours/friends came next in terms of preference at 11%. On-farm demonstrations and farm-to-farm visits elicited a response of 8% and 6%, respectively. Mobile phones, television, books and brochures all had a response of 4%. Billboards and newspapers had a response rate of 3% while internet and songs/poems elicited a low response of only 2%. The least preferred channels were DVD/CD players with a response of only 1%.

Table 4.9 Preference of ISFM communication and dissemination channels among farmers (Source: own data)

			Preference
ISFM channels	Type	Category	% Response
Farmer field days	Modern	Community-based	17
Radio	Modern	Mass media	15
Workshops/Seminars	Modern	Community-based	11
Neighbors/friends/relatives	Traditional	Interpersonal	11
On-farm demonstrations	Modern	Community-based	8
Provincial administration meetings	Modern	Community-based	6
Farm-to-farm visits	Modern	Community-based	6
Mobile phones	Modern	ICT-based	4
Television	Modern	Mass media	4
Books	Modern	Print-based	4
Brochures	Modern	Print-based	4
Billboards/Posters	Modern	Print-based	3
Newspapers/Magazines	Modern	Mass media	3
Internet	Modern	ICT-based	2
Songs/Poems	Traditional	Interpersonal	2
DVD/CD players	Modern	ICT-based	1
Total			100

In general, community-based (i.e. farmer field days, workshops, seminars, on-farm demonstrations, farm-to-farm visits, meetings) channels were by far the most preferred with 45% response as shown in Figure 4.15. These were followed by mass media (i.e. radio, television and newspapers) at 23% and local inter-personal (i.e. neighbours, friends, relatives, songs and poems) channels at 13%. The print-based (i.e. brochures, books, and posters) and ICT-based (i.e. mobile phones, internet and DVD/CD players) channels were least preferable eliciting a response of only 12% and 8%, respectively.

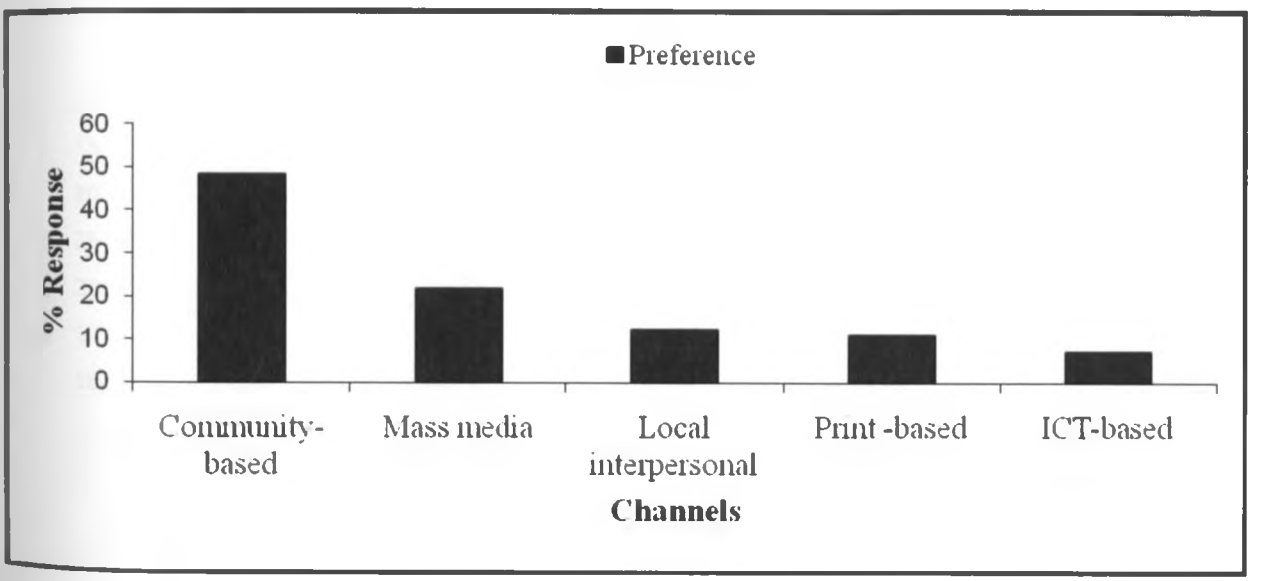

Figure 4.15 Farmers' preference for ISFM channel categories

From the statistical analysis shown in Figure 4.16, though community-based channels were more preferable than mass media and local interpersonal channels there was no significant difference in terms of preference. However, community-based channels were significantly preferred to ICT-based and print-based channels. The ICT and print-based channels were least preferable.

Local interpersonal and mass media channels though not significantly different from the other channels were less preferable in comparison to community-based channels on one hand but more preferable when compared to ICT-based and print-based channels on the other.

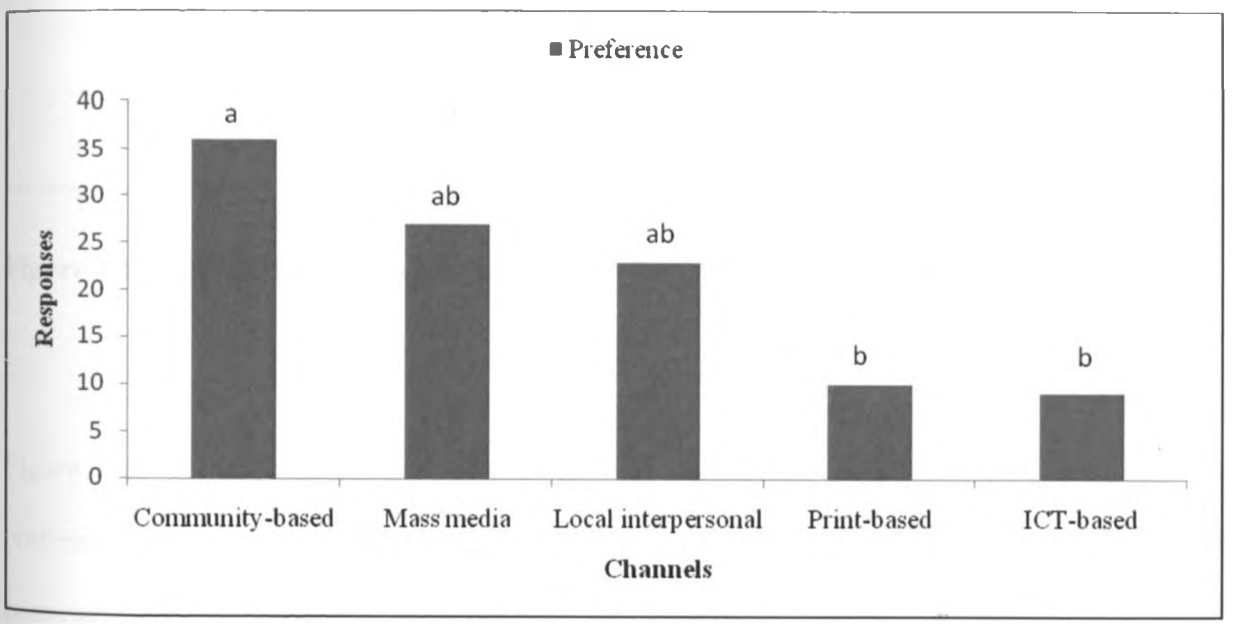

Figure 4.16 Preference of ISFM channel categories among farmers $P \leq 0.05$ Communication and dissemination channel categories with the same letters are not significantly different

As shown in Figure 4.17, most farmers highly preferred modern communication and dissemination channels with an 88% response being noted, as opposed to the traditional ones (12% response).

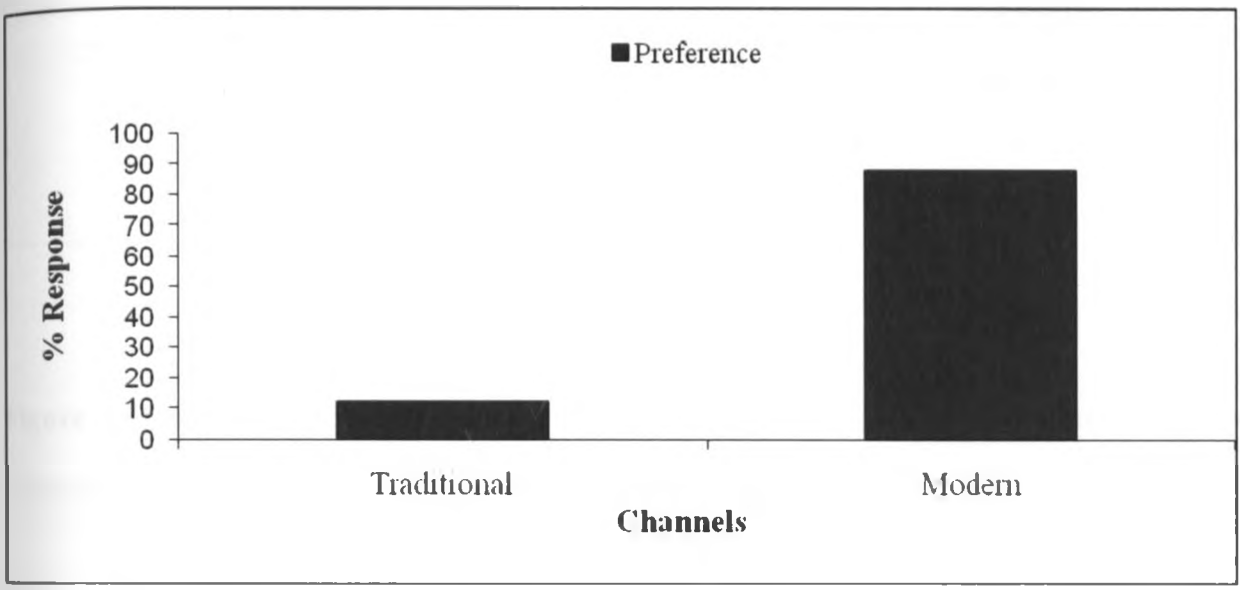

Figure 4.17 Comparison of farmer preference for traditional and modern channels

Figure 4.18 shows cosmopolite interpersonal or community based channels were the most preferred with a 59% response as compared to mass media (26%) and local interpersonal (15%) communication and dissemination channels.

