ASSESSMENT OF THE EFFECTIVENESS OF COMMUNICATION CHANNELS DISSEMINATING FALL ARMYWORMS INFORMATION IN MAIZE PRODUCTION: A CASE OF KAKAMEGA COUNTY, KENYA

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I declare that this is my original work and has not been submitted for the award of a degree in any other University or any other institution.

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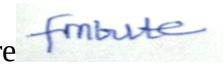
Signature  Date6th January 2022

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DEDICATION

This project is dedicated to my dear family members especially my children, my daughter Berenice Lukungu Nkonge and my son Ivanovich Nkonge who had to endure long periods of their mother being away at school, including my supportive friends such as Dr. Hilda Lumbwe among others. The inspiration and incredible support they all rendered to me during this research and academic journey is unspeakable.

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ABBREVIATIONS AND ACRONYMS

FAW:	Fall Army Worms
MLND:	Maize Lethal Necrosis Disease
FAO:	Food Agricultural Organization
GDP:	Gross Domestic Product
IPM:	Integrated Pest Management
SDG:	Sustainable Development Goals
ICT:	Information Communication Technologies
KACE:	Kenya Agricultural Commodity Exchange
SMS:	Short Message Service
USAID:	United State Agency for International Development
UNESCO:	United Nations Educational, Scientific and Social Organization
SAP:	Structural Adjustment Programs
MOA:	Ministry of Agriculture
MLFD:	Ministry of Livestock and Fisheries Development
KMFRI:	Kenya Marine and Fisheries Research Institute
KARI:	Kenya Agricultural Research Institute
NLMIS:	National Livestock Market Information System
RATIN:	Regional Agricultural Exchange Intelligence Network
AGMARKNET:	Agricultural Marketing Information Network
USD:	United States Dollars

ABSTRACT

Globally, effective communication channels have played an imperative role in the dissemination of critical information to farmers. However, dismal attention has been given to the access of such information communication channels in disseminating information to farmers in the developing world, especially information on Fall Army Worms (FAW) pest attacks.

This study, sought to assess the effectiveness of information communication channels used in information dissemination on Fall Army Worms in maize production amongst farmers in Lugari-Kakamega County, Kenya. It was guided by three objectives: (i) To determine socio-demographic factors that influence information access on control of Fall Army Worms by maize farmers; (ii) To analyze farmer's perception on access of mass media channels disseminating Fall Army Worm information; and (iii) To assess farmer's perception on access of inter-personal communication channels disseminating Fall Army Worm information.

The study employed a descriptive cross-sectional research design guided by the diffusion of innovations theory.The study applied a purposive sampling technique to identify participant farmers. Data was analyzed using the Statistical Package for Social Sciences (SPSS) software. Qualitative and quantitative data was collected through key informant's interviews, pre-tested questionnaires and focused group discussions.

The study arrived at three conclusions. First, social economic factors play key roles in farmers' access to information concerning FAW through Television and mobile phones. Improving access to education could increase farmer access to agriculture information such as the management of FAW. Equally, increasing access to wage employment can improve farmer's access to information concerning the management of FAW. The second conclusion is that radio, phone messages and television were the most effective communication channels for FAW information. There should be policy support towards access to radio, phone and television coverage in order to increase farmer's access to FAW management practices. Lastly, interpersonal communication channels such as agro dealers and peers play key roles in transmitting information for the management of FAW. Therefore, farmer groups and interaction should be encouraged.

The study therefore recommends the County government to enhance future dissemination of FAW information via radio, for mass media channels and fellow farmers, for interpersonal channels in both local dialects and Kiswahili languages. Additionally, there is need for re-tooling of extension agents, lead farmers, seed companies and agro-input-dealers on modern methods of FAW control and management.

CHAPTER ONE: INTRODUCTION

1.1. Background of the study

Agriculture forms the backbone of most economies of developing nations in the world(UNDP, 2015). This is as a result of the diversification in agricultural production in the different countries and adoption of modern technologies in production that has led to the improvement of agricultural productivity(Stoeckl *et al.*, 2015). Agriculture is stated to contribute to reduction of poverty, raise income and improve food security for 80 percent of the world`s poor, who live mainly in the rural areas and are engaged in farming as part of their livelihood strategies. The agriculture sector in Kenya contributes about 33 percent towards the total gross domestic product (GDP), with agriculture accounting for 60 percent of Kenya's exports(Ministry of Agriculture Livestock and Fisheries, 2017).

In Africa, agricultural production is faced with challenges such as climate change, unreliable rainfall patterns, drought, flooding, pest attacks and diseases. These challenges limit the potential in agricultural production which lead to food insecurity. Food security had emerged as a critical issue due to the increase in population in most African countries necessitating enhanced agriculture production despite the increase in agriculture input pricing.

Pest attacks such as Fall Army Worms (FAW) contributed to food insecurity in Kenya which was compounded by lack of access to accurate, timely reliable agricultural information and limited extension services(Prokopy *et al.*, 2015). Additionally, White stated that the relevance of agriculture information was a critical resource in supporting agriculture production in farmers' decision making, learning and adoption processes.

According toMcCorkle and McClure (1995), farmers' information sourcing behavior uses predominately informal communication channels in evaluating information and formulating decisions, factoring in features such as credibility, usability, workability and accessibility which affect the ability to change or innovate in line with the information disseminated. Mundy and Compton (1991) documented that effective information dissemination was mostly through communication channel ability, validity, diversity of channels, use of local language and knowledge.

Goergen *et al.* (2016) documented that the first pest attack cases of FAW in Africa were reported in the Western and Central regions in January 2016. The *Spodoptera frugiperda (FAW)* is a species in the order of Lepidoptera which includes moths and insects.

According toNagoshi *et al.* (2018), the consumption patterns of FAW are primarily of maize and are capable of feeding on over 80 plant species such as rice, sorghum, millet, soybean, wheat, alfalfa, cotton, turf, and fodder crops. Maize (*Zea Mays*) is one of the most abundantly produced cereal in Africa which is an international prime commodity driving the agriculture sector because of it is diverse use in the food industry, livestock sector and in the manufacturing of bio-fuel. Some of the counties that have had high maize production, in Kenya include; Trans Nzoia County, Bungoma County, Nakuru County and Uasin Gishu County, which have all had FAW pest attacks(Kimani, 2017).

Craig (2017) outlined the FAW attack losses in Kenya for the year 2017 to have amounted to 15,000 hectares of maize fields that were valued at KSh 1.3 billion. Additionally, 25 African countries were affected by FAW pest attacks. The sub-Saharan countries such as Zambia, Malawi and Zimbabwe had losses of 90,000 hectares, 17,000 hectares and 130,000 hectares of maize losses respectively, making FAW a threat to Africa's food security, (Kansiime*et al.*, 2019). The 2018 household survey deemed "knowledge for life, fall armyworm: impacts and implications for Africa", conducted in Ghana and Zambia, outlined that the impact of FAW attacks culminated to 98 percent of farmers having had their maize crop affected. The average maize loss of farmers was at 30 percent in Ghana and at 35 percent in Zambia.

A Kenya national FAW task force that consisted of researchers and private organizations was setup in the year 2017. Due to the high FAW damage, there was increased emphasis on the control of FAW pest attacks as it reduced environment damage through the excessive use of pesticides thereby promoting environmental conservation and food security.

The first FAW attacks in Kenya showed that other than floods, which accounted for 10-15 percentage yield losses, FAW yield loss accounted for 4-6 percent in the regions of South Rift valley, Nyanza, Central, Western and Coast parts of Kenya. Furthermore,Ateya (2018) attributed the significant FAW losses to the newness of the

FAW pest in Africa, farmer's lack of information about FAW and the limited knowledge on FAW by agriculture stakeholders to address the FAW pest attacks.

Some studies from agricultural research organizations such as the Kenya Plant Health Inspectorate Service (KPHIS), Ministry of Agriculture and Kenya Agriculture Livestock Research Organization (KALRO) developed FAW control measures which formed the information content for dissemination to farmers(State Department of Agriculture FAW Consortium Members, 2017). Additionally, some of the recommended FAW interventions include inter-cropping, planting of pest-resistant seed, biological control with use of pesticides and information awareness programs through the use of available communication channels(Prasanna *et al.*, 2018).The information on the established FAW control measures and innovations were disseminated predominately by extension agents complimented by mass media channels and interpersonal communication channels; this emphasized the importance of these communication channels in information dissemination(Songa *et al.*, 2002).

A Study by Khan on assessing farmers' perceptions, knowledge, and pest management strategies showed that farmers develop coping strategies according to the information content, which influenced the implementation of the FAW control measures. However, it was identified that there was a need for appropriate channels that met farmer's needs. Furthermore,Olaniran (2015)stipulated that appropriate communication channels are those for specific purposes, such as agriculture information for targeted audience, that access the channels and utilize the information that thereby eliminates unclear information communication channels.

Kenya's extension services are an integral part of the agriculture sector, especially in Maize production which is a staple food for the majority of the population predominately consisting of small-scale farmers engaged in maize production as a source of their livelihood and food security(Doris *et al.*, 2019). Obiora (2013), Khan and Damalas (2015) defined agricultural extension as an informal educational system where farmers' decision-making processes are exposed to new technologies that enhance agricultural production with an aim of farmer adoption.

According toChimoita *et al.* (2017) agricultural extension agents provide information to farmers on new agricultural technologies on successful practices among farmers which create a link between researchers and research targets. This was complemented

by the integrated approach which included the use of Information Communication Technologies. The role of research and advisory services is therefore essential in order to facilitate accurate, specific, unbiased technical and management information to farmers on agricultural production to enhance productivity(Vidanapathirana, 2012).

1.2. Statement of the problem

Agricultural production of maize in Kenya had a number of challenges ranging from droughts, floods, uneven distribution of maize farming inputs and the Fall Army Worm attacks on the maize crop(Ekerete and Ekanem, 2015). Although these challenges had a big impact on maize production, research has put in place certain recommended practices to combat FAW pest attacks. The extension advisory service provided assistance which the small-scale farmers relied on but presented a dissemination gap of extension officers who were unable to reach the farmers effectively(Ogola, 2015).

According toGruber *et al.* (2017) effective communication channels are important in awareness creation and change of behavioral patterns which can contribute to enhanced production due to adaptation of new technologies. Production challenges in maize have necessitated an urgent need for information access. However, due to the extension agent to farmer ratio of one extension officer to one thousand five hundred farmers (1:1500), there is a dissemination gap resulting in the extension officers being unable to reach the farmers adequately with the FAW recommended practices(Mokeira, 2014).

The use of information communication channels to alleviate the problem of farmer's information access, through successful dissemination of information on FAW control necessitates the need for effective communication channels which can reach the majority of farmers(Toepfer *et al.*, 2019). Given the spread of FAW infestations and damage extent on maize, interventions were needed through the use of various communication channels such as mass media which include television, radio, internet, cell phones, print and electronic media as well as interpersonal (face to face) communication(Naibei, 2018).

Information on how to respond and prevent the pest attacks needs to be quickly transmitted to extension service providers and smallholder farmers to ensure information reaches the intended target audience through the use of effective

communication channels(Nakasone and Torero, 2016).Mathiesen (2014)defined information access as the availability, reachability, findability, comprehensibility, and usability of information by the targeted information users.

Abubakar *et al.* (2009) states that previous studies show that agriculture information has been distributed differently and using different communication channels, with the most notable communication channels being television and radio. Others include extension officer's trainings and visits as well as telephone short messaging system (SMS). However as pointed out byAge *et al.* (2012), there had been an imbalance in the distribution and targeting of agriculture information and if that continued the problems facing farmers were more likely to persist.

Statistics show that FAW crop losses account for up to 4-6% of maize crop failure and low maize production yield in Kenya(Ogola, 2015). There are a well-known number of practices to combat FAW attacks and these have been discussed by many in the agriculture sector. But the major problem has been getting that information across to the small-scale farmers and establishing which communication channel would disseminate the information effectively(The World Bank, 2012). This study therefore sought to identify the effective communication channels used in disseminating information about FAW to maize farmers.

1.3. Justification of the study

Dissemination of information on control of Fall Army Worm (FAW) is of importance to smallholder farmers growing maize. It helps farmers reduce the risk of suffering losses that would eventually lead to food insecurity due to FAW pest attacks(Howland *et al.*, 2015). According toLavis *et al.* (2006), information sharing helps in altering the farmer's behavior patterns and therefore it provides reliable and accurate information on the control of Fall ArmyWormin order to help farmers change the cultural pattern of maize production. Timely planting, including adoption of new innovations facilitated by information communication channels contribute to farmer's cultural change in agronomical practices such as timely planting and the adoption of new innovations facilitated by information communication channels which complement the extension service efforts(Tambo *et al.*, 2019).

The study findings will be relevant in policy interventions which include new emerging Integrated Pest Management (IPM) techniques that farmers could adopt and

use to mitigate the challenges of FAW attacks on maize production, thereby reducing the production costs incurred due to increase in input usage resulting from extensive and indiscriminate use of synthetic pesticides. This would help enhance food security in the country and contribute to achieving the Sustainable Development Goals (SDGs) number two (ending poverty and hunger) and SDG goal number 12 Sustainable consumption and production patterns(Gupta and Vegelin, 2016).

The control of FAW reduces damage caused to the environment through excessive use of pesticides and thus promoting environmental conservation. This study shall provide additional information on Fall Army Worms, which will contribute to the available limited literature; establishment of the most effective communication channels to use for the dissemination of information on fall armyworms, prove to be important in contributing to the literature on maize production, and conservation of the environment(Gruber *et al.*, 2017, Howland *et al.*, 2015, The Food and Agriculture Organization of the United Nations [FAO], 2017)

1.4. General Objective

The overall purpose of the study was to assess the access of information communication channels used in information dissemination on FAW in maize production in Lugari, Kakamega County. The general objective is broken down into the following specific objectives:

i. To determine socio-demographic factors that influence information access on control of Fall Army Worms by maize farmers.
ii. To analyze farmer's perception of access to mass media channels disseminating Fall Army Worm information**.**
iii. To assess farmer's perception on access of interpersonal communication channels disseminating Fall Army Worm information**.**

1.5. Research Questions

i. What socio- demographic factors influence information access on control of Fall Army Worms by maize farmers?
ii. How effective are mass media channels in disseminating information of Fall Army Worms among farmers?
iii. How effective are the inter-personal communication channels in information dissemination of Fall Army Worms among maize farmers?

1.6. Scope of the Study

This research focused on assessing the access of information communication channels used in disseminating information on the control of FAW among maize farmers. The research assessed the influence of socio- demographic factors influencing the access of informationby maize farmers.Furthermore, the study assessed mass media and interpersonal communication channels and how these channels were used to access information on the control of Fall Army Worms by maize farmers. This therefore ensured the gathering of preferred and frequently used information communication channels by maize farmers as a measurement of access based on the farmer's perception.

The research was conducted using household structured questionnaire interviews involving maize farmers who were randomly selected from the farmer list sourced from the Ministry of Agriculture office in Lugari. The study conducted a focus group discussion of maize farmers that were located in an area which had experienced an attack of FAWs.

Additional interviews were conducted on key informers, agriculture stakeholders in that locality which included; the agro-dealers, KALRO staff, Seed Companies and ministry staff from the Ministry of Agriculture.

The research area was in Lugari, Kakamega County and specifically in randomly selected localities that were a representation of the entire County and the maize farmers in Lugari.The major study limitations were inadequate resources that led to the use of a small sample size for the study and poor network infrastructure. This affected household interviews and data collection as we were using electronic questionnaires on tablets for data collection.

