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SCHOOL OF JOURNALISM AND MASS COMMUNICATION

AN ASSESSMENT OF INOORO FM'S *MUGAMBO WA MURIMI* PROGRAMME ON THE UPTAKE OF INFORMATION ON SOIL FERTILITY MANAGEMENT TECHNOLOGIES AMONG SMALLHOLDER FARMERS IN KANDARA SUB-COUNTY, MURANG'A COUNTY

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K50/86624/2016

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2019

DECLARATION

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We declare that this work has been prepared under our supervision and is presented with our approval.

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DEDICATION

To Babu, Mamu, Denille and Marie for their inspiration

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ABSTRACT

Declining soil fertility in many parts of the Central Highlands of Kenya undermines food production and rural livelihoods. The challenge is compounded by reducing extension coverage and access to information among smallholder farmers. Moreover, current knowledge on improved agricultural practices obtainable in research findings does not reach farmers on time. Since sustainable agricultural development such as uptake of soil fertility management technologies to a large extent depends on knowledge and information sharing through appropriate communication channels, improving positive effects of the existing channels, more so the widely available channels, such as radio is critical. This study sought to assess the effects of radio on the uptake of information on soil fertility management technologies in Kandara Subcounty, Murang'a County. The study focused on the *Mugambo wa Murimi* radio programme aired on Inooro FM. The specific objectives were: to determine sources of information on soil fertility management for smallholder farmers, assess the relevance of information on soil fertility management technologies to smallholder farmers, examine smallholder farmers' perception of *Mugambo wa Murimi* radio programme on information on soil fertility management technologies and assess the perceived effects of *Mugambo wa Murimi* radio programme on uptake of information on soil fertility management technologies. The study was guided by diffusion of innovation theory. Mixed method approach consisting of household survey, key informant and focus group discussion was employed. The study used cross sectional survey design to collect data from 139 farmer households. The findings suggest that farmers receive information on soil fertility improvement technologies from a myriad of sources, with the radio being the most ubiquitous source of information on soil fertility management in the study area. Listenership and relevance of *Mugambo wa Murimi* programme on soil fertility management tend to be linked with social economic characteristics such as age, education and gender. Findings show that farmers were able to practice organic pepino melon farming from listening to *Mugambo wa Murimi*. The robustness of the programme is related to its broadcast in vernacular, ease of availability and access over other electronic devices such as mobile phones. The effect of information received from the programme is however less than optimal due to linearity of the communication approaches adopted, limited time it is allocated and lack of expertise to handle topics on soil fertility. Participatory programming, covering topics on soil fertility management, engaging soil experts, and allocation of more time is thus recommended to improve *Mugambo wa Murimi* programme as source of information on soil fertility management.

LIST OF ABBREVIATIONS AND ACRONYMNS

FAO	Food and Agricultural Organisation
ICT	Information and Communication Technology
ISFM	Integrated Soil Fertility Management
KNBS	Kenya National Bureau of Statistics
ORM	Organic Resources Management
SFM	Soil Fertility Management
SOM	Soil Organic Matter
SSA	Sub-Saharan Africa
UH	Upper Highland
UM	Upper Midland
MWM	Mugambo Wa Murimi
DOI	Diffusion of Innovation

LIST OF KIKUYU WORDS

Mugambo Wa Murimi (Voice of farmer)	A radio programme on Inooro FM that is meant to sharpen one who is already farming and one who is planning to practice farming.
Inooro	Means to sharpen.
Mathete/Mukigi (lantana)	Tree shrub that is grown or naturally grows along fences whose leaves are used in compost making and very rich in organic matter. It is also a natural fence.
Maigoya	A type of young shrub whose leaves and stem are used to make mulch and very rich in organic matter.
Machatha	Shrubs used in making mulch.

CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter provides background to the research, detailing issues relating to soil fertility and communication related problems. It also provides the research objectives and questions. The chapter first discusses food productivity in Kenya as the basis for further discussion of issues relating to soil fertility and application of various technologies aimed at enhancing fertility and attendant agricultural production. It also gives a brief description of Inooro FM's *Mugambo wa Murimi* programme. It finally describes the significance, scope and limitations of the study.

1.1 Background of the Study

Agricultural productivity in many parts of Africa largely depends on soil fertility. Research by various scholars indicate that since food is mainly produced on land and soil, soil health determines the performance and sustainability of farming (Jalloh, 2013; Lal, 2009; Lal and Stewart, 2013; Töpfer et al., 2013). Accordingly, declining soil fertility is globally acknowledged as a fundamental barrier to food productivity (Guilpart, et al, 2017).

Various factors are assumed to contribute to decline in soil fertility in many parts of Africa. These include intensification of crop production under continuous cropping systems, failure by farmers to replenish lost nutrients through the application of organic sources of nutrients and limited use of fertilizers (Bationo and Waswa, 2011). Other factors according to Bekunda, et al (2010) are soil erosion, nutrient leaching, and crop harvests which lead to loss of about 36 kg and 5 kg of nitrogen and potassium per acre respectively yearly (36 kg N ha-1 yr-1, 5 kg P ha-1 yr-1) especially in the intensively cultivated highlands of East Africa.

1.1.1 Food Productivity in Kenya

In Kenya, food productivity has significantly declined, due to a number of reasons including poor soil fertility, population pressure, drought, relay cropping and non-use of both organic and inorganic manure (Kamoni and Makokha, 2010; Waswa 2012). Regions such as Rift Valley and Western parts of the country continue to report drop in crop yields. Vihiga County, for

instance in the Western region, represents a zone with high agricultural potential but severe plant nutrient depletion; nitrogen and phosphorus being the main limiting nutrients affecting growth of food crops (Shepherd et al., 1997). The situation in central highlands is no better as the problem of soil nutrient depletion is a common phenomenon as high rainfall and sloppy topography makes the area highly prone to soil erosion that contribute to massive loss of soil nutrients (O'Neill, 1997).

In the central region, the dense population demands for sustainable food production to feed its populace. With more than 500 persons per KM^2 (GOK, 2009) and small land sizes, farmers are often forced to put a large percentage of their land under relay cultivation, a major contributor to loss of soil nutrients. Njuki and Verdeaux (2001) posit that farmers grow between six and seven crops because of reduction in land size, loss of market for old crops, and opening of new markets for new crops. Kandara sub-county, for example, has $193km^2$ out of 235 km^2 total area under agricultural production (Jaetzold et al., 2006).