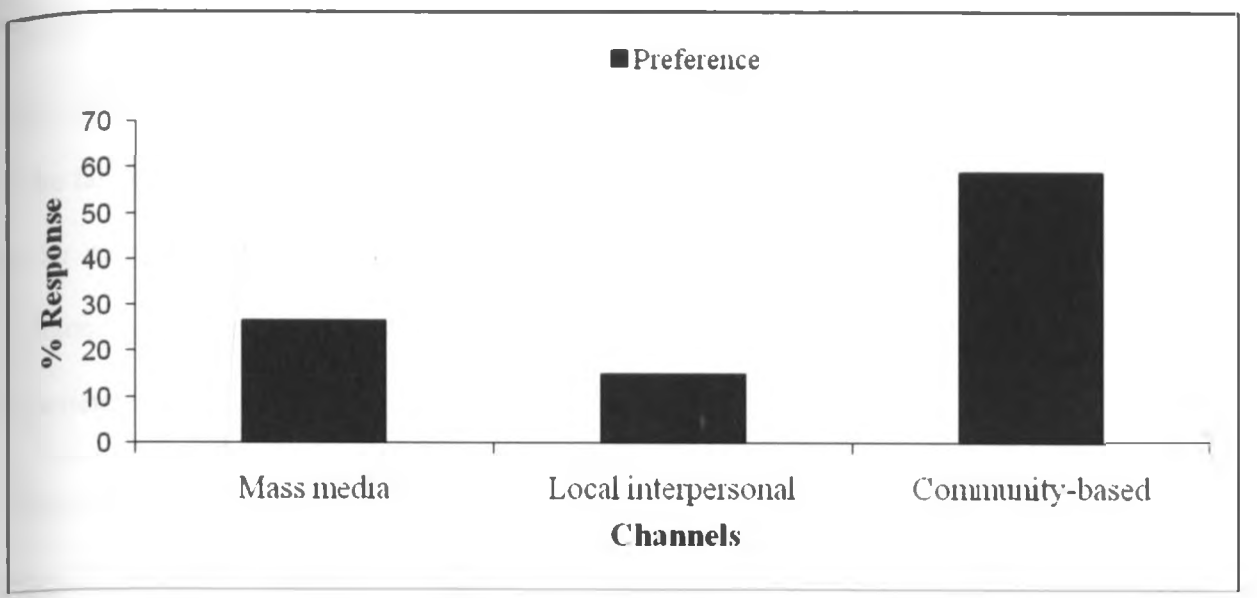

Figure 4.18 Comparison of farmer preference for mass media, local interpersonal and community-based interpersonal channels

Farmers may gain information on new innovations through interaction with peers which they internalize over time. They will often fall back on this information i.e. their own experience before they make important decisions. This information source was preferable to farmers because information is gained through a two-way, interactive process that entails feedback. The strong preference for farmer's own experience, which is a traditional source of information, has been noted in other similar studies. Farmers' own experience has been frequently cited as a source of information and given utmost importance when making decisions on the use of seed, fertilizers and pesticides (Boz and Ozcatalbas, 2010; Drafor and Atta-Agyepong, 2005). However, it is worthwhile to note that the ISFM paradigm is itself knowledge-intensive. This necessitates enhanced farmer interaction with external sources of information i.e. sources outside his/her

social system for example extension workers. Although farmers prefer or tend to use information they are more familiar with gained through their own individual experiences, it is crucial that these farmers interact with external sources of information through appropriate channels for them to be more ingrained in ISFM practices. In this way farmers will gradually integrate local indigenous knowledge with scientific knowledge thus making more meaningful use of their own experiences.

Sources of information like farmer cooperatives, agricultural companies, input dealers and learning institutions were not preferred by most farmers in the study area. These sources mostly involve the use of disseminative channels which are one-way and not interactive, and hence unattractive to farmers. In addition, most farmers in the study area predominantly grow food crops such as maize, beans, and bananas that are often not associated with cooperatives unlike cash crops. In support of this, Boz and Ozcatalbas (2010) observed that only farmers involved in capital-intensive activities like horticulture tend to use information sources such as cooperatives, agricultural companies, input dealers etc which they described as modern.

As shown by the results, community-based or cosmopolite interpersonal channels were the most preferred channels and significantly preferred to channels like the ICT-based and print-based ones (see Figure 4.16). These communicative channels are highly interactive and hence elicit feedback which plays an essential part in farmers and other stakeholders reaching a mutual understanding. This eventually facilitates uptake of technologies by farmers. Cosmopolite interpersonal channels have been found to be very important in developing countries, and may even be used instead of mass media at knowledge stage in the innovation-decision (information-decision) process, as mass media are not widely available (Rogers, 2003). Farmer field days are extension approaches in which farmers gather at a particular farmer's plot whereby a specific

topic is demonstrated and discussed with extension agents and researchers (Amudavi *et.al.,* 2009; Place *et.al.,* 2005). Field days provide opportunities for publicizing information and knowledge from on-farm testing and research observations and for obtaining feedback for improving future research (Oswald, 2005). Effectiveness of farmer field days is borne out of the fact that they provide a platform for sharing information on various farm practices and exchanging experiences, thereby facilitating farmer-to-farmer technology dissemination (Knowler and Bradshaw, 2007). The more experienced farmers anchor the working mechanism of field days as they become the best discussion partners for other farmers, and jointly they assess the worthiness of technologies and appropriateness to their farming conditions (Amudavi *et.al.,* 2009).

Farmer groups and farmer field schools are popular as knowledge sources because they foster solidarity and build in-group morale (Ramisch *et.al.,* 2006). This is where farmers get to internalize knowledge created and organized by the flow of information streams. They thus offer a suitable platform where farmers can meet their peers and exchange ideas, information and knowledge.

The low preference for websites as knowledge sources could be attributed to the prevailing high cost of internet access in Africa (Oguya, 2006; Munyua, 2007). Inadequate infrastructure, low band-width and weak policies are some of the obstacles to the growth of the ICT sector in rural areas. This has resulted in the failure of many poor and small-scale farmers to embrace the internet revolution thus the very low utilization of websites.

Although, radio are not as interactive as community-based channels they are nonetheless popular with rural people (or farmers) as they have numerous merits. Radio was the second most preferred channel after farmer field days (see Table 4.9). The relatively high preference of radio could be attributed to its many advantages that include relative affordability, wide geographical

reach, entertainment, portability, and stimulation of the imagination (Norrish *et.al.,* 2001). However, it is worthwhile noting that with the emergence of community FM radio stations which are more interactive than conventional radio stations, radio will become an even more viable channel of communication.

Therefore, according to this study farmers tend to prefer modern, cosmopolite channels of communication i.e. cosmopolite interpersonal (community-based) channels such as farmer field days which are normally organized by extension agents and researchers rather than traditional, local interpersonal ones. Therefore, the hypothesis that farmers prefer traditional, interpersonal channels was rejected. It was also noted that farmer groups and Farmer Field Schools (FFS) were preferred as knowledge sources, which may be similar but not necessarily synonymous with information sources, while farmers' own experience was preferred as an information source.

4.3 Farmer needs influencing preference

Figure 4.19 illustrates that the need for a farmer to gain information or knowledge (information/knowledge needs) at 53% was by far the most influential need affecting preference for any particular information source. This means that farmers will prefer information sources that they consider informative. The second most influential need influencing farmers' preference for information sources was personal integrative needs i.e. status, credibility at 24% followed by other needs which a total influence of only 23%.

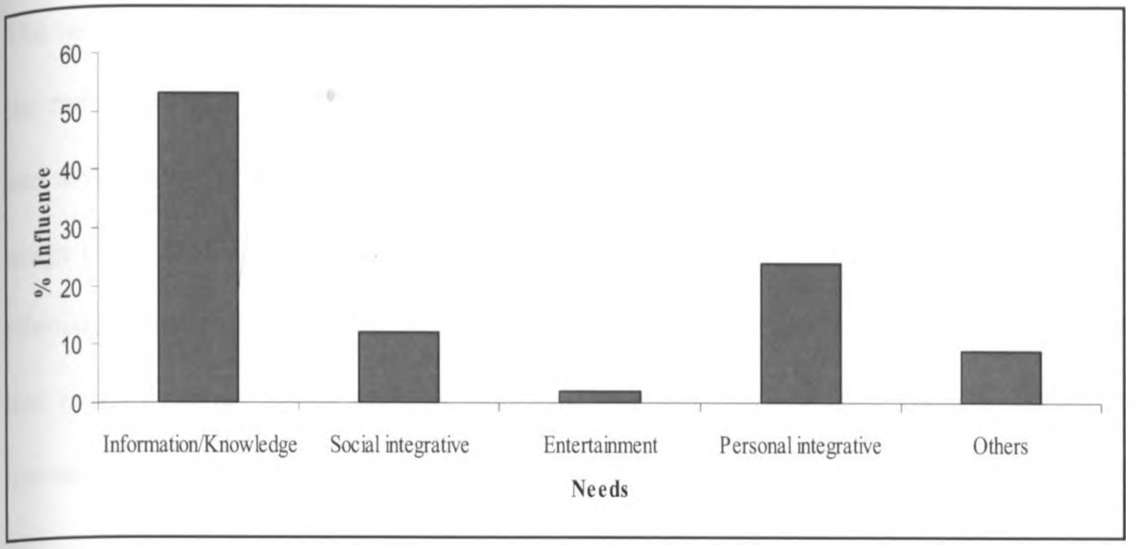

Figure 4.19 Farmer needs influencing preference for ISFM information sources

Similarly, figure 4.20 shows that information/knowledge needs were quite influential in determining farmers' preference for ISFM communication and dissemination channels at 55% influence. Implying that farmers prefer channels they conceive will enable them to be more informed or knowledgeable. Personal integrative needs came second at 25% influence, followed by the other needs which had only a total influence of 20%.