CHAPTER TWO: LITERATURE REVIEW

2.1 The concept of agricultural communication

Agricultural communication is a field tasked with communication about agricultural information between the various stakeholders in the agricultural sector and also between the agricultural and non-agricultural stakeholders(Mwombe *et al.*, 2014). It mainly encompasses ensuring the use of effective methods of communicating agricultural technology which is aimed at the improvement of farmers and their practices in farming. In turn, it improves the production, planning and management of agriculture(Age *et al.*, 2012). It is about information exchange on natural resources, agriculture innovations and agricultural inputs.

Agricultural communication occurs through the use of proficient communication channels such as media; telephones, radios, televisions, newspapers, magazines, journals and the internet. It also includes interpersonal (face to face) channels such as extension agents, peers, fellow farmers, agro dealers, seed companies and barazas aimed to address the various target audience(Gebru *et al.*, 2019). Agricultural information knowledge, which is the content disseminated by the channels, is vital for the development of agriculture and contributes to improved livelihoods of farmers. Consequently, ineffective channels cause certain constraints that impeded the efficiency of Agriculture communication.

Agriculture communication is a wide and varied field which incorporates news writing, radio and video production, graphic designs, photography, special events planning, website, advertising and image management or publicity(Telg and Irani, 2011).

Agriculture technology is reliant on suitable innovations and the creation of viable communication approaches for suggested techniques to target users with the aim of information access by the target(Dimelu and Anyanwu, 2005).

Agricultural communication has been advancing throughout the years. During the frontier period of the 1700s in the United States of America, the general public was essentially agrarian. A significant part of the communication was informal and most information on agricultural practices was sourced from colonists.By the year 1920,

radio turned into a very relevant channel to impart agricultural information(Boone *et al.*, 2000).

In Kenya, Agricultural extension services and knowledge goes back to the 1900s as an intermediation between farmers and technologies. Methodologies that were used include farm visits, group *baraza*s, unified extension and farmer field schools, all led by private and public extension services. Therefore, in order to enhance farmer information access and use of ICTs, the utilization and convergence of radios, television, phones, cameras, recordings and extension services are critical for effective information dissemination(Ongachi, 2017). Additionally, interpersonal communication channels like extension services, farmer field schools, *barazas* and leader or model farmers have been most frequently used. This is due to increased features of audio, visual, instant feedback and high interactivity features of the information sharing process which reduces the challenges of complex technical terms comprehension.

It is important though to note that these approaches rely mainly on extension agents.Batchelor et al. (2014) states that the ideal farmer - extension agent ratio is 1 extension agent for every 400 farmers which is unattainable due to the small number of extension officers and the large farmer population which deems the extension agents inefficient.Poor infrastructure, such as road networks especially in rural areas and lack of transportation, renders the communication between extension agents and farmers very ineffective. ICT tools provide the convergence of channels and extension services in provision of agricultural information to the large population of farmers requiring the latest information that answers farmer's agricultural challenges effectively in its communication goals(Efa *et al.*, 2010).

FAW information communication content focuses on the documented control measures which include: scouting, identification, raising alarm of FAW attack, communication of severity, recommended agronomical practices like early planting, control practices appropriate to the stage of the maize growth, and the FAW pest life cycle stages. Preventing the FAW pest life cycle requires the use of insecticides, biological controls such as the use of natural enemies of FAW like insects and sex pheromone traps to prevent FAW mating process.

2.1.1 Role of Communication Channels in Disseminating Agricultural Information

Information assumes a key part in agricultural advancement and in boosting agricultural productivity. Furthermore, viable communication knowledge exchange encourages shared comprehension among farmers, agricultural researchers and augmentation specialists (Agboola, 2000). Agricultural information awareness is an essential element for expanded production and enhances social and economic development through access to information. Information, if limited or not clear such as information on FAW pests, may be misconstrued for other common pests such as the African Army Worm, caterpillar pests, and maize stalk borer, thus application of ineffective management practices due to inadequate information (Day *et al.*, 2017).

Levi, (2015) ascertains that mass media communication channels likeradio,television and mobile phones have advanced information access among farmers as well as complimenting extension service and agriculture organizations.Jung *et al.* (2013) highlighted that the combined usage of Information Communication Technologies like smart phones for various services including internet, phone calls, SMS and watching television enhances ICT usage. Information is vital if farmers need to progress past their present level of production. Thus a relentless stream of exact, reasonable, genuine information connecting the researcher with the farmer through the different sources that convey such informationis vital(Gruber *et al.*, 2017).

There is need for accurate reliable information content which can be termed as correct if verified by the agriculture technocrats and is defined as effective information. It is defined as such if it consists of information which can be implemented and thereafter, produce similar positive results by most farmers(Efa *et al.*, 2010).Additionally, an authentic information source can be a technical expert facilitating user friendly information not complicated to implement, which can be facilitated by information communication channels.

Some information communication channels utilized by most farmers are mass media channels. For example, radio, television, daily papers, magazines, leaflets and publications from government or business sources such as Agro- dealers and seed companies. These channels, combined with the usage of Information Communication Technologies like smart phones for various services including internet, phone calls,

SMS and watching videos as well as television, enhance information access(Jung *et al.*, 2013).

Access to these mass media channels entail issues of affordability and purchase power of the farmers as observed in a study conducted in Tanzania where only a small proportion of the smallholder farmers could access information using ICT tools(Adams, 1982). Farmers' access to information through home visits was done through close interactions with agricultural extension officers, agriculture business firms, or in little gatherings commonly referred to as community barazas used for presentations, courses, workshops or agronomical knowledge demonstrations according to farmer's limited resources (Masambuka, 2019).

Researches on communication channels have discovered that mass communication channels are critical in awareness creation, the passing on of information and sensitization or evolving of perceptions, while interpersonal or personal interaction channels contribute to attitude changes (Kante*et al.*, 2018).

Studies have revealed that radio contacts the greatest audience as a mass media channel in developing nations as radio can reach an extensive group at once making it a reliable source of communication especially in awareness creation(Rogers and Nichof, 2002). According to Tambo *et al.* (2019) in a study conducted in Uganda among maize farmers evaluating three mass media channels; radio, mobile phone SMS messages and video shows on farmers' knowledge on management of FAW attacks, revealed that information communication channels significantly increased farmers' knowledge about FAW and the adoption of agricultural technologies and practices for the management of FAW. The study showed radio having been the most used channel by farmers followed by SMS texts and lastly video. Furthermore, the study showed that access to multiple combined campaign channels had higher outcomes than exposure to one channel, with some evidence of information replica effects among the farmers.

A radio is considered as a reliable information source and is believed to be genuine and credible, but other features such as familiarity, accessibility and diversity are considered as evaluation criteria by farmers(Mundy and Compton, 1995). Radio has characteristics of credibility which alludes to the reliability of the information passed to farmers as being vital, relevant and important thereby affecting the reception of the

information. This affects the appropriation of agricultural innovations as farmers deem information likable and adoptable based on the source of the information channel(Kolar and Kakade, 2013).

According to Ekoja (2003), radio assumes a critical role in passing on information about agribusiness to the farmers and comparatively, various daily newspapers which issue articles and periodicals about agribusiness and agricultural practices. According to Efa *et al.* (2010) in a research on a project on Community-Based Armyworm Forecasting (CBAF) conducted in Malawi, Tanzania and Zimbabwe indicated that radio, newspapers, and television had been used for transmitting information to a large crowd. The CBAF research further accelerated attitude change by introducing information to create opinions which were enforced by community folk performances. This complimentary approach helped in the adoption of the CBAF initiatives through the use of communication channels.

Apart from radio, other studies have shown that cell phones have provided a stage for farmers to share and source information on farming. Farmers have found several ways to utilize cell phones in running their farm practices, agribusiness; market price for agriculture produce, and advertise their products while others directly call their clients to sell their produce (Ghafourian *et al.*, 2012). Moreover, farmers are utilizing short message services (SMS) to stay up to date with the latest information on climate, new farm implements, current farming methods and additional utilization of pesticides and herbicides in their homesteads(Murthy, 2009).

Aderibigbe (1990) suggested that interpersonal communication between farmers is one of the best methods for connecting the farmers since a larger part of them are uneducated. This allows face to face communication to provide better communication clarity for the farmers due to the high interactivity and instant feedback. Further interpersonal communication such as communal village messengers, the market center meetings and verbal information exchanges were well known among the rural farmers and preferred, more so, among older farmers.

This is in line with Beaman *et al.* (2021) in his study on peer learning among farmers, which established that fellow farmer communication contributed to increased agricultural technology adoption and diffusion. Shapande *et al.*, (2011) asserted that the reaction of youthful farmers with respect to convenience, practicability, and

legitimacy of information dissemination was more positive when contrasted with older farmers, which inferred that there is a need to enhance the standards of agricultural communication with regards to the practicability of information access to ensure audiences are enticed to use the communication channels.

2.1.2 Communication Channels Used to Disseminate Agricultural Information

As indicated byYahaya and Olajide (2000) the dissemination and adoption of technological advancements remain the foundation of the projected improvement in agriculture.Olowu and Edgren (1998) states the improvement and creation of applicable and suitable technological advancements are some of the pre-requisites for viable agricultural production. Throughout the years, several international and local organizations have delivered content focusing on extension services and farmers aiming at upgrading agricultural production. Communication assumes an integral part of human development, particularly in agriculture. Communication incorporates those circumstances in which a source transmits a message to a recipient with theintent to influence the recipient's conduct.

Kenya has five main recognized categories of media channels which include: television, radio, print media daily newspapers (including magazines, journals, and pamphlets), cell telephones and internet(Naibei, 2018). The readership of print media is low due to the low educational levels. Asset ownership of the farmers also affected the readership of the print media.

Bowen (2010), Olowu and Edgren (1998) study identified that 37 percent of Kenyans did not access a daily newspaper in over a year with the readership rate higher in urban areas than the rural areas. The study conducted in 2012 by Media Council of Kenya consisting of 3000 farmers uncovered that 85 percent of respondents' accessed radio, 83 percent used television, 68 percent read newspapers, with internet and cell phones at 42 percent and 41 percent distinctively(Media Council of Kenya, 2014). The Media Council of Kenya, revealed that radio is more prominently used followed by television, newspapers, internet, and cell phones respectively, but the study did not establish which media channels were deemed effective. Synovate, a leading research company in Kenya gathered that in each quarter of the year, the daily newspaper loses one percent of their readership as most people either use radios or access information

in different ways such as electronic newspapers on the internet as opposed to print media Nyabuga *et al.* (2013).

a. Print Media

Print media, incorporates daily newspapers, books, and magazines, have been used to disperse farm husbandry information particularly among the educated farmers. Growth in the number of literate people in the nation guarantees more utilization of print media which can be used as reference documents since it is a permanent record of information(Mohsin, 1997). Sawisky (2010)stated that newspapers are a key component of maintaining quality of life for most communities. Print media can be purchased or accessed at an individual's convenience' in hard copy or electronically. Farmers can get an insight of specialist's information through these media channels in order to adapt to the rising issues via mailing their issues and inquiries to the editors in relevance to the information they publish in the magazines and newspapers (Shahzad *et al.*, 2011).

A study was conducted by Mburu (2013)on the Viability of a free Newspaper in the Nairobi metropolitan area in Kenya and the findings indicated that there was a significant number of people who accessed newspapers either by reading at offices, work place, eateries, barber shops or borrowing from friends. They did this because they could not afford the relatively high cost of newspapers. The findings indicated that there was need for a newspaper that would address the common man's issues at the grassroots. For instance, our understanding of politics and the world around us would be different because we would not have newspapers, television, magazines and books to explain what is happening in our communities and beyond.

b. Mobile Phone Services

The fast development of portable communication channels or devices and the emergence of mobile services has created more channels and opened up different approaches to enhance information exchange in the agricultural segment and also do away with information imbalance existing among farmers, (Mittal and Mehar, 2012). The introduction of cell phone services in Kenya has grown to 64.2 percent for every 100 occupants (Communication commission of Kenya, 2011). This rate of cell phone adoption and use in Kenya illustrates that the mobile phone and service innovations

are viable information channels which are important devices in terms of empowering the common citizen, particularly the rural people(Murthy, 2009).

Cell phones have numerous merits which are: their versatility, the ability to exchange voice, visual and instant short messages, making information access an affordable cost. This cost is gradually decreasing by the day making it even more affordable as a channel of communication (Mangstl, 2008). In Africa the International Telecommunications Unit (ITU) study details individuals using the Internet grew from 10 percent in 2010 to almost 20 percent, with mobile phone subscriptions reaching about 69 percent in 2014 and a penetration rate of 2 percent in 2010, including the mobile broadband penetration growth of 20 percent in Africa with high adoption of mobile phones among the youths (ITU, 2014).

Wanga (2012) revealed that the short message (SMS) and voice alert services have revolutionized agriculture in Siaya County with farmers having used SMS to access agriculture information to improve their production. These services were facilitated by fibre link communication and Information technology communication organizations, which brought together around 2000 farmers in the area. The services are operated under a framework that used the 'push and pulls' approach and a question and answer approach, where subscribed individuals send agriculture queries and in turn receive technical answers.

A similar SMS service provider specialist is M-Farm Ltd., which gives access to confined, current information on various markets climate as well as weather patterns and also a platform for purchasing and selling products through short messages services, conducted a research to review farmers' ICT tools with findings revealing the use of the phone for agriculture information access increasing especially among cash crop farmers. Kenya Agricultural Commodity Exchange (KACE) has Sokoni SMS for farmers to access market costs for various products in Kenya; the SMS platforms provide electronic information from a mobile phone source.

c. **Television**

The television is one of the influential channels of mass media communication, which disburse information quickly about innovations in the agricultural sector among farmers, as it has an essential effect on individuals' demeanors, convictions, and

influences adoptions. Television's audio and visual features activate pre-existing individual mental perceptions of farmers.Brown (1986) has contended that television consolidates numerous image frameworks, for example, visual pictures, sounds, music, talk with composed dialect, and presents them at the same time, offering detailed information dissemination.

According to Buren, (2000) the principle behind communication is that individuals opt to pick the least demanding approach (channel) to acquire information and learn, thus television information is arranged in the least complex way by structuring television programs to be instructive, simple about wellbeing, education and farming advancement.

In Kenya, there are a couple of television programs running on various channels focusing on farming such as Shamba shape-up. It is an unscripted television show aired on Citizen television one of the television channels in Kenya that enables smallholders to transform their Shambas (farms) through a viable enhancement of crop and livestock production. The platform offers an inventive method for ensuring that research and science are utilized by more farmers. Shamba shape-up was at first a program sponsored by US Agency for International Development (USAID). However, it currently has an entire host of sponsors. Other television programs that incorporate the targeting of farmers are Mkulimani Ujuzi, a program in Kiswahili on television with questions that are answered shedding light on technological innovation in the Agricultural sector.

d. **Radio**

In recent years, the Kenya Frequency Modulation (FM) stations have increased, with Nairobi having up to 46 radio stations. Radio leads in general in media utilization followed by the cell phone, television, daily newspapers and the internet respectively(Kimutai, 2011). In relation to this, numerous vernacular radio stations have additionally developed with almost every language group and tribe in the country having a station which can successfully relay information to the target audience(Kimutai, 2011).

According toMoemeka (1994), since 1960, the United Nations Educational, Scientific and Social Organization (UNESCO) has been focusing on the significance of radio

broadcasting in disbursing knowledge or education to various communities, particularly in the rural setting of developing societies. This is attributed to the fact that the radio has remarkable attributes. A portion of these merits include; easy availability of the radio, user friendly as it is adaptable and can be used both by educated and ignorant individuals to access information. Additionally, the radio frequency signal is everywhere throughout the nation hence making it accessible to everyone in all corners of the country (Njelekela and Sanga, 2015).