In the foregoing circumstances, soil fertility decline is a threat to the survival of farming communities not just in Kenya but many other parts of sub-Saharan Africa (Tittonell-et al, 2012). This calls for research in the mitigation of the threats through actions such as promoting uptake of soil fertility management technologies.

On one hand, researchers are anxious with information from their findings to share with policy makers, decision makers and farmers. On the other, traditional methods of passing information especially to farmers through extension is no longer viable due to cost implication and their low ratio to farmers.

It is inevitable that information is communicated to policy makers on the relationship between soil fertility, agricultural productivity and future economic prosperity while laying emphasis on the relationship between agricultural productivity and the environment, water conservation, desertification and climate.

Farmers who are the end users of information need to be empowered with better knowledge to understand basic principles of good soil fertility that will eventually help improve farm productivity. With limited access to extension services alternative communication channels that are easily accessible by smallholder farmers need to be used.

Radio and especially vernacular radio informs rural audiences in language understood by majority. Inooro FM is among the many vernacular radio stations in Kenya informing both rural and urban audiences. It has a programme specially dedicated to farmers which covers issues in agriculture.

Inooro is a Kikuyu word that means to sharpen, the name to the radio station was coined from this word. Inooro FM is a vernacular radio station that broadcasts in Kikuyu language with various feature programmes meant to empower its listeners such as *Mugambo wa Murimi*. This programme that is the focus of this study runs for about 7 minutes each day with a repeat in the evening between 7:40pm and 8:00pm, is meant to sharpen one that is already farming and or one that is looking to practice farming. Inooro FM programmers saw the need to educate and inform its audience who it defines as "responsible hardworking entrepreneurs in the agriculture sector" through this program.

1.2 Problem Statement

Widespread decline in soil fertility poses a threat to farmer livelihoods in many communities of Sub-Saharan Africa (Kassie et al., 2012; Tittonell et al., 2012). This observation is particularly critical for countries such as Kenya where smallholder farmers produce 60-80 % of the food consumed (FAO, 2015). There exist potential pathways to achieving sustainable agricultural development which to a large extent depends on focusing attention in terms of increased knowledge and information sharing through appropriate communication channels (FAO, 2006:2). However, current knowledge on improved agricultural practices obtainable in research findings does not reach farmers on time, with the increasing poor extension agent to farmer ratio tending to compound existing constraints in farmers' access to current agricultural information (Olajide, 2011). Studies by Kaizzi, Mohammed and Nouri (2017) suggest that the low adoption of existing soil fertility management technologies are communication related.

Farmers often use sub-optimal agricultural practices since most of them are not conversant with the latest farming practices due to lack of information, knowledge, inputs and their management (Jack, 2011).

Rogers (2003), in the diffusion of innovation theory, contends that interpersonal communication channels can create and change a person's attitudes as they allow for immediate feedback. Comparatively, mass media channels have greater advantages to interpersonal channels as they can reach larger farmer audiences who are scattered over large rural geographical areas. Although media platforms such television, print and online can be used to communicate with these audiences, they remain inaccessible to most rural farmers due to low literacy levels and lack of essential support infrastructure (Wilson 2002). According to Servaes (2008), radio is much more pervasive, accessible and affordable and hence can be accessed by many rural farmers. And since radio has the advantage of providing rural farmers with information on broad aspects of agricultural production in languages they can understand, it stands out as the best channel of communication for use in rural areas (Chapman *et al*. 2003:2). Although many radio stations broadcast information on the necessity of adopting soil fertility management technologies, there is often little information on the levels of uptake of the information. This study therefore assessed the effects of radio programme *Mugambo Wa Murimi* in the uptake of information on soil fertility management technologies.

1.3. General Objective

The overall objective was to assess the effects of *Mugambo wa Murimi* radio programme on the uptake of information on soil fertility management technologies in Kandara sub-county in Murang'a County.

1.4 Specific Objectives

This study was guided by the following specific objectives:

i. To determine sources of information on soil fertility management for smallholder farmers in Kandara sub-county.

ii. To assess the relevance of information aired by *Mugambo wa Murimi* radio programme on soil fertility management technologies to smallholder farmers in Kandara sub-county.
iii. To examine smallholder farmers' perceptions of *Mugambo wa Murimi* radio programme on soil fertility management technologies in Kandara sub-county.
iv. To assess the perceived effects of *Mugambo wa Murimi* radio programme on the uptake of soil fertility management technologies in Kandara sub-county.

1.5 Research Questions

To achieve the above objectives, the study answered the following questions;

i. What sources of information on soil fertility management are available for smallholder farmers in Kandara sub-county?
ii. How relevant is the content on *Mugambo wa Murimi* radio programme on soil fertility management technologies to smallholder farmers in Kandara sub-county?
iii. What is the perception of Kandara sub-county smallholder farmers of *Mugambo wa Murimi* radio programme?
iv. How is the uptake of soil fertility management technologies affected by information from *Mugambo wa Murimi* radio programme?

1.6 Significance of the Study

It is apparent that smallholder farmers have the potential to achieve sustainable food production if supported (Collier & Dercon, 2014). Agricultural technologies have achieved enormous yield gains as well as lower costs for farmers who have adopted them. Accordingly, the uptake of soil fertility management technologies by smallholder farmers promises solutions to problems of loss of soil fertility and declining crop yields.

In order for information to be considered relevant and useful, it must have value to the farmers as well as to the various agencies that support its generation and dissemination. Hence evaluating the effect of information sources is critical especially in the transfer of knowledge, advice and education to farmers about technologies, such as, SFM and practices that stimulate desirable agricultural developments (cf. Anderson & Feder, 2004). This study will thus

contribute to the corpus on information and communication and particularly the use of radio programmes in advocating use of SFM technologies and attendant agricultural practices.

In addition, the findings will provide agricultural officers and policy makers in Kandara sub-county with useful insights on the communication factors that influence the uptake of soil fertility management technologies and/or any other agricultural information to be communicated in the sub-county. This is especially because soil fertility management technologies can help manage the problem of declining soil fertility, improve food security and the quality of both food and cash crops. These technologies are central to the growth of farm output and productivity. The findings of this study could also be a reference point for scholars interested in understanding the effects of radio communication on uptake of soil fertility management technologies among smallholder farmers.