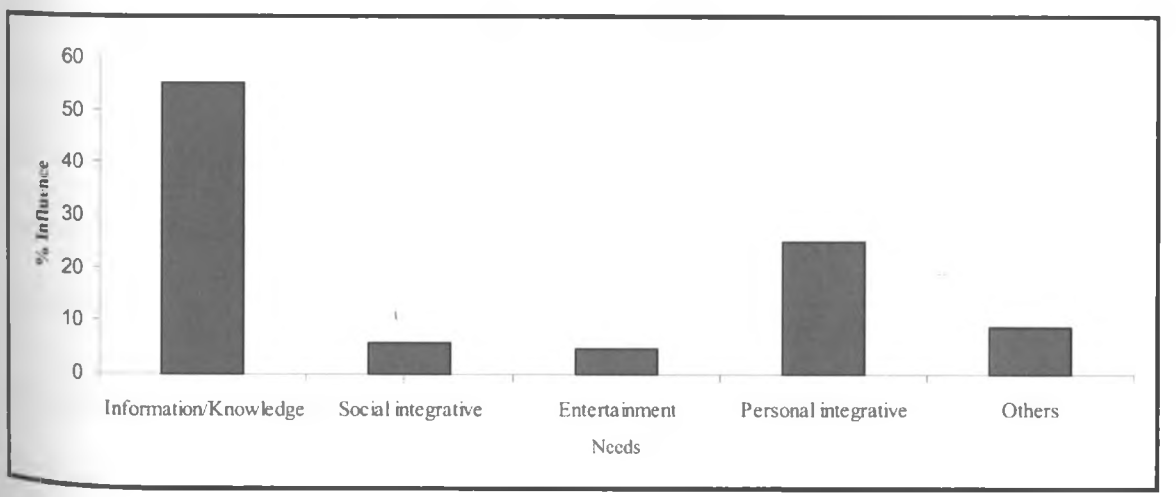

Figure 4.20 Farmer needs influencing preference for ISFM channels

The uses and gratifications theory which was first developed in research on the effectiveness of the radio medium in the 1940s focuses on the explanations for audience members' motivations and associated behaviors, and also emphasizes that media users are actively involved in media usage (Luo, 2002). It has also been applied in the context of various other mass media such as television, electronic bulletins and more recently websites (Cho and Ha, 2004). It has been found that certain human needs such as information acquisition, tension release, escape, and social interaction influence the media people are likely to use to serve their gratifications. For instance, Luo (2002) found that certain kinds of television programs related to various human needs, including information acquisition, escape, emotional release (entertainment needs), companionship (social integrative needs), reality exploration, and value reinforcement (personal integrative needs).

Thus, it can be deduced that the need for farmers to acquire information and knowledge was the major motivation for them to use radio. As shown in Table 4.9, radio was one of the channels highly preferred by farmers in the study and it is apparent that they were driven to choose this particular medium by the need to acquire information or be informed as illustrated in Figure 4.20. In addition, radio was more suitable to farmers as opposed to the other synonymous media within the scope of the uses and gratification theory, such as television or websites because of its numerous advantages that include affordability, ease of access, reliability, informativeness and portability.

4.4 Influence of Socio-economic Factors on Access and Uptake of ISFM

Socio-economic factors e.g. age, farm size, income level, education level cannot be overlooked as they play a major role in determining the media through which farmers are likely to receive information on soil fertility technologies and the subsequent uptake of these technologies. For

instance, it has been suggested that resource-poor farmers have limited access to information on current agricultural innovations such as ISFM thus curtailing the application of these novel practices. A probit model was used to measure the influence of some socio-economic variables on access to ISFM information and knowledge and its subsequent uptake.

4.4.1 Influence of socio-economic factors on ISFM access

Table 4.10 shows that education level, distance from nearest information centre, livestock value and district farmer resides in as the socio-economic variables significantly influencing farmer access to ISFM information and knowledge. Education level and livestock value positively significantly influenced access to ISFM information/knowledge at 5% level. This suggests that as education level and livestock value increased so did farmer access to information and knowledge and vice-versa.

On the other hand, district of residence and distance from nearest information centre negatively significantly influenced access to ISFM information/knowledge also at 5% level. This means that as distance from nearest information centre increased, access to ISFM information and knowledge decreased and vice-versa. The other important implication is that farmers in Siaya district were more likely to access ISFM information as compared to those in Vihiga district.

Table 4.10 Probit regression analysis of factors influencing farmer access to ISFM information and Knowledge in Siaya and Vihiga Districts

Access	Coef.	Std. Err.	Z	P>| z |
Age	0.023	0.032	0.700	0.482
Livestval	0.000	0.000	2.120	0.034**
Offinco	-0.000	0.000	-0.530	0.593
Educ	0.327	0.141	2.330	0.020**
Distinfo	-0.221	0.099	-2.220	0.026**
Farmsize	-0.327	0.315	-1.040	0.300
Dist	-2.066	0.919	-2.25	0.025**
Extension	1.153	0.763	1.510	0.131
cons	0.847	1.068	0.79	0.428

Log likelihood = -14.366, LR $chi^2(8) = 41.52$, Prob > $chi^2 = 0.000$, Pseudo $R^2 = 0.591$
Key: Significant at ** 5%.

Table 4.11 shows a probit regression reporting marginal effects of the independent variables on access of ISFM information and knowledge (the dependent variable). The marginal effect is the percentage change in the probability of adoption (or access of information and knowledge in this case) associated with a unit increase of the variable from the mean value (Marenya and Barrett, 2007). For instance, if education level increased by a 100% then the probability of access to information/knowledge would increase by 7% (Table 4.11). Similarly, if distance from a farmer's homestead to the nearest information centre was to be decreased by 100% then the probability of access to ISFM information and knowledge would increase by 4.8%.

Table 4.11 Marginal effects on access of ISFM information and knowledge

Variable	dy/dx	Std. Err.	z	P>|z|
Age	0.005	0.007	0.720	0.469
Livestval	0.000	0.000	2.230	0.026
Offinco	-0.000	0.000	-0.510	0.613
Educ	0.070	0.390	1.820	0.069
Distinfo	-0.048	0.019	-2.470	0.014
Farmsize	-0.071	0.076	-0.930	0.352
Dist*	-0.476	0.220	-2.170	0.030
Extension*	0.244	0.145	1.680	0.092

* dy/dx is for discrete change of dummy variable from 0 to 1, y = Pr (access) (predict) = 0.866

Education level is one of the socio-economic variables that this study found to be significantly important for access of information. The process of information seeking and access generally requires the information seeker to have attained some level of literacy. Furthermore, knowledge-intensive technologies such as ISFM demand for a relatively high cognitive ability on the part of farmers for them to be effectively understood as espoused by Marenya and Barrett (2007). Thus, it is more likely that a farmer of a higher education level (e.g. high school or college graduate) will access up-to-date or current agricultural information as opposed to a farmer who is illiterate or semi-illiterate and would normally be unable to decipher information in an agricultural brochure or even from a workshop organized by extensionists or researchers. The low level of literacy among smallholder farmers in sub Saharan Africa (SSA), western Kenya included, has been identified as a major constraint to effective communication and dissemination of soil fertility information thus acting as major impediment to its access by farmers (Ofuoku *et.al.*, 2008; Sanginga and Woomer, 2009).

Livestock ownership is one of the indicators of the wealth status of farmers and livestock are also an additional source of income some of which can be used to facilitate the farmer to access or seek for information. For example, such a farmer can afford to spare some money for transport to attend a field day or to purchase air time (mobile recharge vouchers) so as to obtain information. The ownership of livestock contributes to wealth status and if farmers are more wealthy they will more often than not be motivated to continue to seek for and access relevant information using various channels so as to cater for their information needs (Dutta, 2009; Sabo, 2007). In general, farmers endowed with resources such as livestock are more likely to access information on new agricultural technologies and consequently adopt them in stark contrast to poor farmers. In support this Bationo *et.al.* (2004) reported that resource-poor farmers in western Kenya had no access to sources and media through which they could receive useful information on soil fertility interventions unlike wealthier farmers.

Rural knowledge centres or community resource centres provide basic communication services to rural communities such as telephone, fax, library, internet, email, community radio and video shows (Asaba *et.al.,* 2006). In the study area, farmers in Siaya district had the option of patronizing North Gem (Malanga) and Simero community resource centres. Unfortunately, there were no such knowledge centres in Vihiga (Emuhaya) district but farmers had the option of visiting Ebusiratsi Divisional Quarters, which is not equipped with ICT facilities such as computers, or the cyber cafes (commercial service providers of internet access) in Luanda town. These cyber cafes are, however, some distance from most of the farms posing additional predicaments e.g. transport costs. Therefore, this is a likely contributory factor to the higher likelihood of farmers in Siaya district having more access to information than their counterparts in Vihiga district as shown by the probit model in Table 4.10. Thus the further the distance of

information and knowledge centres from a farmer's residence the lesser the likelihood that particular farmer will access information and vice versa. This is why the aspect of distance from information/knowledge centres is very crucial and is a significant influence on the access a farmer has to agricultural knowledge (Aina, 2006; Asaba *et.al.*, 2006).

Therefore, the null hypothesis that socio-economic factors have no influence on farmer access to ISFM information and knowledge was rejected and the alternative accepted as education level, livestock value, distance from nearest information centre and district of residence were deemed to be significant.

4.4.2 Influence of socio-economic factors on ISFM uptake

Table 4.12 shows a probit regression analysis reporting effects of some selected variables on farmer application of ISFM. Education level of farmer was significant at 1% level and positively influenced uptake of ISFM. Livestock value and off-farm income were significant at 10% level. Livestock value positively influenced uptake of ISFM whereas off-farm income negatively influenced uptake of ISFM.

Age, farm size, district of residence and extension visits were the socio-economic variables found not to significantly influence uptake of ISFM (Table 4.12).

Table 4.12 Probit regression analysis of factors influencing farmer uptake of ISFM in Siaya and Vihiga Districts

Appisfm	Coef.	Std. Err.	z	P>| z |
Age	0.020	0.019	1.040	0.298
Livestval	0.000	0.000	1.890	0.058*
Offinco	-0.001	0.001	-1.780	0.075*
Educ	0.319	0.103	3.080	0.002***
Farmsize	-0.223	0.247	-0.900	0.366
Dist	-0.501	0.651	-0.770	0.442
Extension	0.773	0.528	1.460	0.144
Cons	-3.680	1.390	-2.650	0.008

Log likelihood = -21.282, LR chi^2 (8) = 28.12, Prob > chi^2 = 0.0005, Pseudo R^2 = 0.398

Key: Significant at *10% and *** 1%

Table 4.13 shows the marginal effects after a probit regression of the independent variables against ISFM uptake. For instance, a 100% increase in education level would increase probability of ISFM uptake by 12.7 %.

Table 4.13 Marginal effects of variables on ISFM uptake after probit

Variable	dy/dx	Std. Err.	z	P>| z |
Age	0.007	0.008	1.040	0.298
Livestval	0.000	0.000	1.910	0.057
Offinco	-0.000	0.000	-1.780	0.075
Educ	0.127	0.041	3.070	0.002
Farmsize	-0.089	0.099	-0.900	0.366
Dist*	-0.198	0.252	-0.780	0.560
Extension*	0.300	0.194	1.550	0.122

* dy/dx is for discrete change of dummy variable from 0 to 1, y = Pr (access) (predict) = 0.512

As shown by the results, the level of education of the farmer was crucially important as far as uptake of ISFM was concerned. As mentioned earlier, a farmer was considered to have adopted ISFM when he/she used improved seeds, inorganic fertilizers with a combination of organic fertilizers (e.g. manure). Marenya and Barrett (2007) mentioned education level as one of the factors immensely influencing adoption of ISFM. The major reason for this has been that ISFM practices are knowledge-intensive and thus require considerable management input (Marenya and Barrett, 2007; Tittonnel *et.al.,* 2008). Formal education predisposes an increased managerial ability and cognitive capacity in an individual (Marenya and Barrett, 2007). It is therefore imperative that focus be placed squarely on training farmers in the study area on management and skill building while at the same time encouraging younger members of the farm household to pursue formal education to at least secondary level.