Radio assumes an integral part in the transmission of information across various Information Communication Technology tools such as cell phones and computers/laptops. The aim of radio is to gather stories and events, which are then changed to news and information (Opara, 2010). The place of radio as a channel of information and news is marked as a defined communication channel which educates and widely disseminates information. Radio adequacy depends on its intrinsic characteristics as well as more vitally on how it is utilized and for what reason(Jensen and Thysen, 2003).

Instructional radio is another method for utilizing radio for social change and advancement as it targets an organized learning gathering, with somebody ready to oversee and guide as well as inspire output. It has been effective in educating on civic duties, functional aptitudes and cooperative attributes(Grenholm, 1975). The demerit is that it may not be appropriate for wide scale use due to the need for funds for transport and work force to facilitate the radio gatherings which are held mostly in rural areas and are utilized in the introduction of new innovations, dialogue, decision making and behavior change(Grenholm, 1975).

Radio includes the introduction of customary radio shows of around 15-30 minutes with the target groups forming listening gatherings. The target groups are intended to tune in and afterward have a dialogue relating to the discussion in the radio shows, with subsequent results of radio messages promoting positive reactions to information choices and ultimately social change.

The other initiative is the radio school which is meant to encourage the non-participants and influence the mindset change of the general population. Additionally, the Mali Shambani, in Kenya, is a weekly hour-long radio program on KBC Radio Taifa highlighting agricultural news and reacting to an extensive variety of subjects,

including market costs and patterns, cultivating systems, climate and weather issues, financial openings, inputs, land utilization, and quality models(Nabusoba, 2014).

Each radio program offers an interactive session where farmers are given the chance to call in and present agriculture related queries to a board of specialists either by means of telephone or SMS. Likewise, Farmer Voice Radio (FVR) is a radio expansion benefit at present working in Kenya, Malawi, Tanzania, Mali, Ghana and Zambia that aims at addressing the small-scale farmers(Nabusoba, 2014).

e. Extension Officer and Fellow Farmers

The Ministry of Agriculture under the government gives the greater part of extension services to both farmers and agribusiness ventures, after putting into action the Structural Adjustment Programs (SAPs) in the 1980s. However, the government was faced with pressure to downsize its predominant part in the national economy. Kenya's spending on extension services together with staff numbers of extension officers had decreased notably. At the time, the productivity of the public agricultural extension service in Kenya was probed and its viability turned into an exceptionally questionable subject (Gautam and Anderson, 1999).

The system was ruled as obsolete, top-down, paternalistic, uniform (one-size fits-all), unbendable, subject to bureaucratic wasteful aspects and in this way unfit to adapt to the dynamic requirements of developing agricultural practices. The over reliance on extension services by smallholder farmers creates more pressure on the few extension agents available(Age *et al.*, 2012).

More than 5 million farmers depend on just around 5,500 extension agents working in the agricultural sector for guidance and information. With the ratio of extension agents to farmers being 1:1500, it makes it impossible for Kenyan farmers to get the information they require, (CABI, 2012). However, there are some associations that one can source extension services from in Kenya such as Ministry of Agriculture (MOA), Directorate of Extension Research Liaison and Specialized Training, Extension Services Division, Agricultural Sector Coordination Unit, Horticulture Crops Development Authority, Ministry of Livestock and Fisheries Development (MLFD), Kenya Marine and Fisheries Research Institute (KMFRI) , Public Research

and Education Institutions and Kenya Agriculture Livestock Research (KALRO)among others.

In the case of Tanzania, agricultural data is predominantly dispersed through extension agents and farmer to farmer communication. Fellow farmer communication is another communication channel readily available to farmers in the absence of the extension agents. Be that as it may, the numbers of extension staff in most regions are yet to equal that of farmers, with the high extension to farmer nation requirement at 3,833 extension agent staff with the requirement being 12,000 officers.

2.1.3 Significance of Information in Agricultural Production

Management of information and basic knowledge assumes an imperative part in improving agricultural production efficiency and tending to the issue of sustainable food security, thus if agricultural communication is properly managed, stakeholders and farmers can access proper information and invaluable knowledge in a convenient way(United Nations Development Programme [UNDP], 2012). This would, in turn, minimize the challenges, doubts and vulnerability of farmers in regards to what they go through in the process of producing and marketing their various agricultural products (UNDP, 2012).

Agricultural production processes just like other production processes require in depth information and knowledge without which can diminish farmers' yields. For example, duringthe planting phase, information on high yielding seed varieties and strategic times to plant are essential while in the growth phase there is a need for fertilizer, pesticides, herbicides and new methods of cultivation information (Ekoja, 2004). Moreover, information on the best reaping time, weather, climate patterns and changes can empower farmers to increase their yields and achieve better agricultural results(Otter and Theuvsen, 2014).

Agricultural production improvement has drawn the consideration of policy makers in Kenya because of the major role of agriculture in the nation's economic development (Odhiambo *et al.*, 2003). While creation and profitability goals are easily attainable, Kenya needs to put to use more economically viable, imaginative and present-day ways to deal with agricultural information utilization and modernize its extension system.

Information and Communication Technology (ICT)- based ventures were put into play as a major aspect of the methodologies to help remedy the low agricultural profitability and better agricultural production among farmers, thus compensate for the extension service gap. Some of the ICT based programs that offer agriculture information includes; Drum-Net, M-Farm, National Livestock Market Information System (NLMIS), Kenya Agricultural Commodity Exchange (KACE) and Regional Agricultural Exchange Intelligence Network (RATIN) (Ogutu *et al.*, 2014).

Regardless of the anticipated ICT-based management information system (MIS) programs, few researchers have given experimental proof of the access of such programs, especially in the developing nations. For instance, according to Houghton, a comprehensive econometric investigation is required to determine and measure the degree of the information flow generated by cell phone communication, electronic information and other ICT tools in economically contributing to agriculture production.

2.1.4 Sources of Agricultural Data

Agricultural information can be accessed from a number of sources, such as information on weather forecasting and climate change, which can be sourced from the national meteorological office (Narula and Arora, 2010). Additionally, information can be sourced from other data providers, for example, research institutes such as Ministry of Agriculture, International Centre of Insect Physiology and Ecology (ICIPE), KALRO as well as different organizations, institutes of higher learning and agriculture consultants.

As indicated by Malhan and Rao (2007), Houghton (2009), Agricultural Marketing Information Network (AGMARKNET), a web-based interface, offers to farmers everyday reports of the costs of products in the market. This data is accessed from the primary source or secondary sources depending on the reason for the information use as utilized by the private sector, companies and businesses to establish information content for information sharing. The most common information available to farmers is on agriculture production, market prices for agriculture produce and any emerging agricultural challenges such as pest attack. Information on agriculture has been created and distributed by government stakeholders, learning institutes and non-governmental organizations as well as private organizations.

2.1.5 Types of Agricultural Data Required by Farmers

For farmers to enhance their productivity, they have to know the best practices in agronomy and other agricultural practices. Information gives farmers insight which may incorporate general practices, for example, improved seeds to plant, utilization of fertilizers, irrigation systems, weed eradication, pests and disease management, crop harvesting as well as sales and marketing of farm produce (Tiwari, 2008).

The data that is important before the planting period is inclusive in the management of crops and organization of activities relating to crop production, farm implementation and their costs as well as accessibility in the market, soil fertility and irrigation systems (Kanu *et al.*, 2016).After crop planting, additional information is required to increase the quality of the harvest; this may be inclusive of information on agronomical practices, crop market prices, the weather pattern, fertilizers with its application and pest control (Rao, 2004). According to Ratnam *et al.* (2006) management of diseases, weeds, prevention and control of pest attacks heavily relies on good information delivery, which requires appropriate communication channels suitable to the target audience.

Agriculture marketing, financial, post-harvest information and resource information can determine costs for produce in the market(Irivwieri, 2007). A constant stream of pertinent information from various sources such as the government, sales, marketing agents and non-Governmental organizations, facilitated by mass communication channels like radio and internet, contribute to the enhancement of agriculture production(Boone *et al.*, 2000).

2.1.6 Factors Affecting Effective Dissemination of Agricultural Information

AccordingOmogor (2013), some challenges to successful communication are factors that influence negatively on the expected communication message and from being effectively decoded by the targeted audience. In the utilization of technological innovations, there are numerous hindrances and challenges in legitimate and reasonable utilization of information such as technologically advanced communication channels, data transfer restrictions, capacity of media transmission and limited infrastructure that facilitate usage of ICT tools which affects Africa much more in rural areas. Limited internet, radio and telephone connectivity especially in

rural areas, coupled with the high cost of ICT tools, low purchase power of farmers and low ICT skills create a challenge in the use of communication channels (Ghafourian *et al.*, 2012).

As indicated by Lucky, the absence of experience and lack of education limit farmers' creativity and makes it hard to exchange new farming practices in extension service delivery. Therefore, this gap is covered by the inclusion of Information Communication Technologies that enhance knowledge transfer due to the visual and audio features of most ICT tools. Another hindrance in channeling information to farmers, according to Narula and Arora, (2015) is the point of view of the sender of the information and if it is understood by the target audience as the audience's environment and knowledge levels may restrict knowledge comprehension due to vocabulary and culture among other things.

Training is assumed to upgrade farmers' capacity to obtain, recognize and comprehend information to minimize the risk of information being misunderstood or deemed useless (Lucky and Achebe, 2013).Olayide (1972) took note that rural individuals that had no access to basic infrastructure, for example, accessible roads, water supply, schools, hospitals, and shopping Centres, were affected by the lack of access to communication channels. This impacted the indigenous farmer's ability to gather and share information in many underdeveloped communities.

When it comes to print media, some critical components which influenced their usefulness were the nature of information, farmers' enthusiasm, freshness of the information, punctuality in production, accessibility to print media, pertinence of information, proficiency level of farmers, and the cost of accessing these print media items(Rehman *et al.*, 2011).

Adeniji (2007)states that information access is critical for agriculture productivity but the fragmented and disorderly agriculture communication sector requires clear verified effective communication channels that address effective information access. For information to accomplish the coveted outcomes, the theories that influence information communication channels are cardinal to ensuring effective communication with the consideration of the variables involved. The conceptual framework illustrated in figure 2.1 show the variables of the study.

2.2 Conceptual Framework

The conceptual framework of the study was generated in order to understand the linkage between the outcome variable and the independent variables of the study. The study conceptual framework shown in Figure2.1 summarizes the linkage between the dependent variables and the independent variables.

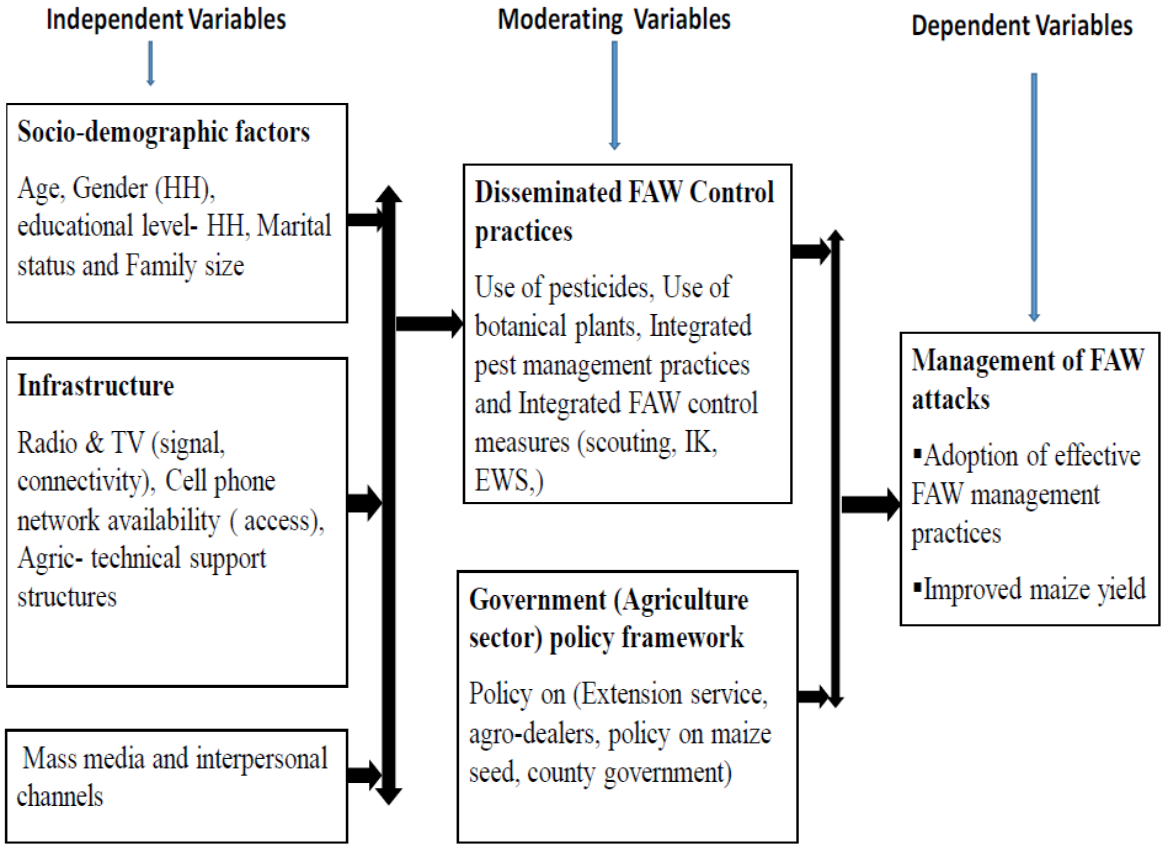

Figure 0.1: Study conceptual framework

Socio- demographic factors like educational level, age, gender and family size affect the economic status of the household which influences the information sourcing behavior of farmers. Furthermore, access to information communication channels is impacted by the skill set of the farmers which facilitates the farmer's usability, familiarity, like-ability and interactivity of the communication channels, thereby enhancing the access of the channels notwithstanding the factors that enhanced accessibility of the communication channels, such as the good radio and television signals, including the cell phone network connectivity.

Additionally, the agriculture technical support structure consisted of the agriculture stakeholders; ministry of agriculture staff (extension agents), seed companies and agro-dealers that formulated the information content for dissemination through the

communication channels. The channels included radio, television, cell phone and interpersonal channels such as extension agents, peers in the community, fellow farmers and agro-dealers. Disseminated FAW practices consisted of the use of integrated pest management (IPM) which includes field scouting, identification, raising alarm of FAW attacks, communication of severity and the use of pesticides.

Government provided an agriculture sector policy framework that guided implementation modalities of the FAW control measures. The policy recommended to the extension services (best agronomical practices), agro-dealers (best pesticide use practices) and an improved seed variety (maize seed coating).The outcome of the process where all the players performed their part was the adoption of the effective FAW practices, which improved the maize yield and food security. Farmer adoption of the IPM practices reduces environmental damage due to over use and indiscriminate use of pesticides thereby contributing to sustainable agriculture production.

2.3 Theoretical Review

This research was constituted within the diffusion theory by Rodgers (1995). There are five established adopter categories according to the diffusion theory of innovation; innovators, early adopters, early majority, late majority, and laggards. While the majority of the general population tends to fall in the middle categories, it is still necessary to understand the characteristics of the target population.

When identifying the adopted communication channel which would be deemed as the most effective for the dissemination of Fall Army Worm information, the study used the criteria of the farmer's most preferred communication channels as they appealed to the different adopter categories. These categories had different tendencies in adopting and using an innovation.

Information around farmers' communication and information-seeking behavior has been shown to be useful for understanding the needs of client groups and to target intervention programs(Tucker and Napier, 2002). A better understanding of the processes by which new knowledge diffuses within and across societies and communities can suggest actions and investments that can be undertaken by governments and firms with the aim to promote innovations(Feder and Savastano, 2006). This will assist in planning and administering educational programs related to

agriculture production, environmental quality, and agricultural health and safety in relation to the assessment and evaluation of the impact of Fall Army Worm infestation(Tucker and Napier, 2002).