The findings of this study could show radio producers of farming programmes the effects of their programmes on agriculture. The study will thus help assess the quality of their programming and whether they need to improve modalities of production and dissemination. This could also provide the basis upon which to review programme production policies in terms of allocation of resources towards effective programmes that involve other stakeholders.

1.7 Justification

Declining soil fertility is a challenge faced by many smallholder farmers across SSA. In Kandara sub-county, soil fertility decline is manifested in falling crop yields and agricultural production. Granted, SFM technologies are reportedly to be in abundance. However, basic information on their availability and use is scarce among smallholders (Martey et al., 2014).

This study conducted in Kandara sub-county was necessary as an effort to assess the effect of *Mugambo wa Murimi* radio programme on uptake of information on SFM technologies among smallholders. Although studies have been done on *Mugambo wa Murimi* radio programme, this programme has not been studied in terms of uptake by farmers of information on soil fertility management technologies in the particular study area.

1.8 Scope and Limitation of the Study

This study conducted between July-August 2019 was limited to assessing effects of *Mugambo wa Murimi* radio programme on the uptake of information on soil fertility management technologies among smallholder farmers who listen to this programme on Inooro FM. The geographical scope was limited to Kandara sub-county's three wards, namely; Ruchu, Ithiru and Nga'raria. The respondents were smallholder farmers, extension officers, crop officer and Inooro FM's programme producers.

The study was not without limitations. Given that most of the respondents in cross sectional survey as in this study rely on their memory, measurement errors were encountered. The self reported data on yield improvement attribution to *Mugambo Wa Murimi* could not be independently verified. A pilot survey was carried to pretest the instruments which enabled the researcher take cognisance of the errors and rectify them to closely reflect the true situation. Further, in depth FGDs were carried out with the most knowledgeable farmers to gain more insight into the reality and to clear any inconsistencies.

1.10 Operational Definitions of Terms

Adoption means the use of a given soil fertility management technology by a farmer for at least two consecutive seasons prior to the time of the study.

Soil fertility management refers to the use of soil fertility improvement practices such as organic inputs, crop rotation and conservation agriculture (among others) combined with knowledge on how to adapt these practices.

Soil organic matter is the fraction of the soil that consists of plant or animal tissue in various stages of breakdown (decomposition).

Stakeholders are persons and organisations that should benefit from, engage with, a project (on SFM research) either directly through their involvement in the research or indirectly through the communication and scaling-up of research products.

Uptake means the implementation of a given SFM technology by the farmer.

CHAPTER TWO
LITERATURE REVIEW

2.0 Overview

This chapter reviews relevant literature on sources of information on soil fertility management for farmers, relevance of the information, perception and perceived effects of radio on farming practices.

2.1 Introduction

Agricultural production is information sensitive, with access to information being one of the prerequisites and drivers for agricultural development (Padre et al., 2003). This critical sector needs to create, share and disseminate up-to-date and appropriate knowledge and information (Lotfi, Mukhtar, Sahran, & Zadeh, 2013). And there is need to include feedback among the actors to enable establish trust and genuine sharing of information to address information gaps.

Information dissemination plays a central role in development of agriculture, a knowledge intensive industry whose sources of information include scientific research and indigenous knowledge. For sustainable agriculture, the right knowledge and information need to be disseminated to farmers and other stakeholders at the right time, in a user-friendly and accessible way (Odongo, 2014). In particular, studies by FAO (2006: 2) indicate that increased transmission of knowledge and information is critical at every stage of agricultural production chain; from the start to the end for sustainable agricultural development. Moreover, agricultural knowledge and information is effectively generated, captured and disseminated through knowledge management systems with clearly defined mechanisms (UNDP, 2012).

2.1.1 Soil Fertility Management

Soil fertility management (SFM) is an exercise that involves agricultural practices that are adapted to local conditions to maximise the efficiency of nutrient and water use, and improve agricultural productivity (Tadele, 2017). SFM strategies used usually center on the use of soil fertility management technologies such as mineral fertilizers and locally available soil amendments to replenish lost soil nutrients. Local solutions involve nutrient management by use of organic fertilizer from natural sources such as animal waste like cow dung, crop residues

and compost; these release nutrients into the soil by continuous decomposition (Ngetich et al., 2012).

Akinola et al (2009) posit that soil fertility management has been successful in many countries due to its use of local materials and cultural practice that has effectively improved soil fertility and reduced weed and diseases infestation. Soil infertility indicators according to Odendo et al., (2010) are change in soil colour, soil odour and drop in crop yields. Farmers observing changes in these need to seek intervention by using soil fertility management technologies. Enhanced soil fertility and a reduction on yield losses due to crop diseases has been observed through use of soil fertility management technologies; green manure, animal manure, agroforestry, crop rotation, mulching and mineral fertilizers among other interventions as explained below.

2.1.1.1 Green manure

Green manuring is a method of soil fertility restoration in which fresh plant material either *in* situ or brought from a long distance is turned under to maintain soil carbon pool (Kumar, -et al., 2014). Green manure improves soil fertility by increasing microbial activities thus an increase in the nutrient supplying capacity of soils. It also moderates the soil structure, reduces soil erosion, controls growth of weeds and soil borne diseases (Eriksen, 2005). Sources of green manure include soybean, green gram, groundnuts, kassod tree and common beans. (Cobley, 1976).

2.1.1.2 Mulching

Mulch has successfully been used to improve and sustain soil fertility as well reduce diseases, pests and weed infestation according to Bhardwaj (2013). He further posits that mulches regulate nutrient levels and hamper weed emergence particularly at the beginning of the planting season.

2.1.1.3 Agroforestry

Agroforestry has been reported to play a major role in resource capture through deeper roots accessing both water and nutrients and recycling through leaf fall (Smith and Olesen, 2010).

Soil enrichment, carbon sequestration and biodiversity conservation are also benefits of agroforestry system (Jose, 2009).