Livestock are very crucial in a farming system as they are a major source of manure and draft power. Therefore, there is no doubt that the more livestock a farmer has the higher the likelihood of the cost-effective use of manure to replenish soil fertility as the need to purchase it is reduced. Livestock are also an additional source of income some of which can be used to purchase inputs like fertilizer and improved seed which are very necessary for the application of ISFM. Shortage of livestock has been mentioned as a constraint to the uptake of inorganic fertilizer and new cultivars (Wubeneh and Sanders, 2006).

Off-farm income was the other significant factor influencing uptake of ISFM. Off-farm income negatively influenced ISFM uptake as it is possible that individuals with higher off-farm incomes invested their time, energies and money in non-farm activities at the expense of ISFM-related activities. According to Reardon *et.al.* (2000), the micro "Dutch Disease" effect arising from better opportunities in the non-farm sector divests investments from the farm resulting in non-

adoption of new technologies. Reardon *et.al.* (2000) further mentioned this as one the reasons for farmers' failure to adopt hybrid maize in Botswana.

The district a farmer resided in was found not to be influential in influencing uptake of ISFM. This is because the key factors that lead to non-adoption of agricultural innovations apply equally across the two districts. Lack of awareness of new technologies, poverty, illiteracy among other reasons have been cited as causes of low adoption and this applies across the western Kenya region (Bationo *et.al.,* 2004; Odendo *et.al.,* 2006; Sanginga and Woomer, 2009).

Thus the null hypothesis that socio-economic factors have no influence on farmer uptake of ISFM was rejected and the alternative accepted as education level, livestock value and off-farm income were found to be significantly influential.

4.5 Impact of ISFM knowledge access and application

As shown in Table 4.14 farmer access and application of ISFM knowledge had a significant effect on maize yield, $F(1, 10) = 7.85$, $p < 0.05$.

Table 4.14 Single factor ANOVA of ISFM knowledge access and application effect on maize yield

Source of Variation	*SS*	*Df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	6622295.00	1	6622295.00	7.85	0.02	4.97
Within Groups	8434233.00	10	843423.30			
Total	15056528.00	11				

Similarly, farmer access and application of ISFM knowledge had a significant effect on bean yield, $F(1, 24) = 7.40$, $p < 0.05$ (Table 4.15).

Table 4.15 Single factor ANOVA of ISFM knowledge access and application effect on bean yield

Source of Variation	*SS*	*Df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	509258.40	1	509258.40	7.40	0.01	4.26
Within Groups	1652532.00	24	68855.52			
Total	2161791.00	25				

This demonstrates that access to agricultural information and knowledge enhanced farmer productivity more so in terms of crop yields. According to Asaba *et.al.* (2006), agricultural information is a key component in improving small-scale agricultural production and linking increased production to markets, thus leading to improved rural livelihoods, food security and national economies. Therefore, it is imperative information flow to agricultural producers through appropriate dissemination and communication channels is enhanced.

4.6 Role of Extension Agents in ISFM Communication and Dissemination

As indicated in Tables 4.10 and 4.12, extension visits had no significant effect on farmer access to ISFM information and knowledge and eventual uptake. The inconsequentiality of extension visits and the ensuing lack of impact has been a subject of discussion among extension scholars (Chirwa *et.al.*, 2005; Feder *et.al.,* 2010). This is a pointer to the inefficiency of the agricultural extension systems in developing countries.

While farmers consider agricultural information disseminated and communicated by public extension agents to be accurate and reliable their overall impact on farmer adoption of new technologies is lacking due to problems associated with the extension system in Kenya. Public extension agents in Kenya face numerous constraints which hinder them from carrying out their

functions effectively. The various problems encountered by extension agents have been occasioned by inadequate funding from the government and donors (Feder *et.al.*, 2010; Nambiro *et.al.*, 2005). Constraints include lack of adequate fuel and maintenance of the few available vehicles and motorbikes, lack of communication gadgets like mobile phones, lack of equipment to deliver services, under-staffing and conflict of interest between government and other service providers e.g. NGOs. Feder *et.al.* (2010) cites bureaucratic inefficiency, poor program design and implementation as factors that have led to poor performance and disjointed links with client farmers and researchers. This has led to poor penetration of extension activities in rural areas, especially in the more interior and inaccessible parts.

Cases of conflict of interest arise when NGOs give incentives and provide some services for free resulting in a situation where communities are inclined to ignore the services offered by government extensionists. This is corroborated by Muyanga and Jayne (2006) who report the incidences of conflict where some extension providers give out materials (e.g. seeds, goats, heifers, etc) for free while others strongly advocate for cost recovery leading to high expectations by the community and confusing clients in the process. Extension agents have a role to play in the dissemination and communication of ISFM information and knowledge to farmers but they should be facilitated in carrying out their duties so as to have more impact.

CHAPTER 5

5.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

The study findings showed that community-based and mass media channels have the most strengths and advantages as vehicles of communicating and disseminating ISFM information and knowledge. Community-based channels were also significantly preferable among farmers. Socio-economic variables (e.g. education level, wealth status, and distance from information centres) had a significant influence on farmer access to ISFM information and knowledge and subsequent uptake.

5.2 Conclusions

Community-based and mass media channels had numerous strengths hence were considered more advantageous by farmers than the other channels. Therefore, they are most suitable for the communication and dissemination of ISFM information and knowledge to farmers. Farmer field days and radio and were the two channels considered by many farmers in the study to be highly accessible, reliable, informative and comprehensible. The community-based channel category was significantly preferable among farmers with farmer field days among the most favored communication channels.

However, there is need for researchers, extension workers and policy makers to consider exploiting the use of community FM radio stations to promote the application of ISFM in the region as they have largely been under-utilized despite the numerous advantages of radio. Farmer groups and Farmer Field Schools (FFS) and farmer groups are also a good concepts which should

continue to be supported by the relevant stakeholders as they are very popular knowledge sources among farmers. It was also noted from this study that access to agricultural information and knowledge improved crop yields, therefore, enhancing farmer productivity. It is imperative that information flow to agricultural producers is enhanced by intensifying the use of appropriate communication channels i.e. community-based channels like field days as well as other channels like radio which are also suitable.

Education levels of farmers were found to be significant with regards to access and uptake or application of ISFM information and knowledge. It is hoped the initiative taken by the government of Kenya (G.o.K) in providing free primary and secondary education will boost literacy levels in the country. Education will also be very crucial in bridging the digital divide between resource-poor farmers in the rural areas and people in the urban areas (like researchers, policy makers and some extensionists). Farmers who are more educated would be in a better position to utilize ICTs, which are relatively complex, in acquiring information efficiently and cost-effectively.

Rural Knowledge Centres (RKCs), libraries, Market Information Centres (MICs) and other information centres are significant crucial conduits of ISFM information and knowledge delivery. Increasing their numbers in the two districts/counties will shorten distances to the centres and in increase availability of information as there will be more information and knowledge centres in the community as opposed to the current situation. These centres should necessarily be equipped with ICT facilities like computers, high-speed internet, telephones, mobile phones and faxes so that the digital divide is bridged. The initiative to lay out submarine and terrestrial cables in several African countries (Kenya included) e.g. the East African Submarine Cable System

(EASSy) fibre optic project, is anticipated to boost internet speeds thus contributing to decreasing the digital divide.

Although community-based channels are very important to farmers, it has been suggested in other quarters that it is always best to use a combination of channels (Opara, 2008). Therefore, initiatives to boost the use ICTs among rural farmers should be promoted to complement community-based channels for faster and more efficient ISFM information delivery.

Farmer asset endowment was noted as a factor significantly influencing access to information and knowledge, and the subsequent uptake of ISFM. Livestock ownership, a key indicator of the wealth status of farmers, was found to increase farmer access to information and knowledge as this provided additional income that was used for purposes of seeking for information. In addition, livestock are extremely crucial as they provide manure, which is an important component of ISFM.

Lastly, there is need to ensure extension agents are equipped with the requisite facilities as well as streamlining their activities so as to improve the efficiency with which they provide extension services for greater impact in information and knowledge delivery. Farmers need to be engaged, persuaded and shown the benefits of ISFM through farmer field days and demonstrations in order for them to learn, ask questions and provide their own feedback to the extension workers as well as researchers.

5.3 Recommendations

The following recommendations are proposed:

1. Farmer field days and other community-based (cosmopolite interpersonal) communication channels which have been used extensively by stakeholders (research agencies, NGOs, NARES, CBOs) have their advantages and should continue to be promoted.

2. Stakeholders (research agencies, NGOs, NARES, CBOs) should take the necessary measures to promote the use of community FM radio stations to convey messages on ISFM.

3. AfSIS project staff, agricultural NGOs, extension agents and other stakeholders to train and educate farmers on the benefits of ISFM as well as on general crop and animal management.

4. Adult literacy programs should be promoted in the region while at the same time encouraging younger members of the farm household to pursue formal education to at least to secondary level.

5. Agricultural stakeholders i.e. research agencies, NGOs, Government of Kenya etc. should invest adequately in Rural Knowledge Centres (RKCs), libraries, Market Information Centres (MICs) and other information centres to augment the already existing ones i.e. Malanga and Simero community resource centres in Siaya District, and equip them with ICT facilities like computers, high-speed internet, telephones, mobile phones and faxes.

6. Specific measures should be expedited to improve wealth status of farmers in the region. Relevant policy initiatives such as the re-introduction of fertilizer subsidies, like has been done in Malawi, would considerably improve living conditions and overall wealth

status of the farmers not to mention general improvement in food security and crop production.

7. Stakeholders should take measures to boost the use of ICTs among rural farmers as they are currently not favored thus being under-utilized e.g. information transfer using mobile phones via short message service (SMS) at subsidized rates.

8. Agricultural extension in Kenya should be facilitated with necessary equipment and funds for them to still remain relevant in terms of information and knowledge delivery to rural farmers.

REFERENCES

Aina, L.O. 2006. Information provision to farmers in Africa: The library-extension service linkage. World Library and Information Congress: 72nd IFLA General Conference and Council 20-24 August 2006, Seoul, Korea. Available on-line at http://www.ifla.org/IV/ifla72/papers/103-Aina-en.pdf (Accessed 02.12.09).