According to Rodgers (2010), the theory of Diffusion of Innovation details major factors that have an influence on the adoption of communication channels that meet farmer's expectations. The study evaluated the management of FAW through access to mass media channels as a medium which transmits information to the audience through radio, television, newspapers and Interpersonal channels that use face-to-face communication among individuals.

The theory stipulates that Mass media channels are effective at the knowledge stage where information dissemination occurs, while interpersonal channels are effective at the persuasion stage in the innovation-decision process which includes: Knowledge, Persuasion, Decision, Implementation, and Confirmation stages, (Rodgers, 1995). The combination of the mass media and interpersonal channels facilitate information communication and adoption of the FAW information disseminated.

CHAPTER THREE: METHODOLOGY

3.1 Research Design

As defined by Burns and Grove (2010), a research design is "a blueprint for conducting a research with maximum control over factors that may interfere with the validity of findings". This study collected both qualitative and quantitative data and hence employed a descriptive cross-sectional research design. This research design is very important for this study because description research design enabled the researcher to get the accurate views of the farmers on the topic at hand. In addition, the method is convenient, enables the data to be collected faster and enables questions to be asked personally in an interview using a questionnaire about things which cannot be observed easily. Descriptive research is useful for describing information, data, events, perceptions, and issues.

The study employed a cross-sectional approach because it was conducted at one point in time, which is a once off single study. A cross-sectional research approach does not require the researcher to conduct follow-up studies on the subject matter in the same study area to observe changes.Thus, a descriptive cross-sectional research design is the cheapest and easiest method to provide significant information over a short period of time. Data required for this study was collected using semi-structured questionnaires, interview guides and focus group discussions.

3.2 Study Area

The study was conducted in Lugari which is located approximately 345km west of Nairobi Kenya and in locations known as Marakusi A and B in Lugari sub-county of Kakamega county, Kenya as illustrated by Figure 3.1. Lugari Sub-County is situated on the western part of the Rift Valley region, with its main borders being the Northern part of Trans-Nzoia, the Western side being Bungoma and the Southern part of Nandi County which is a high maize production area. The altitude of the research site ranges from 800-1200m above sea level. Temperature ranges from 15^{o}C to 30^{o}C with a mean temperature of 23^{0}C. Lugari was selected to be the study area due to the well-known extensive maize production for both small scale and medium scale farm sizes. In addition, the area is one of the highest maize producing sub-counties and contributes directly to the country's food security.

Lugari Sub-County was ranked second in reported Fall Army Worm incidences, with the highest infestation rate, while Kakamega County ranked number one in previous cropping seasons (MoA, 2017). The area has high potential for increased agricultural production and is part of the important agro-economic zones in the country(Songa *et al.*, 2002). The soils in the region vary between sandy loam and loamy reddish brown. Lugari Sub-County experiences a bimodal rainfall pattern with the long rain season occurring between March and July while short rains are from August to December annually. The sub county population is approximately 122,728 inhabitants with average farm sizes of 2.5 hectares.

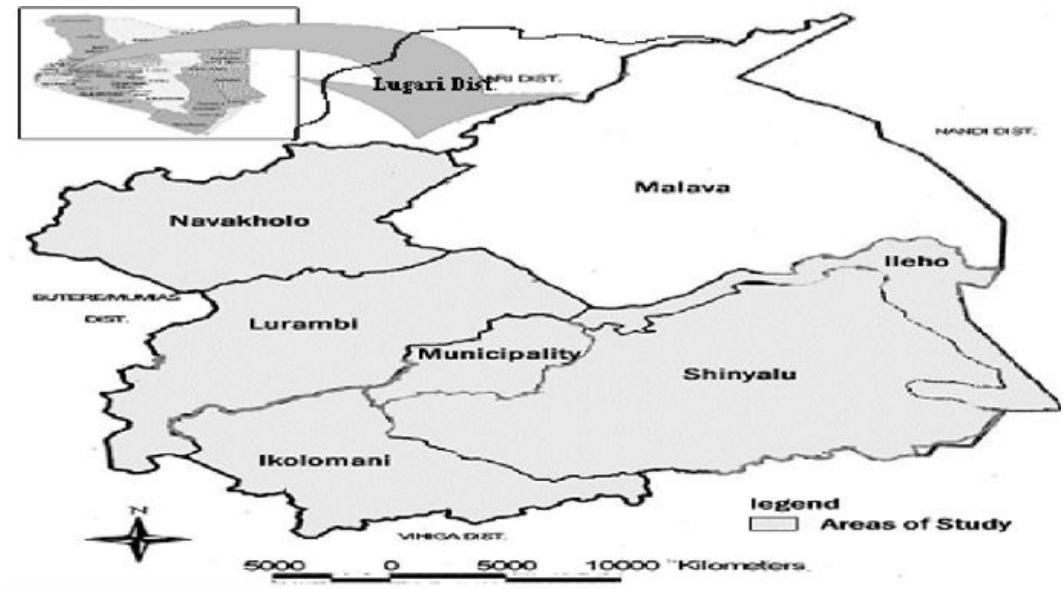

Figure 0.1: Study area map of Kakamega county

Source: The County Government of Kakamega Electoral Sub Counties Boundaries, (2019)

3.3 Target Population

The study targeted a population of 122,728 smallholder maize farmers in Lugari sub-County, this data was obtained from the Ministry of Agriculture report (2017). According toKombo and Tromp (2006), a target population is a group of individuals, objects or items from which samples are taken for measurement.

3.4 Sample Size Determination

According toMugenda and Mugenda (1999), a sample size is a smaller group obtained from the target population. This sub-group is carefully selected so as to be

representative of the whole population. The sample size was obtained from 310 total maize farmers in Lugari using Fisher's Formula(Fisher *et al.*, 1991) at 95% Confidence Interval in determining the sample size for the study because it provides data on all the individuals from a selected population and eliminates sampling error.

$$n = \frac{p\,(1-p)Z^2}{d^2}$$

Where,

n-population sample size

d-desired level of precision

p-Estimated proportion of the population of maize producers in Lugari county.

z-the abscissa of the normal curve that cuts off an area at the tail (1.96-at 95% Confidence Interval)

The study assumed that 15% of the population inLugari County engage in maize production. At 95% confidence interval, Z-value is 1.96

$$n = \frac{0.15\,(1-0.15)1.96^2}{0.05^2}$$

=196 respondents.

Table 0.1: Summary of the composition of the study sample

Study population	**Target population**	**Sampling method**	**Sample size**	**Data collection instruments**
FAW affected Farmers	310	Simple random	155	Questionnaire
FGD Farmers	21	Purposive	21	Focused Group Discussion guide
Seed Companies	3	Purposive	3	Interview guide
Extension Officers	4	Purposive	4	Interview guide
Agro-inputs dealers	5	Purposive	5	Interview guide
(MoA, Officials)	1	Purposive	1	Interview guide
Total	**344**		**189**	

Table 3.1 shows that the sample consisted of 155 farmers namely 3 seed companies (agronomists), 4 agricultural extension officers and 5 agro dealers. The three seed companies were Western Seed Co, Pannar Seed Co and Kenya Seed Co as well as oneMinistry of Agriculture official in Lugari Sub- County, Kakamega County.

3.5 Sampling Techniques

According to Mwakaweleu (2015) a sampling technique is "a process used by a researcher to select a number of individuals or objects from a population such that the selected people contain representative elements of the entire group". To start with, all the key informants and participants in the focused group discussions were picked purposefully from the list obtained from the Ministry of Agriculture. Lugari Sub County had 310 farmers (from Lugari County) with previous cases of Fall Army Warms infestation.

In the context of this study, probability sampling gave each and every farmer in Lugari sub-County equal chances of being picked during the selection of the 310 farmers. Under probability sampling, the study used systematic sampling method to find the n^{th} number (Equations 2, 3, 4 and 5) so that every 2^{nd} farmer from the sampling was picked systematically and formed part of the sample size of the 155 farmers.

The farmers were subjected to household interviews using a structured questionnaire. For the other classifications of farmers, which included farmers for FDGs, seed company representatives, extension officers, agro dealers and MoA officials were part of key informants selected using purposive non probabilistic sampling methods. This sampling technique was used in order to get adequate and correct information subject matter specialists on FAW(Creswell and Clark, 2011). In addition to knowledge and experience, purposive sampling was used due to factors such as availability and willingness as well as the ability to participate in the study(Bernard, 2017). Furthermore, interview guides for key informants (KI) and a focused group discussion (FGD) guide was used to gather data on key identified variables.

3.6 Sources of data and tools

The research data was collected from among small scale farmers, using semi-structured questionnaires, focused group discussions, and key informant interviews from Ministry of Agriculture staff and agro - dealers including seed companies.

3.6.1 Interview schedules

Interview schedules were chosen as they allow for follow-up questions to probe further when the researcher deems that he/she can get more information from the research participants. The quality of the research depended on the responses obtained

from the interviews thus the researcher using purposive sampling in choosing exactly which participants to interview.

This strategy for sampling was adopted to solicit a variety of expert views on the issues in the research. The interview guide was semi-structured but had a majority of questions which were open-ended in order to allow for a variety of views from the respondents. This data collection tool was used to gather data from key informants who gave overview data on how mass media communication is employed to inform farmers about FAW attacks and which of these mass media communication channels were the most effective.

3.6.2 Semi-structured questionnaire

Most of the quantitative primary data was gathered through the use of self-administered questionnaires. These questionnaires were highly structured in nature and contained, for the most parts, close-ended questions with the inclusion of a few open-ended questions deemed necessary.

Farmers were asked to respond to a wide range of concepts on a 5-point Likert scale were: 5 indicated Strong Agreement; 4= Agreed; 3= Un-decided; 2= Disagreed; 1=strongly Disagreed, regarding the influence of socio-economic factors and management of FAW.

These questionnaires were structured to undertake an interview for an hour or less with the intent of being very minimal. Semi-structured questionnaires were used as they were deemed to be time saving and to have higher response rates than most of the other data collection tools used in research(Marshall and Rossman, 2006).

3.7 Data Processing and Analysis

According to Kombo and Tromp (2011), data analysis refers to examining what has been collected in a survey or experiment and making deductions and inferences. It involves uncovering structures; extracting important variables, detecting any differences and testing underlying assumptions. It involves scrutinizing the acquired information and making conclusions.

For more data, reliability and validity of the research study, the researcher used data and information triangulation by collecting both primary data and secondary data.

Primary data was collected in the field using questionnaires, focus group discussions and interviews with key informants while secondary data was collected from those already published (Marshall and Rossmam, 2006).

Data was managed and later on analyzed using Statistical Package for Social Sciences (SPSS version 23) which tabulated frequencies and percentages. Pearson's Moment correlation and Chi square tests were done to determine the degree of correlation and association and significant differences between variables.

To statistically determine which of the mass media and interpersonal channels of communication are effective in informing farmers on FAW management, the study used multinomial logistic regression analysis. Multinomial logistic regression was used to predict categorical placement or the probability of category membership on a dependent variable based on multiple independent variables. According to Garson, (2011) independent variables can be either dichotomous (i.e., binary) or continuous (i.e., interval or ratio in scale), based on the nature of the variables.

Farmers were asked to indicate whether the channels have: Low extent: 1, Moderate extent: 2, and Great extent: 3.In order to inform farmers on FAW management, farmers used this scale to rate mass media and interpersonal channels, analyze, for interpersonal and mass media.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Socio – Demographic Characteristics of Maize Farmers

The study sampled 155 farmers to assess the effectiveness of communication channels on disseminating information on the management of Fall Army Worms (FAW). Fifty-five percent of the sampled farmers were female while 45 percent were males as shown in Figure 0.1

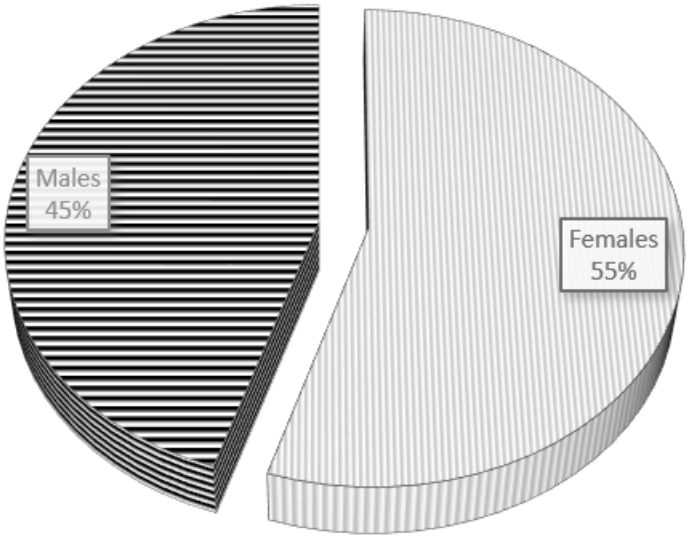

Figure 0.1: Distributions of farmers by gender

Figure 0.1 may suggests that more females are engaged in agriculture activities than males. A previous study by Diiro et al. (2018) that found that there are more females than men in Kenya's agricultural sector. The implication is that information dissemination should focus on women as they are majority participants in agriculture recommendation.

The majority of farmers at 59 percent were aged between 36 and 55 years, 27 percent were over 56 years of age and 14 percent were aged between 18 and 35 years old, as depicted in Figure 0.2. The finding suggested that fewer youths were involved in agriculture accounting for 14 percent of the sample. The majority of the farmers were aged between 36 and 55 years suggesting that the Ministry of Agriculture (MoA) should mainly use of communication channels friendly to farmers older than 35 years.

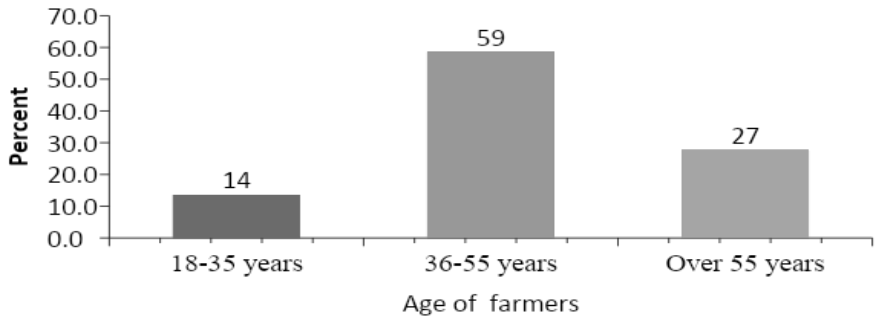

Figure 0.2: Age distribution of the farmers

It can be argued, based on these results that the type of channel used and information disseminated when targeting youthful farmers should be segmented to suit the characteristics. Youth farmer characteristics include things such as mobility. Youth farmers are very mobile as they frequently change residential locations (Tambo et al., 2019).Mobile phone and radio communication may be more youth friendly than newspapers. Furthermore, youthful farmers always want to be knowledgeable especially on new emerging issues that affect their livelihood hence their consistency with Information Communication Technology usage which enhances their information sourcing tendencies.

Meanwhile, 95 percent of the farmers had at least primary education. Table4.1 shows that 47 percent of the farmers had acquired secondary level education, 20 percent had tertiary level education, while 27 percent had primary level education.

Table 0.1: Farmer's education levels

Education Level	Frequency	Percentage
No education	7	5
Primary education	41	27
Secondary education	75	47
Tertiary education	31	20
Others (Specify)	1	1
Total	155	100

This implies that majority of farmers had a basic education, with average literacy levels where most farmers were able to decode agriculture information which facilitated the use and access to communication channels.