2.1.1.4 Crop rotation

Crop rotation is the cultivation of different crops with different characteristics on the same field for successive years and following a previously established sequence, through which effective pests and disease control has been realised (Ball et al., 2005). Studies indicate that crop rotation is practised in both developed and developing economies of the world; however, the difference is in terms of objectives. In conventional crop rotation, emphasis is on the control of stubborn weeds, diseases and pests while in dry land systems of agriculture, the emphasis is on water conservation, minimising salinity and soil fertility improvement (Bajwa et al., 2014).

2.1.1.5 Animal manure

This type of manure is sourced generally from livestock. Animal manure can increase plant nutrients, microbial quality and improve soil physical properties (Ström et al., 2018). Experiments conducted in SSA indicate that humus which accumulates following application of organic resources improves soil water holding capacity, soil structure and texture (Mugendi et al, 2012). Accordingly, organic sources such as green manure, animal manure and agro-industrial wastes are in abundance in Africa (Sanginga and Woomer, 2009).

Despite availability of organic and inorganic sources to solve the problem of declining soil fertility and farmers' awareness of the beneficial contribution of fertilizers, its use in the SSA region remains low compared with the world average. The average rate of inorganic fertilizer uses in SSA for instance, excluding South Africa, is 10 kg ha-1 as compared to 87 kg ha-1 for the developed countries (Bationo et al., 2006). Appropriate communication interventions in turn have the potential to reverse low agricultural productivity through advocating for uptake of SFM technologies for improving soil fertility. Tadele (2017) indicates that farmers who adopted agricultural technologies doubled their agricultural productivity and increased their farm level incomes by 20-50%.

Ngetich (2012) posits that although organic input-based technologies as discussed above have the potential of filling the nutrient deficit created by inadequate use of inorganic fertilizers, either solely or in combination with mineral fertilizers, their uptake is still low.

2.1.2 The Importance of Information on Farming Practices

Increasing agricultural production is critical to meeting the anticipated rising demand for food. (Challa, 2013). Although smallholder farmers are critical to food security, future viability and productivity of small farms remains uncertain (Collier & Dercon, 2014).

Tadesse (2008) defines agricultural information as set of organised ideas that guides farmer decision making. While Aina, Kaniki, Ojambo (1995) and (Ekoja 2000) define agricultural information as both formal and informally validated ideas that are globally acceptable under the following categories.

Scientific information: These are systematically generated ideas by knowledge institutions and/or individuals institutions such as universities, agricultural research institutes, agricultural colleges and private agricultural research organisations.

Commercial information: Include all types of ideas on production technology, pricing, selling, labelling, grading and advertising that impact decision making and profitability of the agricultural enterprise.

Socio/cultural information: This involves way of life, knowledge, attitudes and practices concerning agricultural production that are inherent to particular communities or spatial areas

Legal information: This concerns all ideas and guidelines regulating behaviour of all actors in the agricultural value chain concerning the environment, health, safety and packaging of agricultural produce.

General Information: This is information of general interest to farmers for example handling of natural or man made occurrences such as floods that have the potential to cause wide spread human suffering.

According to Loevinsohn et al. (2013), the most common areas of importance in agricultural production include agronomic practices; soil fertility management; pest management, supplementary crop watering management and breeding. Accordingly improved input/output

outcomes improve profitability and is correlated with technological development that reduces unit cost and in the process increases net returns to the farmer (Challa, 2013).

Fischler (2010) posits that information on recommended soil fertility management technology is an important factor that influences its adoption. This information may be communicated through mass media, interpersonal channels, scientific institutions and extension services from government and NGOs. Interpersonal communication though the best in communicating on agricultural issues faces challenges of lack of sufficient extension officers to attend to all farmer households.

According to Rogers (2010) and Aker (2011), a number of communication channels such as radio, television, pamphlets and innovation platforms, provide information to a social system thus influencing the knowledge and assessment of a given innovation. However, farmers cannot voice their own problems directly to experts for a solution through media such as television and satellite-based systems (Aker, 2011). In instances where smallholder farmers are not a homogenous group, there is need to engage multiple channels to disseminate agricultural information as diversified channels of communication ensure relevant agricultural information reaches as many farmers as possible (Mittal & Mehar 2016). Media with both audio and video functions, though inaccessible to rural farmers due to cost and infrastructure implications, such as, phones have the potential to offset such shortcoming of linearity by allowing for two-way communication between farmers and service providers (Aker, 2011).

2.1.3 Uptake of Agricultural Information

Smallholder farmers, who dominate the landscape of the developing world, require adequate access to knowledge, information and other necessary services to improve farming. Equipping farmers with useful information on agricultural practices at the right time is crucial to its uptake. Farmers in remote villages are excluded from information due to a lack of infrastructure such as access to internet (United Nations, 2005). Information and communication technology (ICT) can play a key role in uptake of information (Aker, 2011). However, ICT is not fully utilised in agriculture due to the fact that majority of farmers based in the rural areas cannot access and use internet (Gakuru, Winters & Stepman, 2009). This is

because internet requires keyboard skills, literacy in English and ability to pay for access to the services. Barefoot (2006), concurs that to solve information related problems, one needs to be information literate and one needs to learn a new set of skills which may include how to locate and use the information needed for problem solving and efficiently and effectively.

In the adoption of agricultural technologies, farmers pass through a series of stages namely awareness, interest, trial evaluation and adoption (Baran 2006). Loevinsohn et al. (2013), explain that, farmers' decisions about whether and how to adopt new technology are conditioned by the dynamic interaction between characteristics of the technology itself and the array of conditions and circumstances.

According to Hall & Khan (2000), diffusion results from a series of individual decisions to begin using a new technology, decisions which are often the result of comparison of uncertain benefits of the new invention with the uncertain costs of adopting it. Adoption might be slow when the successful introduction requires complex skills and their acquisition is costly and time-consuming. Consequently, the suitable know-how and the manner in which the necessary skills are acquired determine the diffusion of technology (Hall and Khan 2003).

Farm size is a factor not to be ignored in technology adoption. Lavison, (2013) posits that farm size can affect and in turn be affected by the other factors influencing adoption. Farmers with a large farm size are likely to adopt a new technology as they can afford to devote part of their land to try new technology unlike those with less farm size (Uaiene et al., 2009)

Rogers (2003) and Uaiene (2009) explain adoption behaviour as being influenced by personal characteristics and endowments, imperfect information, risk, uncertainty, institutional constraints, input availability and infrastructure. Another study on technology uptake by Doss (2003) reveal that characteristics of a technology is a precondition of adopting it. Trialability or a degree to which a potential adopter can try something out on a small scale first before adopting it completely is a major determinant of technology adoption.