Alley, M. and Vanlauwe, B. 2009. The role of fertilizers in integrated plant nutrient management. International Fertilizer Industry Assosiation. Tropical Soil Biology and Fertility Institute of the International Centre for Tropical Agriculture. Availale online at http://www.fertilizer.org (Accessed 18.09.10).

Allison, P.D. 1999. Comparing logit and probit coefficients across groups. *Sociological Methods & Research* 28(2): 186-208.

Amudavi, D.M., Khan, Z.R., Wanyama, J.M., Midega, C.A.O., Pittchar, J., Hassanali, A. and Pickett, J.A. 2009. Evaluation of farmers' field days as a dissemination tool for push-pull technology in Western Kenya. *Crop Protection* 28: 225-335.

Asaba, J.F., Musebe, R., Kimani, M., Day, R., Nkonu, M., Mukhebi, A., Wesonga, A., Mbula, R., Balaba, P., and Nakagwa, A. 2006. Bridging the information and knowledge gap between urban and rural communities through rural knowledge centres: case studies from Kenya and Uganda. *Quarterly Bulletin of IAALD*, 51(4): 143-151.

Ajayi, O.J. and Gunn, E.E. 2009. The role of communication in dissemination of improved agricultural technology in Bosso Local Government area of Niger, Nigeria. *Journal of Agricultural Extension* 13 (1): 66-72.

Asenso-Okyere, K. and Davis, K. 2009. Knowledge and Innovation for agricultural development. IFPRI Policy Brief 11.

Bationo, A., Kimetu, J., Ikerra, S., Kimani, S., Mugendi, D., Odendo, M., Silver, M., Swift, M.J., Sanginga, N., 2004. The African network for soil biology and fertility: new challenges and opportunities. In: Bationo, A. (Ed.), Managing Nutrient Cycles to Sustain Soil Fertility in Sub-Saharan Africa. Academy Science Publishers, Nairobi, Kenya.

Bationo, A., Kihara, J., Vanlauwe, B., Waswa, B., and Kimetu, J. 2007. Soil organic carbon dynamics, functions and management in West African agro-ecosystems. *Agricultural Systems* 94: 13–25.

Boz, I. and Ozcatalbas O. 2010. Determining information sources used by crop producers: A case study of Gaziantep province in Turkey. *African Journal of Agricultural Research* 5(10): 980-987.

Brooks, S., Thompson, J., Odame, H., Kibaara, B., Nderitu, S., Karin, F. and Millstone, E. 2009. Environmental Change and Maize Innovation in Kenya: Exploring Pathways In and Out of Maize, STEPS Working Paper 36, Brighton: STEPS Centre

Chirwa, E. W. 2005. Adoption of fertiliser and hybrid seeds by smallholder maize farmers in Southern Malawi. *Development Southern Africa*, 22: 1, 1-12.

Cho, Y. and Ha, J. (2004), "Users' attitudes towards movie-related websites and E-Satisfaction *Journal of Business and Economics Research* 2(3): 13 - 28.

Damisa, M.A. and Igonoh, E. 2007. An Evaluation of the adoption of integrated soil fertility management practices among women farmers in Danja, Nigeria. *The Journal of Agricultural Education and Extension* 13(2): 107-116.

Davis, K. 2008. Extension in Sub-Saharan Africa: Overview and assessment of past and current models and future prospects. *Journal of International Agricultural and Extension Education* 15(3): 15-28.

Drafor, I. and Atta-Agyepong, K. 2005. Local information systems for community development in Ghana. In: Dixon, J., Wattenbach, H. and Bishop-Sambrook, C. (Eds.) Improving information flows to the rural community. Agricultural Management, Marketing and Finance Occasional Paper 9. FAO, Rome. pp. 5-17.

Dutta, R. 2009. Information needs and information-seeking behavior in developing countries: A review of the research. *The International Information & Library Review* 41: 44-51.

Echezona, R.I. and. Ugwuanyi, C.F . 2010. African university libraries and internet connectivity: Challenges and the way forward *Library Philosophy and Practice* (September). Available online at **http://unllib.unl.edu/LPP/echezona-ugwuanyi.pdf** (Accessed 28.09.10).

Etebu, A. T. 2009. Information for rural communities: A solution for sustainable development in the Niger Delta.*Library Philosophy and Practice* (November), 1-5.

Feder, G., Anderson, J.R., Birner, R. and Deininger, K. 2010. Promises and realities of community-based agricultural extension. International Food Policy Research Institurte (IFPRI), Discussion Paper 00959.

Floridi, L. 2005. Is information meaningful data? *Philosophy and Phenomenological Research* 70 (2): 351- 70.

Franzel S., Cooper P., Denning G. 2001. Scaling up the benefits of agro-forestry research: lessons learned and research challenges. *Development in Practice* 11:524–534.

Greene, W.H. 2002. Econometric analysis - 5th ed. Pearson Education, Inc., New Jersey, 983 pp.

Israel, G.D. 1992. Determining sample size. IFAS. PE0D-6.

Jaetzold, R., Schmidt, H., Hornet, B. and Shisanya, C. 2005. Farm management handbook: Natural conditions and farm management information. Available online at *www2.gtz.de/dokumente/bib/07-1282.pdf* (Accessed 9.08.10)

Kiptot, E., Franzel, S., Hebinck, P., and Richards, P. 2006. Sharing seed and knowledge: farmer to farmer dissemination of agro-forestry technologies in western Kenya. *Agroforestry Systems* 68:167-179.

Kiptot, E. 2008. Adoption dynamics of *Tithonia Diversifolia* for soil fertility management in pilot villages of western Kenya. *Experimental Agriculture* 44: 473–484.

Kledal, P.R., Oyiera, H.F., Njoroge, J.W. and Kiarii, E. 2009. Organic Food and Farming in Kenya. In: Helga, W. and Kilcher, L. (Eds.) The World of Organic Agriculture – statistics and emerging trends. International Federation of Organic Agriculture Movements (IFOAM), Bonn and Fibl, Switzerland, pp. 127-133

Knowler, D. and Bradshaw, B., 2007. Farmers' adoption of conservation agriculture: a review and synthesis of recent research. *Food Policy* 32: 25–48.

Livingston, G., Schonberger, S. and Delaney, S. 2011. Sub-Saharan Africa: The state of smallholders in agriculture. Paper presented at the IFAD Conference on New Directions for Smallholder Agriculture, 24-25 January, 2011. Available online at http://www.ifad.org/events/agriculture/doc/papers/livingston.pdf (Accessed 02.05.11).

Losee, R.M. 1997. A discipline-independent definition of information. *Journal of the American Society for Information Science* 48(3):254–269.

Luo, X. 2002. Uses and gratifications theory and e-consumer behaviors: A Structural Equation Modeling Study. *Journal of Interactive Advertising* (2:2) Spring. Available online at http://jiad.org/vol2/no2/luo/ (Accessed 12.01.10)

Makinen, M. 2007. Background study report for the project Mapya? – Social Media and Children in Low Income Communities *Journalism Research and Development Centre, University of Tampere.* Available on-line at *http://www.uta.fi/jour/jourtutkimus/mediakenya.pdf* (Accessed 18.06.10)

Mango, N.A.R. 1999. Integrated soil fertility management in Siaya District, Kenya. Networking on soil fertility management: improving soil fertility in Africa-Nutrient networks & stakeholder perceptions (NUTNET).Managing Africa's Soils No. 7, 28 pp.

Marenya, P.P. and Barrett, C.B. 2007. Household-level determinants of adoption of improved natural resources management practices among smallholder farmers in western Kenya. *Food Policy* 32: 515–536.

Misiko, M. and Ramisch, J. 2007. Integrated soil fertility management technologies: Review for scaling up. In: Bationo, A., Waswa, B., Kihara, J. and Kimetu, J. (Eds) Advances in integrated soil fertility management in sub-Saharan Africa: Challenges and opportunities. Springer, Dordrecht, The Netherlands, pp. 873-880.

Momodu, M. 2002. Information needs and information seeking behaviour of rural dwellers in Nigeria: a case study of Ekpoma in Esan West local government area of Edo state, Nigeria. *Library Review*, 51(8), 406-410.

Mulwa, R., Emrouznejad, A. and Muhammad, L. 2009. Economic efficiency of smallholder maize producers in western Kenya: a DEA meta-frontier analysis. *International Journal of Operational Research* 6: 250–267.

Munyua, H. 2007. ICTs and small-scale agriculture: A scoping study. Ottawa: IDRC.

Muriithi, A.G., Bett, E. and Ogaleh, S.A. 2009. Information technology for agriculture and rural development in Africa: Experiences from Kenya. In: Proceedings of the conference on International Research on Food Security, Natural Resource Management and Rural Development held at the University of Hamburg, October 6-8, 2009. Available on-line at http://www.tropentag.de/2009/abstracts/full/740.pdf (Accessed 18.06.10).

Muruli, L.A., London, D.M., Misiko, M.T., Okusi, K., Sikana, P. and Palm, C. 1999. Strengthening research and development linkages for soil fertility: Pathways of agricultural information dissemination. Unpublished report to IDRC. Nairobi: TSBF & Institute of African Studies.

Muyanga, M. and Jayne, T.S. (2006) Agricultural extension in Kenya: Practice and policy lessons. Working Paper 26/2006, Tegemeo Institute of Agricultural Policy and Development, Egerton University.

Nambiro, E., Omiti, J. and Mugunieri, L. 2005 . Decentralization and access to agricultural extension services in Kenya. Strategies for Analysis of Growth and Access (SAGA) Working Paper. October 2005.

Nkamleu, G.B. and Adesina, A.A. 2000. Determinants of chemical input use in peri-urban lowland systems: bivariate probit analysis in Cameroon. *Agricultural Systems* 62: 1–11.

Noordin, Q., Niang, A., Jama, B. and Nyasimi, M. 2001. Scaling up adoption and impact of agroforestry technologies: experiences from western Kenya. *Development in Practice,* 11(4): 509-523.

Noordin, Q., Mukalama, J., Rotich, D., Wabwile, E. and Lynam, J. 2007. Scaling upoptions on Integrated Soil Fertility Management in western Kenya: the case of COSOFAP: challenges and opportunities. In: Bationo, A., Waswa, B., Kihara, J. and Kimetu, J. (Eds) Advances in Integrated Soil Fertility Management in sub-Saharan Africa: Challenges and opportunities. Springer, Dordrecht, The Netherlands, pp. 993-1012.

Norrish, P., Lloyd Morgan, K. and Myers, M. 2001. Improved communication strategies for renewable natural resource research outputs. *Socio-economic Methodologies for Natural Resources Research. Best Practice Guidelines.* Chatham, UK: Natural Resources Institute.