Additionally, this study's focus group discussion had majority agree that the higher the educational level of farmers the higher their agriculture production levels. However, results from the stakeholder interviews with the agro-dealers contradicted the focus group discussions conclusion which stated that education was not critical to enhanced agriculture production as what was important was the adherence to integrated pest management instructions by farmers especially with the management of FAW.

Alternatively, Oduro-Ofori, *et al.,* (2015) in his research findings indicated that farmer's highest education was secondary school level which facilitated assimilation of knowledge and information. Further Oduro-Ofori stated that the educated farmers had enhanced problem-solving skills that contributed to better application of the agronomical practices and enhanced productivity, in comparison to farmers with lower education levels.

The analysis of the data showed that the majority of the farmers belonged to households with less than five people. Figure 0.3 below shows that 65 percent of the farmers had family sizes of 1 to 5 members, 33 percent had family sizes of 6-10 members while 3 percent had families with more than 11 members.

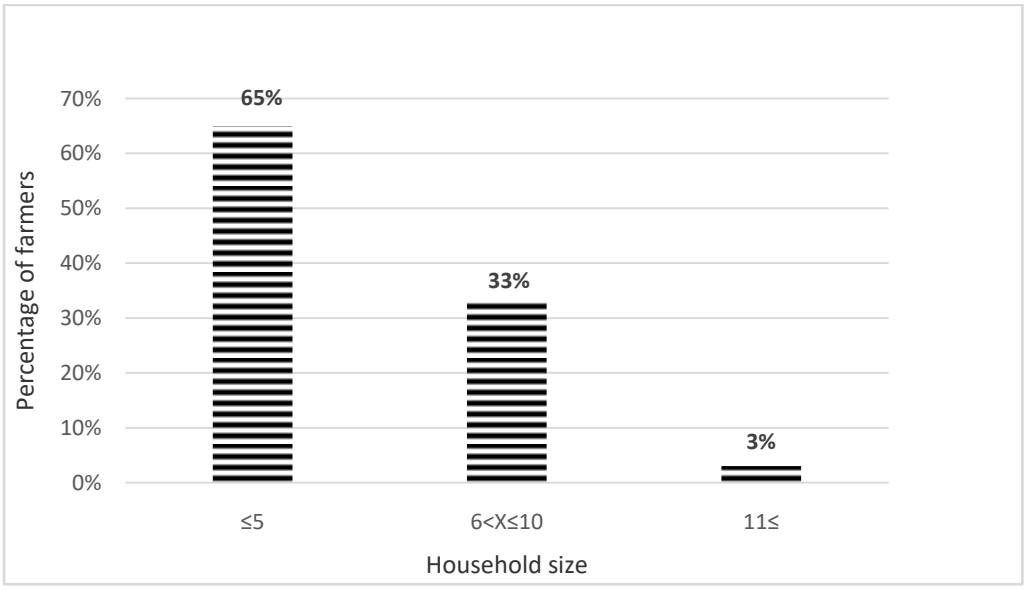

Figure 0.3: Distribution of farmers by family size

The majority family size of 1-5 members indicates that family sizes are smaller. This could be due to family planning health education which is mainstreamed in the agriculture information dissemination programs, especially through *barazas* and

agriculture field days. Therefore, effective communication channels should be user friendly towards the 1-5 household member family size farmers.

The trend toward smaller family could be attributed to livelihood coping strategies that emphasized the re-education of family members including the reduction of family size in order to reduce family living expenses. Additionally, this effect in reduced family sizes could be due to family planning health education which is mainstreamed in the agriculture information dissemination programs especially through barazas and agriculture field days. Rapsomanikis (2015), in his study on the analysis of smallholder farmer's economic lives, outlined that the average family size of most households was 7 members with no difference in gender distribution among the households.He further revealed that most farmers found agriculture to be expensive due to the highly priced agriculture inputs which affect the family purchase power and income levels.

The family size became smaller in order to reduce the living expenses. However,Sanga et al. (2013)outlined in his study that in Africa some cultures believe in a larger family size, especially in the rural areas as a source of farm labor and wealth. It is believed that the more people in the family, the more increased sources of income in the family. Furthermore, his study stated that most agricultural households that are large ranged from 6 – 11 family members, which contradicts with the findings in this study which had majority family size of 1 - 5 members.

The findings in Table 4.4 showed the distribution of farmers according to their location in terms of residence. Out of the 155 farmers interviewed, 76 percent were from Marakusi, 15 percent were from Mbagara, 5 from Sipande and 3 were from Mautuma.

Table 0.2: Distribution of farmers by location

Sub-location	Frequency	Percent
Marakusi	118	76
Mautuma	4	3
Mbagara	25	15
Munyuki	1	1
Sipande	7	5
Total	**155**	**100**

The general distribution of the farmer's residence was more clustered around the locations with more social amenities (Marakusi) such as water, electricity and phone network coverage or connectivity catchment of Information Communication Technology tools. This entails that infrastructure status affects access and utilization of information communication channels and is also influenced by the income level of the households.

These study findings agree with Levi, (2015) as his study revealed that poor infrastructures such as of phone network connectivity, radio/television signals contribute to inefficient performance of ICT tools as well as lack of accesses ability Communication channels are affected by the state of the roads and in rural areas most roads are not passable which affects access. Additionally, limited radio and television frequency cover, poor mobile phone connectivity are due to the geographical location, terrain of the farmer's residence, limited electricity connection to the grid coverage which hampers access and prohibits the utilization of communication channels.

The percent distribution of farmers by occupation is depicted in Figure 4.4. These findings show that the majority of residents of the research study area relied on farming at 77 percent, formal employment at 14 percent, informal business operations at 8 percent and with 1 percent representing others such as donations or remittances.

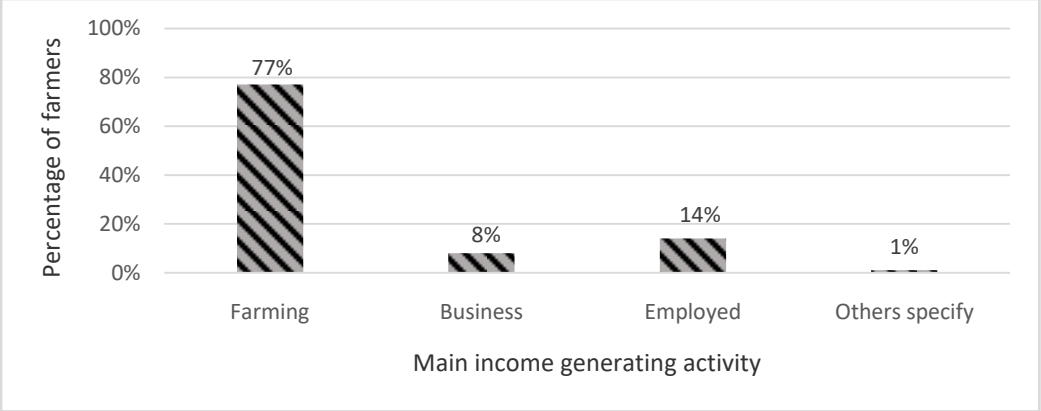

Figure 0.4: Percent Distribution of Farmer's income generating activities

The Focus Group Discussions interviews also revealed that some farmers had a livelihood strategy of combining the activities of agriculture, business and employment with seasonal piece work or contracts.

These findings are similar to those of Ngwili *et al.*, (2015) which revealed that most households were engaged in agriculture activities as a source of income especially in the rural areas. This was complemented by employment as a safeguard in case of any sudden shocks that affect the farmers such as droughts, floods and or any crop failure. Farmers used several coping strategies of combing agriculture and employment, where employment provided a source of capital for purchase of agriculture inputs.

Figure 4.5 shows distribution of farmers by years engaged in agriculture. Study results showed 73 percent of the farmers had engaged in agriculture activities for more than 10 years, while 16 percent had been in agricultural activities for 6-10 years and only 11 percent had been in agricultural activities for 1-5 years.

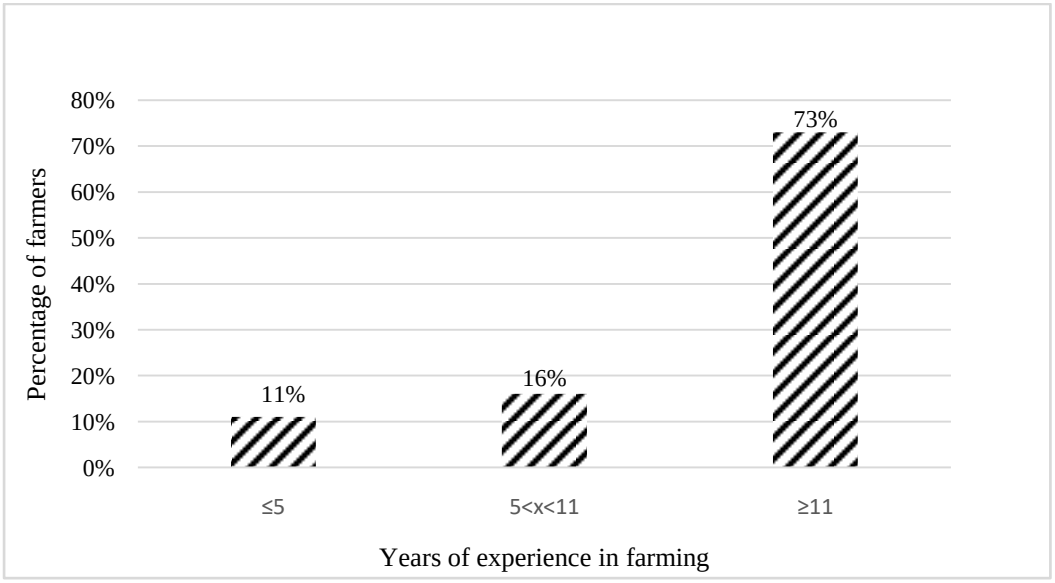

Figure 0.5: The proportion of farming experience for the sampled farmers

A farmer having engaged in farming for many years accumulates experience in farming activities. This experience entails farmers' knowledge of information sources concerning agricultural productions and any information on agriculture.

Since the majority (73%) of the farmers has 10 or more years of farming, they have information sources on FAW control and other agricultural information. The study findings by Tambo *et al.* (2019) on information seeking behavior of farmers in Tanzania, found an association between years spent in agriculture with the type of agriculture activities engaged in. The farmers preferred to be consistent with a particular crop such as cultivation of maize in order to gain experience and access

agriculture information which helped improve production. The fewer years in agriculture meant less agriculture knowledge and productivity level.

Furthermore, the key informant's interview (from the Ministry of Agriculture) emphasized the importance of farmers to be engaged in agriculture activities for many years. This was critical because these farmers were the partners that the ministry relied on to be model farmers or lead farmers. Such farmers could have their own farm demonstration sites in order to facilitate a participatory approach to technology dissemination. The model farmers also became sources of practical agriculture information and innovation making them good interpersonal communication channels.

Alternatively, emerging new issues due to global warming have changed the narrative in farming in very significant ways. Rainfall patterns have changed greatly; therefore, it reinforces the need to strengthen the communication channels in order for farmers to adequately be informed unlike depending on their own experience. Also, something worth noting is that farming trends and techniques keep changing and advancing with time therefore, there is still a need for effective communication channels to be utilized to bridge the time and technological advancement gap.

a) Farmer's agriculture group membership

With regard to the membership of farmer groups, farmers gave their views and were displayed in Figure 4.6. The majority 68 percent of the farmers were members of a farmer group or local association while 32 percent were not in any group or local association.

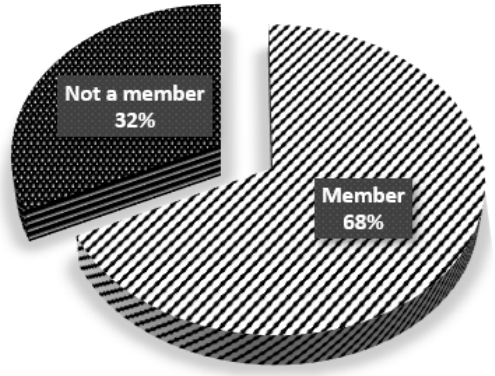

Figure 0.6: Distribution of farmers by membership in a farmer group

Source: Author's analysis of the data collected

These results indicate that farmers value the need to belong to an agriculture grouping. Farmer groups are a source of information, finance, and social interaction. In line with these findings (FAO, 2017) outlined results from a project on an SMS campaign which accelerated adoption of improved seed varieties in Tanzania thereby indicated that farmer associations or groupings were a good source of information for farmers; women were the most prominent active group members.

Regarding the most effective mass communication channel, the majority of the farmers rated radio as the most effective mass media communication channel followed by mobile text messages and telephone calls. The mass media channels rated effective need to be aligned with the different farmer's features in order to be more effective in communication. Figure 4.7 shows distribution of farmers by membership in a farmer group.

4.2 Management of Fall Armyworms

The study employed focus group discussions to find out the level of farmers' knowledge of the management of FAW. Table 0.3 shows general statements rated on a 5-point Likert scale.

Table 0.3: Sources of information for management of Fall Army Worms practices

Statement	N	Mean	Std. Deviation
Early planting at the onset of the rain can prevent or reduce FAW attacks: sourced from peers and barazas.	155	3.80	1.566
Information from mass media channels regarding crop rotation and intercropping with crops such as pigeon peas, cassava and beans coupled with general information on FAW educated famers on FAW control andwas well disseminated	155	4.32	.956
Visits by extension officers, who train famers on spraying crops have helped control army worm especially among female farmers	155	4.50	1.062
Agro-dealers are well informed through various media channel hence were able to provide informational support to farmers on Fall Army Worm Control.	155	4.29	1.246
Interpersonal communication on FAW control among fellow farmers in the community is most preferred due to access to detailed information and instant feedback.	155	4.75	.477

The results indicated a mean of 4.75 and a standard deviation of 0.477. Farmers rated highest the Interpersonal communication channel used to access FAW control information. According to the study findings from the key informants' interviews the Interpersonal communication channel was the farmer community's most preferred mode of communication in the management of FAW.

The Interpersonal communication channel was most preferred due to its high interactivity the communication channel which it offered instant feedback, rapport, familiarity and segmentation in age, gender and farmer locality. Furthermore, most farmers agreed that "visits by extension officers assisted in training famers on spraying crops, hence helped control of Fall Army Worm pest attacks" at a mean of (4.50) and a standard deviation of (1.062). This helped facilitate female farmers to acquire the spraying skills which were mostly dominated by men. Additionally, farmers were in agreement that "information from mass media channels regarding crop rotation and intercropping with crops such as pigeon, cassava and beans coupled with general information regarding FAW control was well disseminated highest", with a mean of (4.32) and a standard deviation of (0.956).

Also results show that "Agro-dealers were well informed through various media channels hence were able to provide informational support to farmers on FAW Control", at a mean of (4.29) and a standard deviation of (1.246). Finally, "Early planting at the onset of the rain can prevent or reduce FAW attacks which were sourced from peers and farmer barazas", which was rated at a mean of (3.80) and a standard deviation of (1.566).

Gebru, (2019) in his findings in a study on information usage revealed that farmers were able to utilize information if there was a fellow farmer support as well as a model farmer with higher agriculture production experience that they had observed. The model farmers contribute to the extension officers' works which were complimented by mass media tools.

This study revealed that extension officers were also critical in reinforcing knowledge practice and acted as a reference by verifying information sources for farmers. This phenomenon concurred with Rogers on adoption and how interpersonal communication channels were the most effective channel in the persuasion stage that enforced action of the decision-making process. This includes: knowledge,

persuasion, decisions, implementation and confirmation stages(Rogers, 1995). Additionally, Roger's theory stated that interpersonal channels facilitated the persuasion stage which enhanced the conclusion of action to be taken by the adopters of an innovation under the information dissemination process.