Studies by Wandji et al. (2012) on perception of farmers towards adoption of aquaculture technology in Cameroon, indicate that positive perceptions of farmers towards fish farming facilitated its uptake. This study agrees with that of Mignouna et al. (2011) on determinants of adopting Imazapyr-Resistant maize (IRM) technology in Western Kenya, which revealed that the characteristics of the technology play a critical role in adoption decision process. They argued that farmers who perceive the technology being consistent with their needs and having characteristics compatible to their environment are likely to adopt since they find it as a positive investment.

More studies by Uaiene et al. (2009) indicate that social network effects influence individual decisions, and that, in the particular context of agricultural innovations, farmers share information and learn from each other. Therefore, belonging to a social group is of great benefit to a smallholder farmer as this may facilitate uptake of information.
Access to extension services has been reported by various studies as influencing uptake of information. Adoption of modern agricultural technologies in Ghana, a study done by Akudugu et al. (2012) is such as example of positive relationship between extension services and technology adoption.

A determinant that cannot be ignored on the adoption of a new technology is the net gain to the farmer from adoption, inclusive of all costs of using the new technology (Foster and Rosenzweig, (2010). The cost of adopting agricultural technology has been found to be a constraint to technology adoption more so among smallholder farmers. The study done by Makokha et al. (2001) on determinants of fertilizer and manure use in maize production in Kiambu county, Kenya, reported high cost of labour and other inputs, unavailability of demanded packages and untimely delivery as the main constraints to fertilizer adoption.

Agricultural growth depends on large and decisive government actions and hence requires political will. Smale and Jayne (2010) have attributed various successes in African agriculture, such as the “hybrid maize revolution” among smallholders in Eastern and Southern Africa in the 1980s to the political will of the respective governments to promote this technology.

Acquisition of information on new technologies is another crucial determinant to adoption of technology. Awareness enables farmers to learn of existence of a technology as well as effective use of the same facilitating uptake. Access to information reduces the uncertainty about a technology's performance hence may change an individual's assessment from purely subjective to objective over time (Caswell et al., 2001). However, access to information on technologies does not necessarily mean it will be taken up by all farmers. This simply implies that farmers may perceive the technology and subjectively evaluate it differently than scientists (Uaiene et al., 2009).

Access to information may also result to dis-adoption of the technology. For instance, where experience within the general population about a specific technology is limited, more information induces negative attitudes towards its adoption, probably because more information exposes an even bigger information vacuum hence increasing the risk associated with it (Bonabana- Wabbi 2002). It is therefore important to ensure the information is reliable, consistent and accurate. Farmers need to know the existence of technology, its benefits, and its usage for them to adopt it.

Just et al. , (1985) posit that as farmers accumulate experience over time, they progressively switch from traditional agricultural technologies to improved technologies on the basis of observed performance and learning by doing.

Wendland and Sills (2008) recognise that experience can be treated as a predetermined variable in the adoption model, and hence, as exogenous, it is endogenous in a dis-adoption model. Farmers with prior experience in traditional technologies that are related to the modern technology being disseminated are more likely to self-select into or out of the adoption process depending on the experience with the outcomes from such technologies in the past.

Farming experience is in two parts; experience in agricultural technology adoption to mean time a farmer has spent using an improved soil fertility technology and farming experience based on the number of years spent on farming as an occupation. Either way, experience

whether through using SFM technology or years practicing farming, play a major role in adoption of a given technology.

Doss (2006); Feder et al., (1985) and Lee, (2005) broadly categorise the determinants of technology adoption as resource endowments (for example, land, labour, livestock and farm equipment); market access (for example, credit and input and output markets); risk and uncertainty (for example, idiosyncratic and covariate shocks); topographic factors (for example, slope, soil type and location); and intellectual capital accumulators (for example, education, experience and extension).

To sum up, various factors determine technology adoption by farmers as explained above, however lack of information on existence and use of technology influences uptake the most as it touches on all determinants.

2.2 Sources of Information on Agriculture for Smallholder Farmers

Agriculture remains a fundamental instrument in achieving sustainable development in the predominantly agricultural dependent economies (World Development Report, 2008). Hence access to agricultural information is a prerequisite and a valuable resource in the search for sustainable solutions to challenges facing this critical sector (Padre et al., 2003).

There exist various sources of information available to farmers. According to Manfre & Nordehn (2013) farmers rely heavily on information gathering through often complex social networks such as fellow farmers, family, extension agents, input suppliers and markets. Though additional media for information communication such as radio, print, mobile phones, television and the internet are on the rise, their use depends on farmer's educational level, affordability of the technology as well as perceived credibility of the source with information from experts such as agriculture officers being given more trust than one from fellow farmers (Manfre and Nordehn (2013).

Garforth (1993), classifies extension service, a source of agricultural information into three categories; namely: individual contact methods, group methods and mass media methods.

Individual contact methods are superior for conviction and action because of the face-to-face relationship of a source and a receiver (Okunade, 2007). The individual contact methods include farm and home visits, office and telephone calls. Group methods include demonstration, exchange visits, farmer field schools, field days, workshops and exhibitions. Mass media methods are used to reach many people at the same time for example electronic media such as radio, television, internet and print media like brochure, newsletters, manuals, books and magazines.

Rogers (1995) lists the most commonly used channels of communication as mass media (radio and television), print media (pamphlets, brochures, labels and magazines) and inter-personal communication (seminars, demonstrations, field days' exchange visits and agricultural shows). Aker (2011) agrees with Rogers stating that a number of communication channels such as radio, television, social media, pamphlets and innovation platforms provide agricultural information to farmers thus influencing their knowledge and assessment of a given agricultural innovation.

A study done by Lokanathan and Kapugana (2012) posits that the main sources of information in Asia include: self-knowledge, family, fellow farmers and friends. The scholars, however, point out that many farmers prefer face-to-face communication. In another study conducted on 145 rural radio forums in India, forum members were found to be in a better position to learn much more about the topic under discussion than non-forum members (World Bank, 2007:27). Accordingly, Radio Farm Forum as an agent for transmission of knowledge was considered to be a huge success.