Odendo, M., Ojiem, J., Bationo, A. and Mudeheri, M. 2006. On-farm evaluation and scaling-up of soil fertility management technologies in western Kenya. *Nutrient Cycling in Agroecosystems* 76:369–381.

Ofuoku, A.U., Emah, G.N. and Itedjere, B.E. 2008. Information utilization among rural fish farmers in central agricultural zone of Delta State, Nigeria. *World Journal of Agricultural* Sciences 4 (5): 558-564.

Oguya, V. 2006. Bridging Africa's digital divide: a case for CD-ROM technology. *Quarterly Bulletin of IAALD* 51(4): 159-165.

Okeyo, J.M., Shepherd, K.D., Wamicha, W. and Shisanya, C. 2006. Spatial variation in soil organic carbon within smallholder farms in western Kenya: A geospatial approach. *African Crop Science Journal*, 14(1): 27-36.

Omosa, E. 2000. The Use and Application of Various Communication Channels at Local and International Levels. In: Women in Agriculture and Modern Communication Technology-Proceedings of a Workshop. March 30-April 3, 1998, Denmark. Available online at http://www.husdyr.kvl.dk/htm/php/tune98/12-EileenOmasa.h (Accessed 06.05.11).

Opara, U.N. 2008. Agricultural information sources used by farmers in Imo State, Nigeria *Information Development* 24: 289-295.

Oswald, A., 2005. *Striga* control-technologies and their dissemination. *Crop Protection* 24: 333–342.

Place, F., Barrett, C.B., Freeman, H.A., Ramisch, J.J., Vanlauwe, B. 2003. Prospects for integrated soil fertility management using organic and inorganic inputs: evidence from smallholder African agricultural systems. *Food Policy* 28, 365–378.

Place, F., Adato, M., Hebinck, P., Omosa, M., 2005. The impact of agroforestry-based soil fertility replenishment practices on the poor in western Kenya. IFPRI, Research Report No. 142.

Ramisch, J.J. 2004. Integrated soil fertility management in practice in western Kenya. The Comminutor: Newsletter of the TSBF Institute of CIAT (Kenya), 8(1): 8-9.

Ramisch, J.J., Misiko, M.T., Ekise, I.E. and Mukalama, J.B. 2006. Strengthening 'Folk Ecology': community-based learning for integrated soil fertility management, western Kenya. *International Journal of Agricultural Sustainability* 4(2); 154–168.

Rasmussen, A.M. 2001. Information and Development: The information effect *Information Development* 17(1): 12-18.

Reardon, T., Taylor, J.E., Stamoulis, K., Lanjouw, P., Balisacan, A., 2000. Effects of nonfarm employmenton rural income inequality in developing countries: an investment perspective. *Journal of Agricultural Economics* 51 (2): 266–288.

Rees, D., Momanyi, M., Wekundah, J., Ndungu, F., Odondi, J., Oyure, A.O., Andima, D., Kamau, M., Ndubi, J., Musembi, F., Mwaura, L. and Joldersma, R. 2000. Agricultural knowledge and information systems in Kenya – Implications for technology dissemination and development. Agricultural Research & Extension Network (AgREN), *Network Paper No.107.*

Rege, R. 2006. Harnessing institutional alliances and partnerships in agricultural information systems in Kenya. *Quarterly Bulletin of IAALD* 51(4)**:** 215-222.

Riesenberg, L.E.and Christopher O.G.1989. Farmers' preferences for methods of receiving information on new or innovative farming practices. *Journal of Agricultural Education* 30 (3): 7-13.

Robinson, K., Elliott, S.J., Driedger, S.M., Eyles, J., O'Loughlin, J., Riley, B., Cameron, R. and Harvey, D. 2005. Using linking systems to build capacity and enhance dissemination in heart health promotion: a Canadian multiple-case study Health *Education Research: Theory & Practice* 20 (5): 499–513.

Rogers, E.M. 2003. Diffusion of innovations- 5th ed. Free Press, New York, 551pp.

Romani, M. 2003. The impact of extension services in times of crisis: Côte d.Ivoire 1997-2000. Centre for the Study of African Economies Working paper series. *Working Paper 19*

Rusike, J., Masendeke, D., Twomlow, S.J. and Heinrich, G.M. 2004. Impact of farmer field schools on adoption of soil water and nutrient management technologies in dry areas of Zimbabwe. Global Theme on Agro-Ecosystems, Report no. 14., Bulawayo, Zimbabwe: ICRISAT. 24 pp.

Sabo, E. 2007. Agricultural information needs of women farmers of Mumbi region, Adamawa State. *Journal of Tropical Agriculture* 45(1-2): 69-71.

Sanchez, P.A., Shepherd, K.D., Soule, M.J., Place, F.M., Buresh, R.J., Anne-Marie, N., Izac, A., Mokwunye, U., Kwesiga, F.R., Ndiritu, C.G. and Woomer, P.L. 1997. Soil fertility replenishment in Africa: An investment in natural resource capital. In: Buresh, R. J., Sanchez, P. A. and Calhoun, F. (Eds.) Replenishing soil fertility in Africa. SSSA Special Publication No. 51. Madison, Wisconsin: Soil Science Society of America, pp. 1-46

Sanchez P.A., Denning G.L., Nziguheba G. 2009. The African green revolution moves forward. *Food Security* 1: 37–44.

Sanginga, N. and Woomer, P.L. (Eds.) 2009. Integrated soil fertility management in Africa: Principles, practices and developmental process. Tropical Soil Biology and Fertility Institute of the International Centre for Tropical agriculture. Nairobi. 263 pp.

Straub, E.T. 2009. Understanding technology adoption: theory and future directions for informal learning. *Review of Educational Research* 79 (2): 625–649.

Sopazi, P. and Andrew, T. 2005. Emerging Information Communication Technology (ICT) opportunities for sustainable indigenous innovations and technology transfer in developing countries. Paper presented at the Globelics Africa, October 31-November 4, in Tshwane

(Pretoria), South Africa. Spiritualist's Sports and Adventurer's Club. Available on-line at http://www.innersports.org/indiabiketrip.htm (Accessed 18.06.10).

Tittonell, P., Misiko, M. and Ekise, I. 2008. Talking soil science with farmers. LEISA Magazine, 24 (2): 9-11.

Tucker, M. and Napier, T.L. 2002. Preferred sources and channels of soil and water conservation information among farmers in three midwestern US watersheds. *Agriculture, Ecosystems and Environment* 92: 297-313.

Vanlauwe, B., 2004. Integrated soil fertility management research at TSBF: the framework, the principles, and their application. In: Bationo, A. (Ed.), Managing Nutrient Cycles to Sustain Soil Fertility in Sub-Saharan Africa. Academy Science Publishers, Nairobi, pp. 25-42.

Vanlauwe, B., Rotich, E., Okalebo, R., Bationo, A., Mukalama, J., Ekise, I., Ndufa, J. and Cadisch, G. 2004. Integrated soil fertility management in practice in western Kenya. The Comminutor: Newsletter of the TSBF Institute of CIAT (Kenya), 8(1):2-7.

Vanlauwe, B., Bationo, A., Chianu, J., Giller, K.E., Merckx, R., Mokwunye, U., Ohiokpehai, O., Pypers, P., Tabo, R., Shepherd, K.D., Smaling, E.M.A., Woomer, P.L. and Sanginga, N. 2010. Integrated soil fertility management: Operational definition and consequences for implementation and dissemination. *Outlook on Agriculture* 39(1): 17-24.

Wubeneh, N.G. and Sanders, J.H. 2006. Farm-level adoption of Sorghum in Tigray, Ethiopia. *Agricultural Systems,* 91(1-2), pp. 122-134.

APPENDIX

SURVEY QUESTIONNAIRE

Date of interview: _____Interviewed by: _____Start time _____Finish time _____

Date checked: _____Checked by: _____

Province: _____District: _____Division: _____

Location: _____

GPS Coordinates: Longitude:_____Latitude: _____ Way point: _____

SECTION 1: Household Characteristics

Farmer Identity (FARMER ID): _____

Name: _____

Age: _____

Gender **(1**=male, **2**=female)_____

Social responsibility held in village (if any) _____

Decision maker _____ [**1= Self, 2= Other (specify)** _____]

SECTION 1A: Farmer's Household demographic Information

Ask about each and every individual member of the farmer's household (sharing residence, income and other resources).Also include workers if they stayed in the household for at least **5 months** (cropping season).

ID	Name	Relation to Head (Code below)	Gender [1=male 2=female]	Age in years	Years of Education	Earned some off-farm income – last 1 month? [1=Yes, 2=No]	If Yes, Type of off-farm activity (Code below)	Amount earned - last one month? (KShs)*	Years of Farming Experience
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									

12									
13									
14									

*** Net amount, exclude the cost of earning the income**

RELATIONSHIP TO HEAD	ACTIVITY CODES:
1=Head **2=Spouse** **3=Child** **4=Relative** **5=Farm worker** **6=Other(specify (_____)**	**1= Salary earner** (e.g., teacher, police man) **2= Casual wage earner/ Farm laborer** **3=Petty business/ Trading** (e.g. Butcher, Charcoal burning, Trading farm produce, kiosk) **4= Artisans** (e.g. Bicycle repair/mechanics, Brick making, Carpentry, Construction, Tailor) **5= Other (don't specify)**

SECTION 1B: Farmer's Household Assets

Asset		No. of items **purchased** in the **last 12 months**	No. of items **currently** owned	Total (current) value **(KSh)**	Asset		No. of items **purchased** in the **last 12 months**	No. of items **currently** owned	Total (current) value **(KSh)**
Farm Assets	**ID**				***Other assets***	**ID**			

Automobile (Tractors, Trailers, Vehicles, Motorcycle)	**1**				Bicycle	**16**			
Carts	**2**				Radio/ Tape-recorder	**17**			
Donkeys	**3**				Car Batteries	**18**			
Wheelbarrows	**4**				Television	**19**			
Ploughs	**5**				Mobile Phones	**20**			
Borehole	**6**				Furniture	**21**			
Well	**7**				Mosquito nets	**22**			
Sickle	**8**				Solar Panels	**23**			
Hand hoe	**9**				Milking churns	**24**			
Chaff cutter for fodder	**10**				Pangas	**26**			
Spraypumps	**11**				Other specify	**27**			
Diesel pumps	**12**								
Water tanks	**13**								
Grinders	**14**								
Beehives	**15**								

SECTION 2: Farm Characteristics

Q1. What is your main farming objective? __ **[1=To earn income, 2=Subsistence, 3=Other specify (_____)]**

Q2. How many times were you visited by agricultural extension staff in the last **one year?**____ **[1=None, 2=Once, 3=Twice, 4=More than twice]**