However other findings contradict the relevance of extension officers as being not effective in their service delivery to farmers. This is due to the high extension officer to farmer ratio and emphasized on the need for additional sources for agriculture information for farmers(Gautam and Anderson, 1999, Rogers, 1995).

4.3 Socio-economic factors influencing Management of FAW

The analysis in Table 4.3 showed that the highest mean (4.57) of farmers had a standard deviation of (0.499) with total agreement that income levels of households (H/Hs) have an influence on the affordability of FAW management practices. In addition, household characteristics like family size, educational level, age of H/Hs head had an influence on the management of FAW with a mean of (4.50) and a standard deviation of (0.632).

Table 0.4: Influence of socio- economic factors on management of FAW

Statement	N	Mean	Standard deviation
Income levels of Households have an influence on the affordability of FAW management practices.	155	4.57	.499
Household characteristics like family size, educational level, age of Households head has an influence on management of FAW.	155	4.50	.632
Cultural norms influence the dependence on maize as a staple food necessitating information seeking tendencies on FAW management practices to enhance production.	155	4.39	.493
Women or youth headed Households with higher variability in source of income have a negative influence on management of FAW.	155	4.30	.807

Furthermore, farmers agreed that dependence on maize as a staple food had made them consistently seek information on Fall Army Worm management with a mean of (4.39) and a standard deviation of (0.493).

Women or youth headed H/H had a higher variability in source of income. This had a negative influence on the management of FAW, with a mean of (4.30) and a standard deviation of (0.807).

The findings of this study collaborate with Lucky, which stated that the absence of experience and lack of education limit farmers' creativity and make it hard to exchange new farming practices or ideas. This limits implementation of expensive FAW management practices. Additionally, this is compounded by higher living expenses, especially if the family size is larger. Their priority would be for family needs before they can consider the implementation of most FAW management practices which are expensive.

According toKante *et al.* (2019)'s research results on an ICT model for increased adoption of farming in Mali, it is indicated that only 18,000 agriculture customers in 2016 accessed mobile based agriculture information despite the existence of over 10.3 million mobile subscribers in 2014.Furthermore, the study stated that quality of information content, cost of information access and channels combined with farmers purchasing power, affected the effort invested towards accessing information and implementation of the information.

To accomplish the best outcomes in extension services delivery and ensure effective communication dissemination in the case of low literacy levels, the ICT's visual, oral and print media should all be combined to enhance utilization. The goal is that the targeted farmers can interpret and understand information disseminated by the communication channels.

In addition, the key informant's interviews with the extension officers suggested that socio demographic factors significantly influence management of Fall Army Worms. These include income and educational levels of the farmers. Many farmers are not able to afford the required chemicals to manage Fall Army Worm attacks and some integrated management practices.

The key informant's response was in agreement with the response from the focus group discussion of farmers. Farmers in the focus group discussions revealed that family size, areas of residence and education level influence farmers' capacity to manage Fall Army Worm attacks. The farmers argued that most of them are not able

to adequately comprehend agronomical terms/jargons that are not available in local languages, this use hindered their understanding. The agronomical terms/jargons made farmers rely on simple practical information and demonstrations from extension services and television.

The key informants confirmed the need for simplified information (without complicated terms/jargons) to be structured along the farmers' level of education, language and exposure. This should be complemented with mass media channels that disseminate FAW information. Additionally, the key informant emphasized the need for uniform information as segmented information according to the farmer grouping reduced quality of information content.

Table 4.5 shows the association between gender, education level, area of residence and occupation of the farmer and access to a phone and television. Education level of a farmer was significantly associated using Television and cell phones to access to information concerning the management of FAW.

Table 0.5: The associations between farmer's socio-economic characteristics with the uptake of television and mobile phone technologies

Socio-economic variables	**Television**		**Mobile phone technologies**	
	χ^2	**P=Value**	χ^2	**P=Value**
Gender	0.336	0.562	0.188	0.669
Educational level	44.597	0.000**	35.600	0.000**
Residence: access to TV and Phone	11.97	0.215	10.622	0.638
employment status	23.998	0.000**	19.734	0.000**
Age	5.000	0.082	0.445	0.800
Marital status	6.499	0.090	10.479	0.045*
Family size	15.735	0.264	12.170	0.514

Statistical significance levels **P<0.01; *p<0.05

The results from the focus group discussion indicated that most farmers with a higher educational levels had more uptake of mobile phones and televisions due to the skills set they possess to use the ICT tools due to their higher educational levels and the higher purchase power (as they have an income) to buy the ICT tools.

In addition, there was no association between farmer's area of residence and uptake of a phone or television with $\chi^2 = 11.97$, p-value = 0.215 and $\chi^2 = 10.622$

and p-value= 0.638 respectively. However, the study established that there was an association between employment status of farmers and uptake of a phone or television, the study found that there was a very strong statistically significant association with χ^2 = 23.998, p-value 0.000 and χ^2 =19.734, p-value 0.000 respectively. Furthermore, the study found no statistically significant relationship between the farmer's age and uptake of mobile phones or television, with χ^2= 5.000, with P-value= 0.082andχ^2= 0.445, and p-value 0.800 respectively.

The above chi square results on the associations between farmer's socio-economic characteristics and the uptake of television and mobile phone technologies from this study indicate that education and employment status and access to the phone and television has a statistically significant association. Education provides the exposure to Information communication channels and employment provide the purchase power for access to communication channels.

These findings are in union with results of Van Campenhout, (2018) study on SRIEED/Malawi project that provided CIT-enabled extension which established that information access and information utilization were strongly influenced by income and education levels. The project facilitated 10 households access agricultural information however, only 1 out of 10 households accessed information due to the skills needed to access the information facilitated by education exposure and cost implications involved.

However, Jowi (2018) in his study on effective communication channels that create awareness of plant clinics, revealed that income level was important for information access. Contrary to this study findings, Jowi's study stated that educational level was not essential in information utilization and no impacted on access to ICT tools such as phones and television.

These study findings revealed no statistically significant association between gender, area of residence, age, marital status, and family size of the farmers and access to phone or television. This concurs with Fu whose research results showed phone and television enhanced learning and comprehension of information among farmers but was not effective in influencing the adoption of ICT tools or the association with some socio-economic characteristic. Table 4.5 shows the association between farmer's socio-economic characteristics and uptake of television and mobile phone

technologies. Table 4.6 shows association between farmer's socio – economic characteristics and uptake of radio and computer technologies. The study conducted an analysis of associations which included the association between gender of the respondent and access to radio or computer and the study found χ^2 =0.963, with P-value= 0.002 and χ^2= 2.811, and p-value= 0.940 respectively.

Table 0.6: The associations between farmer's socio-economic characteristics with the uptake of radio and computer technologies

Variable	Radio		Computer technologies	
	χ^2	P=Value	χ^2	P=Value
Gender	0.963	0.002**	2.811	0.940
Education level	30.123	0.003**	22.408	0.049*
Employment	2.956	0.565	24.401	0.005**

Statistical significance levels **P<0.01; *p<0.05

There was a statistically significant association between gender of the respondent and access to radio; on the other hand, there was no statistically significant association between gender of the respondent and access to computer.

Concerning the association between education level of the respondent and access to radio, the study found statistically significant association between access to radio and the respondent's education level withχ^2= 30.123, p-value= 0.003. The study found a strong association between the respondent's education level and access to computer/laptop with χ^2 = 22.408, with P-value 0.049. Regarding the association between employment status of the respondent and access to radio, the study found no association between respondent's occupation and access to radio with χ^2 = value = 2.956, p-value = 0.565. Alternatively, the study found a strong association between the respondent's education level and access to computer/laptop with χ^2 = 22.408, with P-value 0.049.

Similarly, Tambo *et al.* (2019), in his study on the impact of ICT -enabled extension campaigns, on farmers' knowledge and management of Fall Army Worms in Uganda, highlighted the critical role that education and income played in farmers' access and usage of radio and computer/laptop. The more empowered economically a household was, the more ICT devices the household owned and accessed. On the other hand, he states that education and income does not confirm utilization of the information accessed as other factors such as human abilities or skills, preferences and

motivations to use the information communication channels can affect the process of information access and utilization.

The influence of socio-demographic factors that influenced farmers' access to communication channels were analyzed using chi-square and the results discussed. Farmers in all age group categories had access to information in varying degrees. The present study further showed that age was significantly associated with access to all other information channels ($p<0.05$) except television. Implying that access to information using television is dependent on respondent's age. This present study further showed that age was significantly associated with access to computers/laptops. Alternatively, Levi, (2015) reported that age and television did not have any significant association.

On the other hand, results suggest that the age of farmers had an influence on the farmers' access to information using radio, telephone calls and mobile/text messages. This is in line with what was reported by Olaleye et al. (2009) that the dependence on radio as the source of information makes the older farmers to receive more radio agricultural information.

Chi square test of independence shows that marital status was significantly associated with all the information channels ($p<0.001$). The study results found significant association between marital status and access to information using television and mobile phones ($p=0.025$ and $P=0.026$ respectively). Marital status is an important factor that influences information access. Another study by Chhachhar et al. (2014) found that there was a significant relationship in terms of choosing television programs to watch between the married and those who are single, with the singles preferring to watch programs that are entertaining and not agriculture related.

Further results showed that education level was significantly associated with telephone calls, television and mobile/text messages ($p<0.05$). The findings suggest that telephone calls, television and mobile/text messages as information channels depend on the level of education. A study done by Okwu and Ioorka (2011) reported that literate farmers can effectively use Information Communication Technologies to access information. Meanwhile access to information using radio was found to be independent of the level of education ($P=0.532$). Therefore, radio may not be affected by low or high educational levels among the smallholder farmers.

4.4 Effectiveness of mass media communication channels disseminating fall army worm Information among maize farmers

The majority of the sampled farmers had some knowledge of FAW while a minority had not heard about FAW. Figure 0.7 shows that 97 % knew about FAW while 4% did not know. The result shows that the majority of farmers have information on FAW due to the great threat that FAW had on food security. Farmers' knowledge of FAW is crucial in farmers knowing the effective means of communication regarding FAW.Moreover, the information seeking tendencies of farmers were influenced by their production prospective.

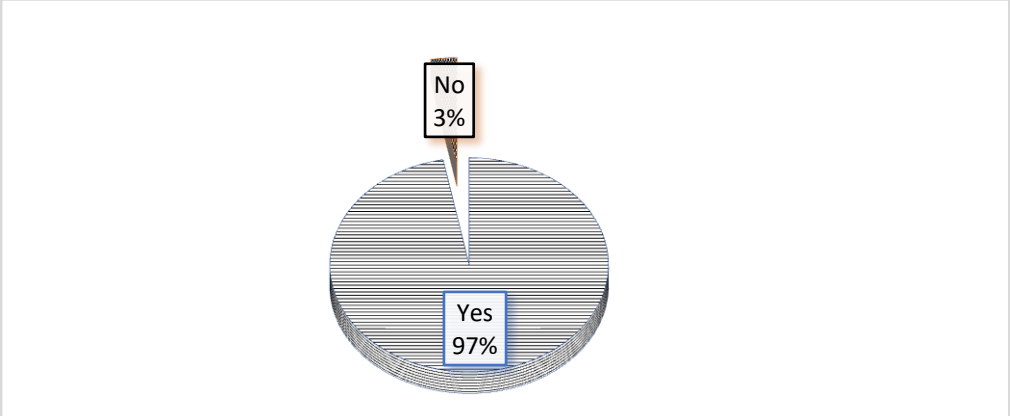

Figure 0.7: Rate of farmer knowledge on Fall Army Worms

In Figure 0.8, radio was the most effective communication channel through which farmers received information concerning FAW. The findings show that the majority, 87 percent of the farmers rated radio as most effective in terms of FAW information dissemination followed by telephone calls which rated at 73 percent and mobile text messages at 65 percent. Additionally, farmers rated newspapers and television as moderate at 29 percent and 23 percent respectively, television as moderate at 23 percent, while mobile App emails, web portals, farmer magazines and CD/DVD rated as not effective.

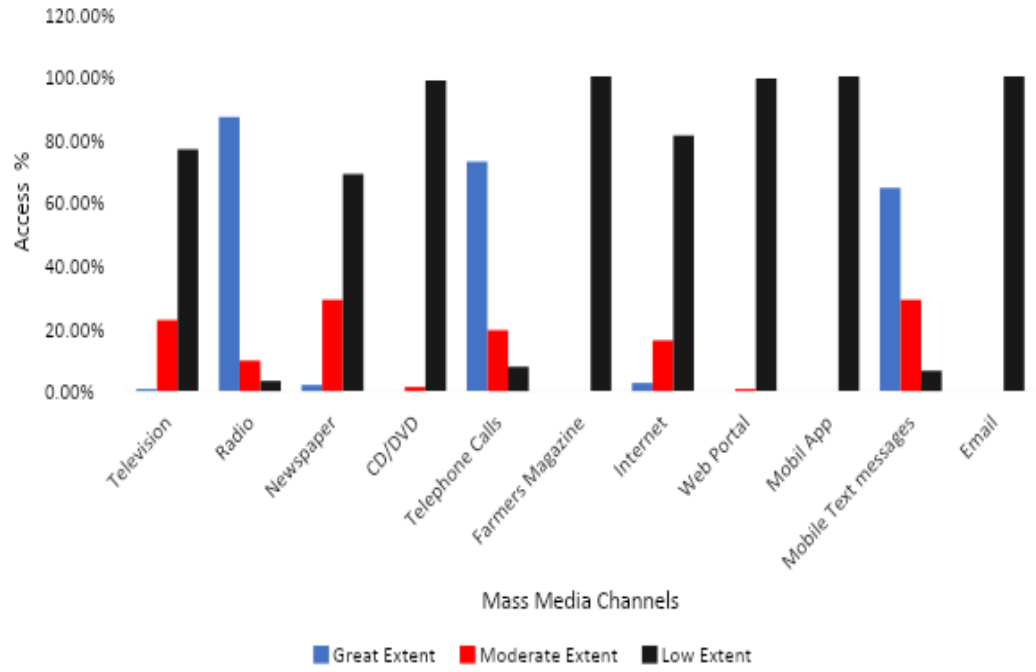

Figure 0.8: Effectiveness of farmer accessibility to mass media communication channels used in Information dissemination on fall armyworms

The result corroborates with the observation by the Communications Commission of Kenya [CCK] (2012)Communication Commission of Kenya (2011) that over the past few years, cell phone and radio usage had increased in Kenya. Okwu and Ioorka (2011) also reported that radio was among the most effective forms of communication especially among literate farmers. Similarly, Hudson (2017) observed that radio, mobile phone, farmer groups and extension agents contributed to increased information access. The study found that most farmers viewed Television, Newspaper, CD/DVDs and magazines. Surprisingly, internet, websites, mobile applications and emails were viewed as among the channels that did not effectively transmit information on FAW. This could be due to due to lack of sufficient income to access internet by some farmers. Moreover, most farmers do not have sufficient access to some sources of energy such as electricity (The Communication Commission of Kenya [2011], Globalist [2017]). Although 10 percent of the farmers had access to solar energy, 61 percent did not have access to any form of energy.