Munyua (2007) posits that the digital divide in Africa, is in a situation where there is a disparity in access to ICTs between rural and urban populations which has been a topic of discussion by many scholars and development experts. ICT-based channels such as DVD/CD videos, mobile phones and the internet portend very minimal advantages to smallholder farmers, a scenario that can be attributed to the relatively high costs of accessing them and complexity of use as well as inadequate investment in infrastructure that can support internet services in rural areas that has resulted in very low utilisation (Oguya, 2006).

Print-based channels such as books are costly to farmers and also require some level of literacy for them to be effectively utilised. Socio-economic factors such as low education level and income have been mentioned as impediments to the utilisation of print-based channels (Sanginga and Woomer, 2009). In Tanzania, studies by Lwoga et al. (2014), revealed that print media was uncommon since many farmers were illiterate preferring extension and radio as their main sources of agricultural information.

Makinen (2007), observed that only a few Kenyans can afford to buy newspapers, not to mention language barriers and illiteracy. The study further revealed that television sets are owned by few Kenyan households and thus have minimal impact in rural areas (Makinen, 2007).

In a study conducted by Adolwa et al., (2012), it was noted that there were very few cyber or internet cafes in Vihiga district where information especially can be accessed online. Where available, the quality of internet connections was said to be very low. There were also no recognised community resource centres or rural knowledge centres available to serve farmers

According to Norrish et al. (2001), community-based channels that include farmer field days, on-farm demonstrations and workshops provide farmers with the opportunity to interact with each other as well as with other stakeholders. These communicative channels enable two-way flow between senders and receivers, thus providing opportunities for feedback and enhanced interaction. Hence these are thought be the most effective channels for knowledge communication and dissemination as they elicit genuine participation, provide immediate feedback, and are effective in demonstrating a tangible technology or technique. However, such community based channels can handle only a handful of farmers hence the need to focus on radio a channel that is more accessible and affordable by many rural farmers (Rao, 2015).

Wanyama et al. (2015) generally categorise sources of agricultural information as public, private nonprofit and private for-profit. Public sources of agricultural information according to the scholars are government extension officers and research organisations. Private nonprofit sources comprise non-governmental organisations, farmer organisations, community-based

organisations and fellow farmers. Private for-profit sources include private firms, processing and marketing enterprises. It is important to note that some of the sources such as research organisations as mentioned by Wanyama et al. (2015) are inaccessible by many rural farmers.

Chapman et al. (2003:23) posit that "due to its ubiquitous nature, radio has been proved to be an effective medium for social change and has been used to address issues relating to agriculture, education, health, population, economic, empowerment, peace building, environment, and human rights among others". Nakabugu (2010) agrees with Chapman et al. and adds that through radio, vital information, for example, on better harvesting methods, soil conservation techniques, post harvesting handling, use of improved seeds and timely planting can be effectively communicated. Dissemination of such information along with new concepts and farming techniques can bring novel opportunities to the farmer (Retz & Hasbullah, 2010).

Kimaru-Muchai et al. (2011) established that some farmers in the Central highlands of Kenya used government extension officers to receive information about green manure, combined organic and inorganic manure, while the rest seek information from sources such as neighbors, radio and television. In their study, farmers who had frequent access to extension were said to be those living within a few kilometers or so from the agricultural offices which made accessibility easy.

In spite of tremendous growth in other forms of mass media like internet and social media, radio continues to gain popularity worldwide. Radio's unique characteristics of having immediacy in content delivery and its capacity to break many barriers of communication comprising illiteracy, gender, age or economic status, positions it as an adaptable medium of mass communication especially in developing countries (Rogers & Nichoff, 2002).

Traditionally, radio has always been viewed as a one-way communication tool, providing information, news, and entertainment to listeners. However, with entry of new communication tools such as mobile phones, it can serve as a two-way platform for dialogue, to further discussions about topics that interest listeners, and to create entertaining and interactive programmes (Rao, 2015).

Ajaegbu et al (2015) credit radio as being an efficient instrument for getting messages to a large number of people at the same time as it transcends the boundaries of space and also leaps across illiteracy barriers. The study agrees with Maina's (2013), who states that despite advances in on-line technology, the radio still retains the advantage of being able to serve dispersed, isolated, and disadvantaged communities thus reducing the barriers of illiteracy and physical distance between communities.

Advances in technology according to Maina (2013), have led to increased listenership instead of declining as earlier revealed in a study by Fleming (2010) which reported an increase of 13% to 16% of radio audiences between 2007 and 2008 in the United Kingdom traced largely to the advent of new audio technologies like mobile phones and podcasts. Albarran et al., (2007), further indicate that radio can be listened to through many modern devices such as laptops, mobile phones, MP3, podcasts and satellite radio.

Meyers (2008) posits that the recent explosion in mobile ownership has been a significant advantage for radio. Radio presenters announce their phone numbers over the air and invite listeners to phone-in or send in short messages with comments on the news, questions, debates, requests among others. Meyers further posits that in some instances, audiences are able to give feedback without even having to pay for a call, by means of "beeping" the station and being called back (Meyers, 2008:14). And that "local radio still performs the function of a community telephone kiosk in many isolated rural areas and radio's immediacy, portability, and ubiquity make it an invaluable tool during emergencies such as landslides that are very common in hilly areas during the rainy season and humanitarian aid context" Meyers (2008:24)

Radio and particularly participatory, demand-driven radio programming as a tool for extension, complements existing agricultural information systems that emphasise interaction among stakeholders (farmers, public and private knowledge brokers, market actors, researchers, policy-makers, the financial sector) where no single actor is the expert. More so, radio programmes in vernacular languages provide new communication channels and space for dialogue for communities in more remote areas, or of varying literacy levels (Rao, 2015).

For farmers, radio has the potential to help connect them to technical specialists, policy-makers, other farmers, suppliers or buyers. Findings from the African Farm Radio Research Initiative (AFRRI) and other evaluation studies showed that farmers' listening frequency is directly correlated with an increase in knowledge of a particular agricultural practice.

Yahaya (2002) terms radio as the most potent source of information for farmers and farmers' companions. And that constant listening to a radio programme contributes to easy adoption of new practices by non-literate farmers and can lead to enhanced productivity (Yahaya & Badiru 2002).