Farm Size

Type of Ownership	Parcels							
	Parcel ID	Parcel Name	Size in Acres	Area cropped in last 1year (Acres)	Does the farmer apply organic manure on this parcel? **[1=Yes, 2=No]**	Does the farmer apply mineral fertilizer on this parcel? **[1=Yes, 2=No]**	Is this the most important parcel **[1=Yes, 2=No]** **[Only one parcel]**	Why the parcel is considered important? **[for important parcel only]**
1=Owned with title deeds	1							
	2							
	3							
	4							
	5							
2= Owned without title deeds	6							
	7							
	8							
	9							

	10							
3=Rented-in	**11**							
	12							
	13							
	14							
	15							

SECTION 3: Crop activities

Instruction: Focus on the most important parcel (identified in the Farm size table). Probe for all crops produced during the last long-rain season, including feeding stuff (fodder leaves, elephant/Napier grass) and tree products (fruits). Use the crop code sheet

Q3. Did the farmer engage in crop production in the **Last LONG-RAIN season? 1**=Yes (Fill table), **2**=No (go to **Sec.4**) _____

Parcel ID [Most Important]	Crop Code See Code Sheet	Area under this crop (acres)	Seed use				Intercropped? 1=Yes 2=No	Mineral Fertilizer Use						Manure - Organic Fertilizer Use				Expenditure on pesticides (herbicides/ insecticides/ fungicides)	Harvest (-777 if not yet harvested)		Sales [Skip to next row if not sold]		For the largest sale
			Seed type? 1=Local 2=Improved 3=Mixed	Qty	Unit	Price per unit		1st Mineral fertilizers			2nd Mineral fertilizers			Type Code below	If type=3, type of plant used? Code below	Qty	Unit		Qty	Unit	Qty	Unit	Price per unit
								Type Code below	Qty	Unit	Type Code below	Qty	Unit										

UNIT codes:			MANURE	FERTILIZERS			TYPE OF PLANT
1 =90 kg bag	5 =numbers	20 = Donkey cart load	0= None	8=NPK (20:20:0)	16=UREA (46:0:0)	24=DAP	
11=50 kg bag	6 =bunch(bananas)	16 =canter	1=Farmyard manure	9=NPK (17:17:0)	17=Folia Feeds	25=MAP	
2 =kgs	13 =grams	17 = pickup	2=Animal Manure	10=NPK (25:5:5s	18=Magmax Lime	26=TSP	1=Tithonia
3 =litre	7 = 25 kg bag	18 = 2kg bag	3=Green Manure	11=NPK (23:23:0)	19=Rock Phospate	27=SSP	2=Calliandra
9 =gorogoro	8 = 10 kg bag	21 = Hand cart load	4=Compost	12=NPK (17:17:17)	20=Kero Green	28=DPS	3=Other specify
10 =tonnes	14 = wheelbarrow	22 = Head load	5=other specify	13=NPK (15:15:15)	21=Mavuno-Basal	29=CAN (26:0:0)	(_____)
12 =debe	15 =cart	23 = Area in acres	(_____)	14=NPK (18:14:12)	22=Mijingu 1100	30=ASN (26:0:0)	
4 =crate	19 =Donkey load	24 = Other (specify)		15=NPK (14:14:20)	23=Mavuno-Top Dress	31=SA (21:0:0)	

Q4. Did the farmer engage in crop production in the **Last SHORT-RAIN season?** 1=Yes (Fill table), 2=No (go to **Sec.4**) _____

Instruction: Focus on the most important parcel (identified in the Farm size table). Probe for all crops produced during the last short rain season, including feeding stuff (fodder leaves, elephant/Napier grass) and tree products (fruits). Use the crop code sheet

Parcel ID [Most Important]	Crop Code See Code Sheet	Area under this crop (acres)	Seed use				Intercropped? 1=Yes 2=No	Mineral Fertilizer Use						Manure - Organic Fertilizer Use				Expenditure on pesticides (herbicides/ insecticides/ fungicides)	Harvest (-777 if not yet harvested)		Sales [Skip to next row if not sold]		For the largest sale
			Seed type? 1=Local 2=Improved 3=Mixed	Qty	Unit	Price per unit		1st Mineral fertilizers			2nd Mineral fertilizers			Type Code below	If type=3, type of plant used? Code below	Qty	Unit		Qty	Unit	Qty	Unit	Price per unit
								Type Code below	Qty	Unit	Type Code below	Qty	Unit										

UNIT codes:			MANURE	FERTILIZERS			TYPE OF PLANT
1 =90 kg bag	5 =numbers	20 = Donkey cart load	0= None	8=NPK (20:20:0)	16=UREA (46:0:0)	24=DAP	
11=50 kg bag	6 =bunch(bananas)	16 =canter	1=Farmyard manure	9=NPK (17:17:0)	17=Folia Feeds	25=MAP	1=Tithonia
2 =kgs	13 =grams	17 = pickup	2=Animal Manure	10=NPK (25:5:5s	18=Magmax Lime	26=TSP	2=Calliandra
3 =litre	7 = 25 kg bag	18 = 2kg bag	3=Green Manure	11=NPK (23:23:0)	19=Rock Phospate	27=SSP	3=Other specify
9 =gorogoro	8 = 10 kg bag	21 = Hand cart load	4=Compost	12=NPK (17:17:17)	20=Kero Green	28=DPS	(_____)
10 =tonnes	14 = wheelbarrow	22 = Head load	5=other specify	13=NPK (15:15:15)	21=Mavuno-Basal	29=CAN (26:0:0)	
12 =debe	15 =cart	23 = Area in acres	(_____)	14=NPK (18:14:12)	22=Mijingu 1100	30=ASN (26:0:0)	
4 =crate	19 =Donkey load	24 = Other (specify)		15=NPK (14:14:20)	23=Mavuno-Top Dress	31=SA (21:0:0)	

SECTION 4: Fertilizer and Manure/Compost Expenditure (or Credit)

Q5. Did you purchase fertilizer or manure/compost in the **last 12 month? 1-Yes, 2-No** [skip to **Section 5**] _____

Fertilizer/ Manure Type	Code **[Code Below]**	If **Code=3,** indicate the type of plant material used **[code below]**	How did you obtain it? **1**= Purchased in cash **2**= Obtained on credit **3**= Other (specify)	If obtained on credit, from whom? **[Code below]**	Quantity of fertilizer/ manure **bought** or obtained on **credit**?		What is/ was the **total cost** of purchase **(KSh)**?	Paid transport for fertilizer/ manure? **1= Yes, 2 = No**	If **Yes,** total cost **(KSh)**	Distance **(Km)**/ Mode **(see code)**	
					Qty	Unit					

MANURE	FERTILIZER Codes	
0= None	8=NPK (20:20:0)	20=KERO GREEN
1=Farmyard manure	9= NPK (17:17:0)	21=MAVUNO-BASAL
2=Animal Manure	10=NPK (25:5:5s	22=MIJINGU 1100
3=Green Manure	11=NPK (23:23:0)	23=MAVUNO-TOP DRESS
4=Compost	12=NPK (17:17:17)	24=DAP
5=Other manure specify	13=NPK (15:15:15)	25=MAP
(_____)	14=NPK (18:14:12)	26=TSP
	15=NPK (14:14:20)	27=SSP
	16=UREA (46:0:0)	28=DPS
	17=FOLIA FEEDS	29=CAN (26:0:0)
	18=MAGMAX LIME	30=ASN (26:0:0)
	19=ROCK PHOSPATE	31=SA (21:0:0)

TYPE OF PLANT	UNIT codes:		Credit Source Codes:
	1 =90 kg bag	8 = 10 kg bag	1= Government agencies
1=Tithonia	11=50 kg bag	14 =wheelbarrow	2= Traders
2=Calliandra	2 =Kgs	15 =cart	3= Farmer cooperatives
3=Crotalaria	3 =Litre	19 =Donkey load	4= NGO/CBO
4=Leucaena	9 =Gorogoro	20 = Donkey cart load	5=Large Company
5=Gliricidia	10 =Tonnes	16 =canter	6=Farmer
6=Mucana	12 =Debe	17 =pickup	7= Other (specify)
7=Other specify (_____)	4 =Crate	18 =2kg bag	Transport mode code
	5 =Numbers	21 = Hand cart load	1=Head load
	6 =Bunch (bananas)	22 = Head load	2=Bicycle
	13 =Grams	23 = Area in acres	3=Cart
	7 = 25 kg bag	24 = Other (specify)	4=Vehicle

SECTION 5: Livestock Activities

Q6. Does the farmer keep Livestock? [1=Yes, 2=No] _____

If **Yes,** fill the table below

Type of Livestock		Actual sales in the last 12 months		Purchases in the last 12 months		No. Currently Owned	Average Value per Head	Feeding regime	Main feed stock 1=Pasture, 2=Livestock feed 3=Both	Source of feed stock (1= On-farm, 2= Off-farm)
Livestock ID	Name	No. sold	Total amount received (Ksh)	No. Purchased	Total amount paid (KShs)					
1	Cow –female cattle									
2	Heifer –young female cattle >12 months									
3	Bull – mature male cattle									
4	Young Bull- young male cattle >12 months									
5	Calf- young male/female cattle < 12 months									
6	Ram – male sheep									
7	Ewe - female sheep									
8	Lamb- young one of sheep									

9	Buck – male goat									
10	Doe – female goat									
11	Kid - young one of goat									
12	Poultry- chicken, goose, etc.									
13	Pigs									
14	Other (specify _____)									

FEEDING REGIMES: 1=Full-time Zero-grazing (cut & carry), 2=Partly Zero-grazing,3= Grazing, 4=Tethering,

SECTION 6: Acquisition and use of information in the application of ISFM technologies by farmers

ISFM Technologies	Acquisition of information				Use of information					Rating the technology(Code next page)				
	Has the farmer acquired information on this technology? [1=Yes, 2=No]	If **Yes, Sources** of information about its use? **[list all- codes next page]**	If **Yes**, preferred **channels** for receiving information ? **[list all- next page]**	If **No, Why? Code next page**	Does the farmer use information acquired to practice technology? [1=Yes, 2=No]	If **No, Why? Code next page**	If **Yes,**							
							Why? Codes next page	Time of technology use after they were first aware of it (months)	Major constraints faced in using it? **Codes next page**	Relative advantage	Compatibility	Complexity	Trialability	Observability
Inorganic fertilizers														
Green Manure (Herbaceous)														
Green manures (Trees)														
Farmyard manure														
Animal manure														
Compost														
Crop residues														
Inorganic + organic fert.														
Cereal-legume rotation														