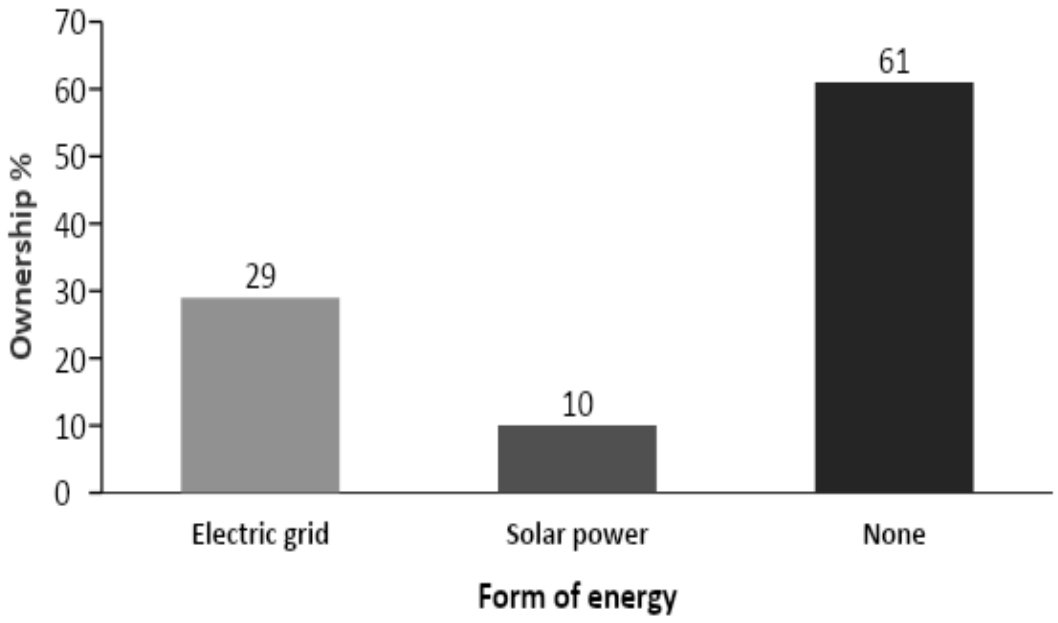

Figure 0.9: Percentage distribution of energy access

Source: Author (2021)

Hanna and Summer (2015) observed that affordable communication infrastructure, such as phone connectivity, radio and television signal coverage and access to power grids play key roles in access to information. Furthermore, the cost of accessing these communication infrastructure also determine access to information (Hanna and Summer, 2015).

4.5 Assessment of Fall Army Worms information dissemination content in mass media communication channels

Table 4.7 depicts the assessment of effectiveness of mass media channels using the criteria of evaluating channel features such as accessibility, acceptability, authenticity, credibility, familiarity, usability, likability, and interactivity according to the farmer's perceptions. Radio was more accessible to farmers compared to followed by cell phone, Television and Newspaper.

Table 0.7: Effectiveness criteria assessment of mass media communication channels

Perception measurements	Television	Radio	Newspaper	Telephone Calls
Accessibility	20	47	8	25
Acceptability	13	45	8	34
Authenticity	35	41	9	15
Familiarity	32	43	6	19
Usability	22	25	12	41
Likeability	12	33	7	48
Interactivity	7	36	7	50

Source: Author 2021

However, a cell phone provided an opportunity for farmers to interact with their fellow farmers and extension officers. In this way, Cell phones provides an opportunity for farmers to seek clarification on the management of FAW. This is consistent with the finding that the use of cell phones was the most preferred channel of communication. Therefore, farmers perceived cell phones and radios as effective forms of communication through which they access information concerning FAW. However, illiteracy could have disadvantaged some of the farmers could have as they could neither write nor read text messages, suggesting the need for farmers to have basic education or skills. For this reason, Television and radio may have aided such farmers. On that account, messages disseminated through mass media channels such as cell phones should be in local languages that can be read by farmers. The results observed were in line with Wanga (2012) who found that the use of short messaging systems (SMS) and voice alert services revolutionized cultivation in Siaya County. The Media Council of Kenya (2014) found that Television, radio, cell phones and daily papers were utilized by farmers as sources of information. Depicted below is a Multinomial logistic regression model performed to determine the influence of mass media channels on farmers' access to information.

Table 0.8: Assessment of Fall Army Worm information dissemination content in mass media communication channels

Mass Media Rate	Coefficient	Standard error	z	P>z	[95% Conf.
Great extent					
Newspapers	0.9313384	0.7905517	1.18	0.239	-0.61811
Emails	-0.341375	1.059533	-0.32	0.747	-2.41802
Radios	2.851768	1.194942	2.39	0.017	0.509725
Internet website	-0.2632926	0.6871461	-0.38	0.702	-1.61007
Phone Calls	-0.3447042	0.7645928	-0.45	0.652	-1.84328
Farmers magazine	1.337594	0.7398897	1.81	0.071	-0.11256
CD_DVDS	-1.742754	0.8300014	-2.1	0.036	-3.36953
Television	1.215179	0.6629806	1.83	0.067	-0.08424
Phone Messages	3.218907	1.580042	2.04	0.042	0.122082
Mobile-Apps	-4.47288	1.745265	-2.56	0.01	-7.89354
_cons	-2.525602	2.052077	-1.23	0.218	-6.5476
Number of observations					149
LR $chi^2(20)$					38.35
Prob> chi^2					0.0080
Pseudo R^2					0.1280
Log likelihood					-130.6657

Radio had a positive coefficient suggesting that using a radio increased the extent to which farmers accessed information on FAW. The positive coefficient suggested that radio was an effective media channel in disseminating information concerning FAW. The effectiveness of radio in dissemination could be due to easy access in different places of the county. Equally, phone text messages and Television had positive effects on the extent to which farmers access information on FAW. Television is an effective channel of communication because it provides audio and visual messages. A study by Prathap and Ponnusamy (2006) found that farmers gained 'adequate' knowledge after exposure to television, newspaper and Internet, while 97% of those exposed to radio had gained adequate knowledge after exposure. Florescu (2014) also carried out a study on the effect of mass media channels of communication in which radio and television were found to be significant.

On the contrary, CD_DVDS (-1.423946) and Mobile- Apps (-3.17238) are negatively associated with moderate access to mass media channels. This means that the use of CD_DVDS and Mobile Apps negatively affects farmer's access to FAW information. CD/DVDs are mostly utilized in the home set up where there are Televisions hence farmers who are always away from home may not access the messages that are

transmitted through CD/DVDs. On the other hand, mobile applications require smart phones and internet in order to be utilized. Farmers that may not be in possession of a smart phone may not benefit from the messages transmitted through mobile applications. Moreover, the cost of internet may be high for some farmers resulting in little or no utilization of the messages transmitted through mobile applications.

4.6 The effectiveness of interpersonal communication channels used in information dissemination on Fall Army Worm among maize farmers.

Farmers were asked to rate the access of interpersonal communication channels. The study used 3-point Likert scale of ratings; Great extent – 1, Moderate extent – 2, Low extent - 3. Four interpersonal communications were assessed and rated on their access, and these were Extension officers/agents, peers, fellow farmers and agro-dealers. Figure 4.10 depicted Information Communication Technologies as the rate of access of inter-personal communication channels used in information dissemination on Fall Army Worm among maize farmers according to farmer's perceptions.

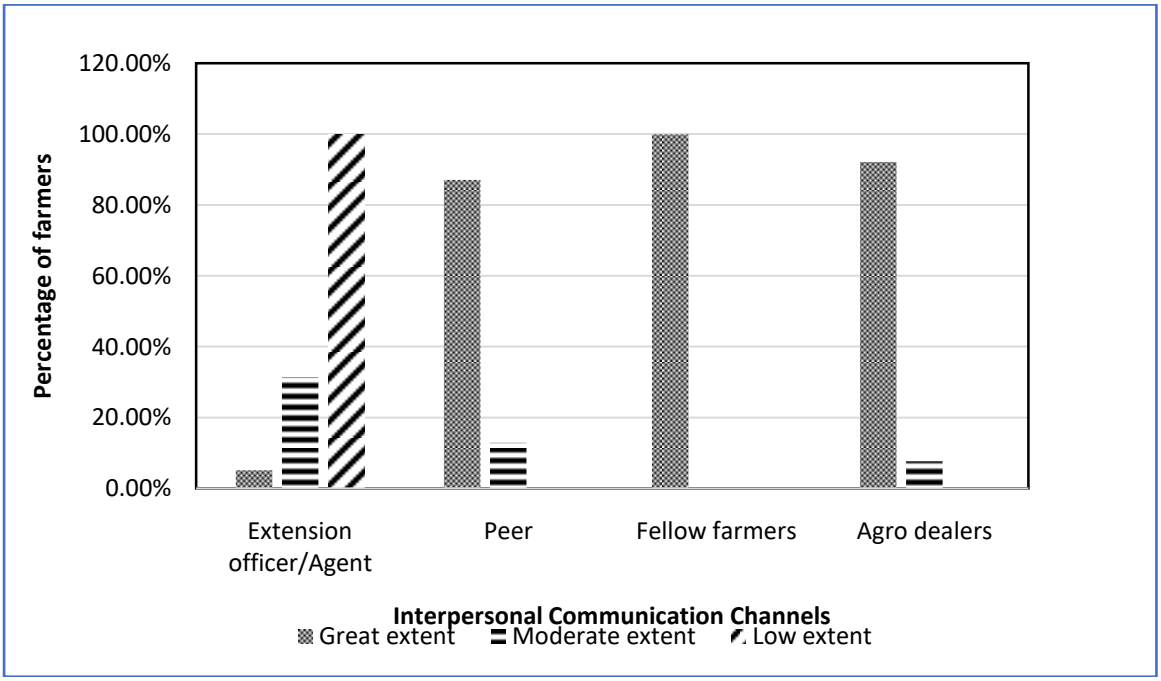

Figure 0.10: Influence of interpersonal communication channels on farmers access to FAW information

The results showed that 100 percent of the farmers rated fellow farmers as effective followed by Agro Dealers at 92 percent and peers at 87 percent. Extension Officers were rated at 5 percent as being very low in access.

Access of mass media communication channels in this study entailed an overall likability, usability, accessibility, acceptability, authenticity, familiarity, interactivity and reliability of the interpersonal communication channels as viewed by the farmers.

Similarly, Lloyd (2016)'s study findings state that hindrances in channeling information to farmers are the farmers' locality and cultural orientation. This may restrict information assimilation, adoption of new ideas and knowledge, as is the case with the older generation of farmers who do not easily adopt new ideas. Hence fellow farmers were rated as the best information source due to the rapport and similarity among characteristics of farmers. The nation has 3,833 extension officers' staff while the requirement is 12,000 officers (Ministry of Agriculture, 2007) which contributed to ineffective extension service delivery.

4.7 Effectiveness criteria assessment of interpersonal communication channel

Table 4.9 depicts the accessibility, acceptability, authenticity, credibility, familiarity, usability, likability and interactivity of inter-personal communication channels by the farmers. The table showed that 45 percent of the farmers reported that Extension Officers/Agents were accessible, 53 percent were acceptable, 63 percent were authentic and usable in each case and 66 percent reported that the Extension Officers/Agents were reliable in terms of interpersonal communication channels.

The results further showed that the respondents' reported a majority of 61 percent of fellow farmers being familiar, 57 percent was interactive and 78 percent were more likable. The study further showed that Agro Dealers were the least accessible at 3 percent and acceptable at 5 percent. The study results depict the critical need for extension services as the farmers use extension officers as technical advisors who are a point of reference for technical information. However due to the limited access to the extension officers, fellow farmers and agro- dealers were used as other information sources that complement the extension officers.

Leeuwis (2010) in her research findings on Knowledge Exchange, Research and Extension detailed that farmers used participatory approach in communication among farmers. This was enhanced by the intermediation process of brokering information by extension officers that facilitated innovation adoption and effective communication processes which combined farmer-to-farmer and farmer-to-extension officer communication. In the same vein, Chimoita, (2017) in his study established that the

majority (73%) of the agents disseminated technologies through farm visits, demonstrations, agricultural show visits and through radio technologies. Table 4.9 shows measurement of interactivity of interpersonal communication channels.

Table 0.9: Effectiveness criteria assessment of inter - personal communication channels

Perception measurements	Inter-personal communication channels			
	Extension Officer/Agent	Peer %	Fellow Farmers	Agro Dealers
Accessibility	45	32	19	4
Acceptability	53	29	14	4
Authenticity	63	10	24	3
Familiarity	20	7	61	12
Usability	64	3	8	25
Likeability	25	16	50	9
Interactivity	10	8	57	25
Reliability	66	3	8	23

4.8 Assessment of Fall Armyworm information dissemination content in inter-personal communication channels

A multinomial logistic regression was performed to statistically determine the access of interpersonal channels of communication, which included extension workers, fellow farmers and agro-dealers. From the results in table 4.10, extension workers (1.572185) and fellow farmers (3.567151) were statistically significant and have a great extent (effect) on the access of interpersonal channels in informing farmers on FAW management. Agro-dealers are not effective, and this could be as a result of not having many agro-dealers to provide farmers with information. Interpersonal communication channels have been found to be effective in communication. Additionally, Westmyer *et al.*, (2006) found that face-to-face channels (e.g. through extension workers and fellow farmers) are effective in communication.

Table 0.10: Access of interpersonal channels in informing farmers on FAW management

Int Rate	Coefficient	Std. Err.	z	P>z	[95% Conf.
Great extent					
Extension workers	1.572185	0.8752131	1.8	0.072	-0.143201
Fellow-Farmers peers	3.567151	1.105888	3.23	0.001	1.399651
Agro- dealers	19.66838	1000.744	0.02	0.984	-1941.755
_cons	-29.74263	1000.748	-0.03	0.976	-1991.173
Number of observations					150
LR $chi^2(6)$					132.98
Prob> chi^2					0.0000
Pseudo R^2					0.4550
Log likelihood					-79.624264

CHAPTER FIVE: GENERAL DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 GENERAL DISCUSSION

Agriculture forms the backbone of most economies of developing nations in the world. However, agricultural production is faced with challenges such as climate change, unreliable rainfall patterns, drought, flooding, pest attacks and diseases. Since 2016, the Fall Army Worms (FAW) have threatened agriculture production in Kenya and other African countries. This has consequently threatened household food security as households face great crop losses. The media has played an important role in the dissemination of information concerning the management of FAW to avoid making huge losses. However, little is known about which of the available communication channels are effective in disseminating information about the FAW. Therefore, this study sought to identify the effective communication channels used in disseminating information about FAW to maize farmers in Lugari of the Kakamega County. Three questions were asked in the research:

i. What socio- demographic factors influence information access on control of Fall Army Worms by maize farmers?
ii. How effective are mass media channels in disseminating information of Fall Army Worms among farmers?
iii. How effective are the inter-personal communication channels in information dissemination of Fall Army Worms among maize farmers?

The study employed descriptive statistics and multinomial logistic regression to answer the three objectives. Level of education, employment status, age and marital status enhanced farmers access to FAW information through Television. This suggested that increased literacy levels and access to wage employment improved farmer's access to information concerning the management of FAW. Access to information through mobile phones was significantly affected by level of education, employment status and marital status. Married farmers were more likely to have a phone, hence the relationship observed.

Radio, phone messages and television were observed to be the most effective mass media channels in disseminating information on FAW. On the contrary, CDs/DVDs and mobile phone applications had negative coefficients suggesting that they were not

effective means of farmer's access to FAW information. CDs/DVDs are mostly used at home hence farmers who work outdoor miss most of the FAW messages disseminated through CDs/DVDs. On the other hand, mobile phone applications require being in possession of smart phones and internet which cannot be accessed by low income farmers.

The study findings on interpersonal communication channels indicated that a fellow farmer was rated as the most effective communication channel, followed by Agro Dealers and Peers, used in information dissemination. Alternatively, extension officers/agents were rated as being accessible, acceptable, authentic, usable and relatively reliable in terms of the farmer's perceptions on extension officer's characteristics as an information communication channel.

5.2 Conclusion

The study arrived at three conclusions. First, social economic factors play key roles in farmers' access to information concerning FAW through Television and mobile phones. Improving access to education could increase farmer access to agriculture information such as the management of FAW. Equally, increasing access to wage employment can improve farmer's access to information concerning the management of FAW. The second conclusion is that radio, phone messages and television were the most effective communication channels for FAW information. There should be policy support towards access to radio, phone and television coverage in order to increase farmer's access to FAW management practices. Lastly, interpersonal communication channels such as agro-dealers and peers play key roles in transmitting information for the management of FAW. Therefore, farmer groups and interaction should be encouraged.