Radio gives farmers an opportunity to interact with each other and other relevant authorities such as extension workers, crop and animal experts through formats like talk shows, phone-in sessions and on location broadcasts (Retz and Hasbullah, 2010). In Murang'a county, *Mugambo wa Murimi* radio programme has been beneficial to farmers through provision of information on agriculture and marketing among other issues. A research on *Mugambo wa Murimi* programme conducted by Mwangi (2014) showed that farmers adopted new farming practices proposed during the show. Accordingly, the programme covered issues on horticulture, green house farming, storage of fodder, crop pests management and artificial insemination.

Girard (2001), states that radio speaks in the language and accent of its community more than any other medium of mass communication. Increasing access to community radio by small-scale farmers in areas with little or no electricity and no formal experience of the extension service therefore, would go a long way towards improving agricultural development. Rural radio with focus on local issues using indigenous knowledge is capable of advocating for increased agro-ecological diversity (Chapman et al. 2003).

The AfriMAP survey (2011), revealed that Kenya has a vast number of vernacular radio stations accessible in regions given little attention by the conventional commercial media. Another survey titled *Media We Want* conducted on 10th June 2010, commissioned to investigate the factors that influence media behaviour revealed that Kenya media users

consume radio the most, followed by television and newspapers. The study's findings further showed that media users expose themselves to more than one channel per day with the majority preferring broadcasts in vernacular language to English or Kiswahili.

For Africa and especially Kenya, radio remains the most critical and preferred mass correspondence medium among rural people (Kimutai, 2011). This view is affirmed by a 2012 MCK report which concluded that in Kenya radio (83%) was the main source of news and information with newspapers and TV coming third and fourth respectively. In another a study commissioned by the Kenya Audience Research Foundation (KARF, 2011), and conducted by Synovate, it was reported that radio listening led in media consumption with 93%, in a population sample of 8504. The percentage represented those who had listened to a radio programme in the previous week.

Rochmad and Komunitar (2013) suggest that for radio to be effective and help develop the community, community members need to be given the opportunity to play a role in management and preparation of radio programmes. This gives them a chance to give priority to issues that affect them most such as declining soil fertility in the case of Kandara sub-county in Kenya.

2.2.1 Advantages of radio

Schramm (1964), argues that the media is expected to motivate people to adopt new customs and practices. It serves as an agent of social change in the course of national development. It is worth noting that information has value when it is disseminated in a way that the end-users get the maximum benefit in applying its content (Weiss, Crowder, & Bernardi, 2000). Choice of media therefore plays as important role in uptake of information.

Various advantages, peculiar to radio as discussed below, have made it the most-used and preferred source of information to farmers, the majority of whom reside in rural areas where basic social amenities are unavailable or very limited in supply (Olajide, 2011).

2.2.1.1 Accessibility of radio

Servaes (2008) posits that "radio is much more pervasive, accessible and affordable" compared to other channels of communication. Farmers who find television, internet, newspaper and books expensive prefer radio as their medium of communication (Jemal 2013). And since radio is affordable, it is capable of sustaining audiences in the rural areas who comprise illiterate, semi illiterate groups of people that rely on it an important medium of communication.

2.2.1.2 Pervasiveness of radio

According to McLeish, (1999) the term broadcasting indicates a wide scattering output covering every home, village, city or town within the reach of a transmitter. Radio signals traverse mountains without difficulties. Thus for countries like Kenya with naturally mountainous regions like the Central highlands, radio is the most convenient medium to reach the rural mass (Jemal, 2013:8).

While all sources of information are relevant and important as indicated in the literature above, radio stands out as the most accessible and used medium of communication thus important for this study. It is therefore crucial that it is assessed on whether it is effective in the uptake of soil fertility management technologies among smallholder farmers.

2.3. Relevance of Agricultural Information aired on Radio to Smallholder Farmers

According to Khaila (2010) farmers need information on all aspects of farming including seeds, fertilizers, markets for their produce, human and financial management. Provision of relevant information increases knowledge of the farmers, an increasingly critical factor in farmers' choice among alternative technologies hence profitability of the farm enterprise (IFPRI, 2004).

Although according to Bouma (1993), farmers and other users of land have expert knowledge about their soils; this is mostly empirical knowledge, which is not soil process or data oriented, but yield or management oriented which is often misleading. Yield decline for instance, as observed by a farmer could, be as a result of a variety of factors including soil fertility decline, adverse weather conditions, soil physical deterioration or a combination of factors.

Diffusion of new ideas increases uses of innovations by generating solutions to constraints that undermine output (Brhane et al., 2017). Relevant agricultural information improves yields, income and profits by informing farmers (Munyua and Stilwell, 2013).

In Malawi, studies by Mahwayo (2010) show that radio provides timely market information and complements agricultural extension services by sending out relevant information on production practices that benefit farmers. This agrees with outcomes of a study by Rasak, (2012) that discloses that radio broadcasting is effective for communicating with farmers and must be undertaken for long duration for effective agricultural extension.

There are various types of information on agriculture related activities that farmers seek to improve their farming ventures. These include information on crop production, livestock production, agro-forestry, pest and diseases control, organic and inorganic fertilizer availability and application, agricultural credit facilities, market prices, improved seeds varieties and rainfall patterns. Oduwale and Ikhizma (2003) identified various types of agricultural information, such as information on pest and diseases control, services available from government and private organisations, marketing farm produce, credit and loan facilities to farmers and utilisation of both organic and inorganic fertilizer.

Dagron, (2001) argues that specific agricultural problems affecting the community have been successfully addressed, such as control of banana pests and the problem of the rhinoceros beetle which affects coconut trees through relevant radio programmes.

The relevance of any radio messages is based on many factors such as the extent to which it influences change towards desired direction which include improved yields and farm income. Information aired by radio programmes should meet information needs for it to have relevance to its audience.

2.4. Smallholder's Perception of Information from Radio programmes

The strength of vernacular radio programmes as an extension tool is widely regarded to lie in its ability to reach farmers and provide information relating to all aspects of agricultural production in a familiar language. Benhamou (2004) explains that whatever is on the agenda, as well as what is not and who are participating as interpreters, as well as who are not – contributes to the perception of relations and roles of different groups in the society, as well as to the re-producing of the reality according to those perceptions.