Rock phosphate														
Rhizobium Inoculants														
Improved germplasm														
Biomass transfers														
Improved fallows														
Micro-dosage of fertilisers														
Agroforestry (fertilizer trees)														
Other specify (_____)														

RATE	WHY – Reasons for use	WHY – Reasons for not using/ MAJOR CONSTRAINTS	WHY- Reasons for not acquiring information on technologies	INFORMATION SOURCES	Communication Channels
1=Very Impressive 2=Impressive 3=Indifferent 4=Other specify____	1=To use as forage 2=Soil amendments 3=Other specify____	1=Labour shortage 2=Land shortage 3=Lack of the right input 4=Lack of the right input at the right time 5= Lack of right input in right package size 6=Lack of knowledge about its profitability 7=Risk involved input use 8 =High price 9=Perceived defects in quality 10=Perceived effect on yield compared to conventional system 11=Inadequate market information 12=Low output price 13=Lack of access to credit	1=No access to extension agents 2=No access to mass media (radio, TV, newspapers) 3=No access to print media (books, brochures) 4=Illiteracy 5=No access to information centres 6=No access to ICTs (mobile telephones, internet) 7=Lack of funds/Poverty 8=Other specify_____	1=Farmer groups 2=Ministry of Agriculture 3=Mass Media 4=Extension staff 5=Research institutions 6=Learning institutions 7=Neighbors/ friends/relatives 8=CBOs 9=NGOs 10=Churches 11=Local administration / village elders 12=Agricultural companies 13=Farmer Cooperatives 14=Stockists	a)Mass media 1=Radio 2=TV 3=Newspaper/magazines b)Interpersonal 4=Songs/ Poems/Skits 5=Neighbors/ friends/relatives c) Community-based 6=On-farm demonstrations 7=Farmer field days 8=Workshops/Seminars 9=Farmer-led experimentation 10=Farm-to-farm visits 11=Public gatherings (*barazas*) d) Print-based

		14=Other specify _____	

15=Experience **16=Other specify (_____)**	**12=Books** **13=Posters/Billboards** **14=Brochures** **e)ICT-based** **15=mobile phones** **16=DVD/CD players** **17=internet** **18=Other specify(_____)**

SECTION 7A: Assessment of ISFM Information Sources

ISFM Information Sources	Rank the different information sources on the basis of the following context **1=high, … 7=lowest**					What farmer needs influence the preference for this information source **[Code below]**
	Accessibility	Reliability	Informativeness	Comprehension	Preference	
Farmer groups						
Ministry of Agriculture						
Mass Media						
Extension staff						
Research institutions						
Learning institutions						
Neighbors/ friends/relatives						
CBOs						
NGOs						
Churches						
Chief's barazas						
Agricultural companies						
Farmer cooperatives						
Cooperatives						
Stockists						
Experience						
Others specify(_____)						

FARMER NEEDS: 1= Information/Knowledge needs 2= Social integrative needs 3= Entertainment needs 4= Personal intergrative (credibity, status) needs 5= other (please specify)

SECTION 7B: Assessment of Channels used by Farmers to Receive ISFM Information

ISFM Information Channels	Rank the different information channels on the basis of the following context **1=high, … 7=lowest**					**Willingness to seek for information**		What farmer needs influence the preference for this information channel **[Code below]**
	Accessibility	Reliability	Informativeness	Comprehen-sion	Preference	Would you be willing to seek for information using this channel? **[1=Yes,2=No]**	**If Yes,** how much would you be willing to pay for this information (in Kshs)	
Farmer Field Days								
Workshops/Seminars								
Radio								
Television								
Newspapers/Magazines								
Billboards/Posters								
Books								
Brochures								
Songs/Poems/Skits								
Neighbors/ friends/relatives								
On-farm demonstrations								
Farm-to-farm visits								
Public gatherings (*barazas*)								

Mobile phones								
Internet								
DVD/CD players								
Others specify(_____)								

FARMER NEEDS: 1= Information/Knowledge needs 2= Social integrative needs 3= Entertainment needs 4= Personal intergrative (credibity, status) needs 5= other (please specify)

SECTION 7C: Assessment of ISFM Knowledge sources

ISFM Knowledge Sources	Rank the different knowledge sources on the basis of the following context **1=high, … 7=lowest**					What farmer needs influence the preference for this knowledge source [**Code below**]
	Accessibility	Reliability	Informativeness	Comprehension	Preference	
Newsletters/ Brochures						
Researchers						
Newspapers						
Published papers						
Documentary TV/radio						

Websites						
Books						
Chief's barazas						
Local training seminar						
Farmer magazines						
Churches/religious organizations						
NGOs						
CBOs						
Farmer groups						
Extension agents						
Farmer Field Schools						
Others specify(_____)						

FARMER NEEDS: 1= Information/Knowledge needs 2= Social integrative needs 3= Entertainment needs 4= Personal intergrative (credibity, status) needs 5= other (please specify)

SECTION 8: Impact of ISFM information and knowledge on crop activities

Instruction: Focus on the most important parcel (identified in the farm size table).

Season [Long-rain =1, Short-rain=2]	Parcel ID [Most Important]	Crop Code See Code Sheet	Area under this crop (acres)	Household decision maker [see code below]	Did the farmer access information and knowledge on use of ISFM technology/ies? [Yes=1, No=2]	Has the farmer applied ISFM technology/ies? [Yes=1, No=2]	If **Yes**, Harvest (-777 if not yet harvested)		If **Yes**, Sales		If **No**, Harvest (-777 if not yet harvested)		If **No**, Sales	
							Qty	Unit*	Qty	Unit	Qty	Unit	Qty	Unit

*Use unit codes in page 5

HOUSEHOLD DECISION MAKER: 1= Male 2= Female 3= Child IF < 18yrs

SECTION 9: Village Information/Knowledge Centres

Type of Information Centre		Frequency of use by farmer?	Distance to the nearest information centre	Distance Unit	Condition
ID	Name				
1	Rural Knowledge Centres				
2	Cyber Cafes				
3	Market Information Centres				
4	Libraries				

Q7. Is the farmer or spouse a member of any co-operative, social group or out-grower group? [**1**=Yes **2**=No] _____

If **Yes,** fill the table below

Name of farmer or Spouse	Member ID (from section 7)	Relation	Cooperatives/ groups the member belongs to (specify all)	Services received from the group or cooperative
		FARMER	**1.**	
			2.	
			3.	
			4	
		SPOUSE	**1.**	

			2.	
			3.	
			4	

EQUENCY OF USE OF INFORMATION NTRES	DISTANCE UNITS	CONDITION	COOPERATIVES/GROUPS	SERVICES FROM GROUP/COOPERATIVE
Very Frequent Moderately Frequent nfrequently/Occasionally Never	1=Hrs walk 2=Days walk 3=Kilometers 4=other specify (_____)	1=Very Poor 2=Poor 3=Moderately good 4=Very good	1=producer coop 2=multi-purpose coop 3=SACCO 4=Informal/self help groups 5=out-grower company 6= Social group (e.g. Church groups, drinking clubs) 6=others, specify_____)	0=none 1=Training 2=Marketing 3=Input acquisition 4= Financial services 5=A.I services 6= Other specify_____)

Crop Codes: arranged alphabetically to be used with the next two tables

Code	Crop	Code	Crop	Code	Crop	Code	Crop
88	apple	128	dhania grains	137	Mkuyu	81	snow peas
43	arrowroots	112	dry peas	149	Mulberry	8	sorghum
140	artemesia	67	eggplant	75	nappier /elephant grass	38	sorghum (drought resistant)
86	avocado	20	flowers	113	nathi (goose berry)	108	soyabeans
51	avocado (grafted)	25	french beans	105	njahi (dolichos)	62	spinach
18	babycorn	100	garlic onion	37	njugu mawe(bambara bean)	91	squash
10	bananas	58	gourds	77	Oats	133	stefali
141	bananas, tc	127	grapes	73	Okra	145	stinging nettle
56	barley	34	green grams	85	Onions	125	strawberries
7	beans	115	green peas	57	orange (grafted)	131	sugar beets
150	beetroot	33	groundnuts	71	Oranges	15	sugarcane
93	brinjals /biriganya	68	guava	22	other fodder leaves	118	sugarcane, chewing
117	bulrush millet	102	indig veg/amaranthus	130	other leaves (bean,njahi)	60	sukuma wiki
82	cabbage	101	indigenous grains	55	passion (grafted)	30	sunflower
139	camomile	27	Irish potatoes	99	passion fruit	64	sweet melon
63	capsicum /sweet peppers	49	irish potatoes, tc	45	passion fruits, tc	42	sweet potatoes
83	carrots	52	irish potatoes, tc	79	pasture (not eleph/napier)	48	sweet potatoes, tc
24	cashew nuts	147	karela	54	pawpaw(grafted)	3	tamarind

28	cassava	**78**	lemon (grafted)
47	cassava, tc	**146**	lemon grass
104	castor oil	**70**	lemons
123	cauliflower	**121**	lettuce
26	chickpeas	**32**	lucerne
94	chillie peppers	**87**	lugard
41	citrus, tc	**97**	macadamia nuts
23	coconuts	**142**	macadamia nuts (grafted)
136	coconuts, copra	**46**	macadamia, tc
135	coconuts, green	**4**	maize (fodder)
6	coffee, cherries	**1**	maize, dry
124	coffee, churned	**2**	maize, green
11	coffee, mbuni	**69**	mangoes
116	corn flower	**143**	mangoes (grafted)
14	cotton	**44**	mangoes, tc
21	cowpeas	**89**	matomoko
19	cowpeas leaves	**151**	medicinal plants
92	cucumber	**9**	millet
134	dates	**106**	miraa
129	dhania	**138**	mkunga

66	Pawpaws	**132**	tangawizi
114	Peaches	**98**	tangerine
96	Pears	**12**	tea
61	pepper, bell	**29**	tobacco
103	pigeon peas	**59**	tomatoes
95	Pineapples	**110**	tree tomato
90	Plums	**50**	trees (multi purpose), tc
126	Pomegranate	**53**	trees (multi purpose), tc
35	Poyo	**5**	trees, commercial
72	Pumpkin	**109**	Turnips
120	pumpkin leaves	**144**	vanilla
17	Pyrethrum	**65**	watermelon
148	Ravaya	**13**	wheat
31	Rice	**40**	wheat (drought resistant)
80	Rosemary	**111**	white suppoise
119	runner beans	**107**	wild berries
36	Saina	**76**	yams
74	Simsim	**84**	yellow passion fruit(mero)
39	simsim (drought resistant)	**122**	zambarao
16	Sisal		