5.3 RECOMMENDATIONS

5.3.1 Policy Recommendations

The study therefore recommends the County government to enhance future dissemination of FAW information via radio in both local and Kiswahili languages. Furthermore, there is a need for retooling of extension agents, lead farmers and agro-dealers on modern methods of FAW control methods.

- Government should increase access to education in order to increase access to information. Increased literacy levels could assist in quickly disseminating information for management of FAW.
- There should be policy support towards increased access to radio, phone and television.
- Training of more extension officers on communication skills and FAW information. Furthermore, peer farmers should be trained as they play key roles in the dissemination of farmer information. Farmers should also be encouraged to join cooperatives in order to increase interaction with their colleagues.

5.3.2 Areas of Further Research

- The need to look at content analysis of Fall Army Worm information being disseminated would be critical in establishing information utilization.
- An establishment of a mobile application on Fall Army Worm information with an early warning system and agronomical practices focusing on indigenous knowledge.
- An analysis of complimentary extension service delivery of model/lead farmers.

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APPENDICES

APPENDIX 1: FARMERS QUESTIONNAIRE

Access of Communication Channels in dissemination of Fall Armyworm

Information in Maize Production: Lugari, Kakamega County

My name is **CHIPANGO LUKUNGU** a student in the faculty of Agriculture, department of Agriculture Economics under the University of Nairobi.I am conducting this research as a fulfilment towards a Master's degree in Agricultural Information and Communication Management. The study aims to establish the access of communication channels in dissemination of fall armyworms information in maize production: a case of Lugari, Kakamega County.Information gathered in this questionnaire will be CONFIDENTIAL and used only for academic and research purposes.

The questionnaire will take 45 minutes. All you say will be confidential and participation is voluntary. If you indicate your voluntary consent by participating in this interview, can you sign the consent below?

Name of respondent _____ (Optional)

Signature_____ (Optional) Date _____

Phone number_____

NOTE: The person to be interviewed will be the household head, spouse or a family member aged 18 years and aboveinvolved in decision making in the household.

THANK YOU FOR YOUR CONSENT

The information provided will be only for academic purpose. Read carefully and give appropriate answers by ticking or filling the blank spaces.The information will be treated confident

SECTION A: GENERAL INFORMATION

1. Indicate your gender (Tick one)Male [ ] Female [ ]
2. By use of a tick ( ), please indicate the age category that applies for you.
   a) Below 30 years[ ]
   b)30 – 34 years[ ]
   c) 35 – 39 years [ ]
   d) 40 – 44 yea[ ]
   e) 45years and above [ ]
3. Highest level of education
   - Primary [ ]
   - Secondary[ ]
   - Diploma[ ]
   - Under graduate [ ]
   - Masters [ ]

SECTION B: MANAGEMENT OF FALL ARMY WORM

4. To what extent do you agree with the following statements on Management of Fall ArmyWorm?

Key:

1 -Great extent
2 - Moderate extent
3 -Low extent

(Please put an X as appropriate).

Management of Fall ArmyWorm	1	2	3
Early planting at the onset of the rain can prevent or reduce fall armyworm			
Information in the media regarding crop rotation and intercropping with crops such as pigeon, cassava and beans educates famers on armyworm control			
Visits by extension officers, who train famers on spraying crops have helped control armyworm.			
Agro-dealers are well informed through various media channels and hence advise famers on Fall ArmyWorm Control.			
To control fall armyworm control, do not spray pesticides to the whole plant, spray into the maize tunnel			

SECTION C: Socio-Demographic Factors

5. To what extent do you agree with the following Socio-Demographic Factors and Management of Fall ArmyWorm?

1 -Great extent
2 - Moderate extent
3 -Low extent

(Please put an X as appropriate).

Socio-Demographic Factors	1	2	3
Occupational characteristics have an influence on management of fall armyworms			
Income levels influence the affordability of fall worm management			
Dependence on maize as a staple food has made me consistently seek information on fall worm management			
Variability in source of income has a negative influence on management of fall armyworms			

Household Demographic Characteristics

6. Location/ GPS.....
7. Sub-location.....
8. Village name.....
9. Status of the Respondent

1=Household head, 2= spouse of the household head, 3=grown up child, 4= relative, 5= other (specify)

10. Gender of Decision maker on agriculture activities.

1=Male2= female

11. Age of household head.(use last birthday, complete years)

1- 18-35 years, 2- 36-55 years, 3-Over 55 years

12. Marital Status of Household Head

1-Single, 2- Married, 3 - Divorced, 4 – Widowed

13. Highest educational level of Household Head?

1=no education, 2=primary education, 3=secondary education, 4=tertiary education, 5- Others (Specify)

14. What is the Occupation of the Household Head?

1=Farming,2=Business,3=Employed,4- Others Specify

15. What is the total number of the HouseHold family members and their age? (Those that live & eat together, last 6 months & above)

AGE RANGE

(Under 5 – 12 yrs), 2- (13-20 yrs), 3-(21- 30yrs), 4-(31- 40 yrs),5-(41- 50yrs),6-(51-60yrs)7- (61yrs +)

16. How many years have you been engaged in agriculture activities.

1=less than a year, 2=1-5 year 3=6-10 years 4=more than 10 years

17. What crops did your HouseHoldgrow in the past 5years?

List most frequent crops grown……..

18. What livestock have you reared in the past 5 years?

19. List most frequent livestock species reared…….

20. Do you grow maize on your land?

1- Yes, 2- No

21. How much yield have you gotten from your maize production in the past 5 years?

Year	2013	2014	2015	2016	2017
No- of bags					

22. Have you had any incidences of FAW attack on your crop?

Yes, 2- No, 3- Never (go to Q19)

23. What has been the effect of FAW on your production of maize?

Crop loss (harvest), 2- Low produce quality, 3- High cost of pesticides, 4-high labor cost

24. What is your motivation for engaging in farming?

1= food security, 2=for income, 3= for both income and food 4-agri-business(commercial level)

25. Approximately how much income do you earn from your farm in each agriculture season?

1=0-5,000Ksh2=5,001-10,000Ksh3=10,000-15,000Ksh4=15,000Ksh and above

26. What are the sources of your income?

1=Salaried employment 2=Off-farm business 3=Casual labor on other farms 4= Sales from other crops e.g. rice, maize, 5- others specify

27. Indicate the assets you own as a HouseHold.

1- Car, 2-motorbike,3- bicycle, 4-plug, 5-tractor, 6-android phone, 7-TV,8-Radio, 9- computer/ laptop

28. Do you have access to electricity? (Include solar)

1. Yes 2- No

29. What is the tenure system of your land?

1- Own customary/ private land, *2-*Communal rights, 3- Rented, 4-Leased

30. How much land is used for agriculture activities in your Household? ...

31. How many acres did you grow maize on last year (2017)?.....

SECTION D: Mass Media Channels

32. To what extent do you agree with the following statements on Influence of Mass Media Channels on Management of Fall Armyworm? Key: 5 Strongly Agree, 4 Agree, 3 Undecided, 2 Disagree, 1 Strongly Disagree (please put an X as appropriate).

Mass Media Channels	1	2	3	4	5
Mass media has significantly informed me about fall worm management					
Control of fall armyworm has been enhanced by print media					
Quality of information in the mass media channels informs me on fall armyworm management					
Social media has improved my fall armyworm management					

33. What kind of information channels do you currently use? (You can make more than one choice).

1=Television 2= Mobile text messages 3= internet 4= Radio 5= Newspaper 6= Telephone calls, 7- mobile app8 Farmers magazines 8= others (please specify) _____

34. What communication channels would you recommend as most suitable as a source of agricultural information?

1- Radio, 2- Television 3- CD/DVD (Video), 4- SMS5- Website6-WebPortal,7-Email, 8- Instant Mail (chat)

35. Based on your experience, which ICT tool would you rate as best for disseminating information to farmer(s)? (ICT skills)

1-*Computer, 2- Telephone, 3 Cell phone 4- Radio 5- TV 6- others specify*

36. Do you listen to the radio? *1-Yes, 2- No*

37. Do you listen to agricultural information from the radio?*1-Yes, 2- No*

38. If yes, in which language does the channel you listen to disseminate the information, why do you like that particular program?

39. If yes, in which language does the channel you listen to disseminate the agriculture information?

1- Vernacular Language 2-English

40. Why do you like that particular program?

1- Effective Interaction with programme' presenters through phone.

2- Can perform other duties while I listen to programs

3- Time program is aired.

Others specify

41. Is there anything that can be done to improve the mode in which knowledge about FAW control is communicated? ...

42. Do you have access to a TV? (Agriculture- programs) *1-Yes, 2- No*

If yes, in which language does the channel you listen to disseminate the information, and why do you like that particular program?

43. What type of mobile agriculture- application do you use?

44. What type of internet- based agriculture information do you access?

SECTION E: Interpersonal Communication Channels

45. To what extent do you agree with the following statements on the Influence of Interpersonal Communication Channels on Management of Fall Armyworms? Key: 5 Strongly Agree, 4 Agree, 3 Undecided, 2 Disagree, 1 Strongly Disagree (please put an X as appropriate).

Interpersonal Communication Channels	1	2	3	4	5
Extension officers are reliable in dissemination of interpersonal communication					
Channels of interpersonal communication affect the intensity off interpersonal communication					
My age influences my interpersonal communication					
Interpersonal communication has significantly influenced fall armyworm management.					

46. Are you currently a member of any farmer group or local association in this village? (If YES, indicate name)

1= Yes (indicate name) , 2=No,

47. Approximately how many non-formal trainings have you attended since you started farming?

1=None 2=1-5 times 3=6-10 times 4=more than 10 times

48. Through what channel (ICT tools) did you get the knowledge about fall armywormattacks?

1- Radio, 2- Television 3- CD/DVD (Video), 4- SMS5- Website6-WebPortal,7-Email, 8- Instant Mail (chat

49. From whom did you get the information on control of fall armyworms? (Interpersonal channel) …….

1= extension agent

2=peer

3=fellow farmer

4= agro dealers

5- Other specify

50. Using a magnitude scale, RANK the channels used for access to FAW information dissemination of the listed communication channels below.

COMMUNICATION CHANNELS (list the channels according to the highest to lowest channel)	MAGNITUDE SCALE	
	Great extent	
	Moderate extent	
	Low extent	

Communication channels:
1= extension agent
3=fellow farmer
4= agro dealers

51. Do you find the channel helpful in solving current pest attacks (FAW)?
1 = YES
NO = 2

1= Extension Agent
2=Peer
3=Fellow Farmer
4= Agro Dealers
5=Other
52. How would you rate the credibility of your information source?
1-Least Credible
5- Most Credible
Rate in a scale of 1-5

Interpersonal Communication Channels	1	2	3	4	5
Extension agent					
Peer					
Fellow farmer					
Agro dealers					
Other					

53. How do you rate the acceptability of the information communication channel?
1-least acceptable5-Most acceptable

Interpersonal Communication Channels	1	2	3	4	5
Extension agent					
Peer					
Fellow farmer					
Agro dealers					
Other					

54.How did you feel about the Mass mediasource of the information? (**authenticity**)
Examples:internet (websites, data bases),agriculture mobile application

Undisputed	*Genuine*	*False*	*Careless*	*Vague*

Undisputed	*Genuine*	*False*	*careless*	*Vague*

TWITTER,WHATSUP, FACEBOOK, INTERNET
2=plant health rallies, banners or umbrella,

Undisputed	*Genuine*	*False*	*careless*	*Vague*

Undisputed	*Genuine*	*False*	*careless*	*Vague*

55.Were you able to give feedback to the source? (**interactivity**) ____
56.How much did you like the channel? (**Likability and usability**).
1= Least likable / 3-more usable
2=Most Likable / 4- less usable
5- others specify

Rate in a scale of 1-5
Respondent Selected channel
1 2 3 4 5

2=internet
1 2 3 4 5

3=mass extension campaigns such as use of magazines, brochure, newspapers, radios.

1	*2*	*3*	*4*	*5*

4=Other

1	*2*	*3*	*4*	*5*

Rate in a scale of 1-5
1= Respondent Selected channel

1	*2*	*3*	*4*	*5*

2= internet

1	*2*	*3*	*4*	*5*

3=mass extension campaigns such as use of magazines, brochures, newspapers, radios.

1	*2*	*3*	*4*	*5*

4=Other

1	*2*	*3*	*4*	*5*

1- Yes , 2- No

Rate in a scale of 1-5

1=plant clinic sessions

1	*2*	*3*	*4*	*5*

2=plant health rallies, banners or umbrella,

1	*2*	*3*	*4*	*5*

3=mass extension campaigns such as use of magazines, brochures, newspapers, radios.

1	*2*	*3*	*4*	*5*

4=Other

1	*2*	*3*	*4*	*5*

57. Is there anything that can be done to improve the mode in which knowledge about FAW is communicated?

Thank you for your participation

APPENDIX 2: FOCUS GROUP DISCUSSION GUIDE

1. What is your role in the agriculture community in your locality?
2. For how long have you been a player within the system?
3. Do you attend any agricultural forumsheld in your area?
    a. If Yes=How much did you like the information offered? What do you think of services offered by the organizations?
4. From your own assessment are you satisfied with the number of farmer organizations offering information on FAW?
    i.
    ii. If not satisfied, would you suggest some of the reasons why?
    (*Probe* ***informant who associates low attendance to low awareness level. Asks following questions***)
        a) Do you have any strategy in place to increase awareness levels amongst the farmers.(*If strategy is through use of communication as an attempt, probe why use of a chosen communication channel,)*
        b) Explain the relationship between awareness levels on FAW and the QUALITY of information; let the farmers explain their perception of the difference.
    iii. If satisfied, what measures have you put in place to maintain or improve the information levels and quality? Do you agree that the information QUALITY is attributed to awareness levels and the amount of information disseminated?
5. As a stakeholder in the agriculture sector in your locality, have you ever made any attempt to increase the awareness level on control of FAW amongst the farmers?
    a. If Yes
    i. Through what communication channels have you made the efforts to relay information about control of FAW?
    ii. What considerations did you put in place to decide on the above-chosen communication channels?
    iii. In your assessment, is the above-chosen communication channel effective in increasing awareness level about fall armyworms?
    b. If No
        i. Would you like to raise the awareness levels of control of FAW amongst the relevant stakeholders?
        ii. What channel would you adapt to do this? For any chosen channel, elaborate why?
6. Do you think increased awareness on FAW would have a direct impact on the farmer's agriculture production?
    i. If Yes, How?
    ii. If No, Why

7. Do you think the socio- economic status of the farmers affects information sourcing of the farmers?
   i. Yes, How?
   ii. No, Why?

APPENDIX 3: KEY INFORMANT INTERVIEW QUESTION GUIDE

1. What are the communication and knowledge sharing strategies that are employed by information experts in the locality?
2. What were the guiding principles on the above stated communication strategy as far as awareness creation on FAW is concerned?
3. Would you suggest the reason why the awareness level On FAW is still low amongst the farmers and other relevant stakeholders within the locality?
4. Do you think the low awareness level could be a significant direct influence on the low application of management of FAW by the farmers?
5. Does the government and relevant ministries/organizations involve its stakeholders in designing and developing frameworks used in information dissemination on control of FAW?

Communication channels used to disseminate information

1. As an institution what measures have you put in place to disseminate FAW information amongst the farmers and other relevant stakeholders?
2. Have you ever been involved in creating awareness about FAW? If yes, what channel do you use to diffuse this knowledge?
3. What prompted you to use the above-chosen channel?
4. What challenges do you encounter in the creation of awareness through the above-stated channel?