Bradford (2009) describes perception as the way in which people approach different issues and accept different information. The principles of perception can be categorised in two different ways: intuition and decision bias. Bradford (2009) further argues that intuition and creativity influence people in different ways and that these factors can lead to biases and errors in decision-making. Consequently, decision-makers often rely on intuition or "gut feelings" in complex situations.

Robbins (1993, p. 135) explains perception as a process during which people organise and interpret outer impressions to explain the environment. Based on this argumentation, decision-making is based on the perception of reality and therefore is essential for decision-making theory (Bradford, 2009, p. 45). Reasonably, scholars have been concerned with the influences of perceptions on decision-making models and much research is developing in order to avoid human error. And that is why Beckford (2002) states that understanding the perception of farmers is more important than understanding what is actually there. Further that perception has influence on the learning process through which images of the decision environment are formulated.

According to Ashby and Sperling (1992), the perception of the attributes of the technology conditions the technology adoption behaviour of farmers. Therefore, even if they have comprehensive information on the innovation, farmers can arrive at a subjective evaluation, which give rise to different results from those obtained by scientists. On the same, Adesina & Zinnah (1996), indicate that farmers' perception of the characteristics of agricultural

technologies strongly influences their adoption behaviour. These characteristics include complexity, relative advantage, divisibility and observability of agricultural technology.

Chioma et al (2015) in their study pointed out that the presentation style of the on-air-personalities (OAPs), the "house style" of the radio house as well as the quality of programme content are the factors that give a radio house the winning edge. The study agrees with that of Kwakwa (2012) who contends that overall image of the stations, clear reception, station heritage, news coverage, kind of programme and presentation style of on-air-personalities were the major factors affecting radio listenership in the Eastern Region of Ghana.

Santoki (2015) conducted a similar survey in Surat city of India and discovered that entertainment, good quality reception, sharing of songs and other information as well as well as the presentation style of on-air- personalities (OAPS) were the major factors that influence audience share/listenership in that location.

On the contrary, a study in Nigeria indicate that some people seem to have a negative perception of media messages. OCHA (2012), indicates that mass media messages were seemingly ignored, which led to the devastating effects of the floods that destroyed property, farmlands, animals, and loss of human lives.

Perception about information among recipients is affected by both the farmer characteristics and the source of the information including the personalities disseminating the information and this eventually affects its uptake. In order to make judgment about perception therefore, it is important that such factors are considered.

2.5. Perceived effects of agricultural Radio Programmes

Currently, knowledge, technology and creativity are the key driving forces in social and economic development of any nation. This contrasts with the past where economic growth was underpinned by traditional factors of production such as land, labor and capital. The critical drivers of global economic trends today are know-how, technology, creativity and information. Radio has developed over the years into a well-established tool for both community

empowerment and improving the information and communication capacity of remote rural populations. It has proved to be the most effective mass media in promoting agriculture and development in rural areas, particularly as a tool for the delivery of quick information (Eboh, 2009).

Media effects refers to the way people or the society may be influenced by both news and entertainment, including film, television, radio, newspapers, books, magazines, websites, video games, and music. Lasswell (1927) envisaged media messages as strong drugs or potent weapons that would have powerful effects on a helpless audience.

Early studies by Behrens, (1984), indicate that mass media stimulate farmers about new information which prompts them to go to their peers, extension workers and friends to get more detailed information. In a quasi-experimental study that was designed to determine the effects of the radio as an educational media to transfer agricultural information to farmers in Fars Province, Iran, agricultural education intervention programmes were found to be more fruitful when conveyed through radio. The findings of the study showed that educational intervention through radio resulted in significant knowledge enhancement (3.99 to 6.41 out of 10) (Nazari & Hasbullah, 2010).

According to Farm Radio (2011), radio is not explicitly mentioned in agriculture and national development policy documents. However, African Farm Radio Research Initiative (AFRRI) project results demonstrate clearly that when radio is involved in providing information and when farmers actively participate in programme production, farmers gain. Farmers who are well informed and believe in the need to change technologies or maintain good practices such as SFM learn and succeed.

In a study by Agwu et al., (2008) in Nigeria, it was discovered that the major missing link between research and sustainable food production is lack of effective information delivery system. The ratio of extension agents to farmers in Nigeria, especially in Imo State was found to be grossly inadequate to provide extension services to the large number of farmers. This resulted to a wide gap between available knowledge of improved technology and actual

practice by farmers. The study, therefore, found it necessary to highlight the use of alternative channels of information to enable farmers to have more access to improved technologies that would enhance agricultural productivity. Among the mass media methods that was found very reliable were farmer radio programmes that would reach a large number of farmers quickly creating awareness of innovations and stimulating their interest to adopt.

Radio was and still is one of the most accessible communication media for rural people as indicated in a study by Balan & Norman (2012). And since farmers can easily access this medium, it can be capitalised upon to reach farmers with gainful information; since exposing farmers to information is a key factor to influencing its uptake (Musingafi & Zebron, 2014).

Radio accessibility has been made easy by entry of phone gadgets where a farmer owning one can access their favorite radio station via their mobile phone. According to Girma et al. (2017), about 80% of farmers studied had radio and mobile phones while those who did not own one claimed to have access to radio programmes in other ways. These findings revealed that radio and mobile phones were the most abundant mass communication tools and that radio can effectively be used to aid extension service delivery. The study further suggested that it is important to know which radio station is highly preferred by the target audience, preferred language and broadcasting time to ensure success of a given radio programme.

Dissemination of information or successful communication increases people's knowledge and motivates the public and households to prepare and mitigate disasters (Dennis et al. 2011). Though communication has potential to raise awareness about environmental risks (such as soil degradation and loss of soil fertility), it has several limitations. Such limitations include risk of information overload (O'Neill 2002) and a high likelihood of targeted people failing to pay attention (Renn, 2006). Information on SFM technologies if poorly presented may be misunderstood by farmers and yield poor results.

Further, the linearity in the coding, transmission and decoding can lead to substantial disengagement and generation of meaning of the disseminated messages, distortion and redundancy (Jaeger & Renn 2001). Linearity or one-way communication is a form of passive

participation that limits the extent to which a community or individuals can influence a programme (Evans et al. 2018; Servaes & Lie 2013). Radio programmes that employ one way communication denies listeners the opportunity to participate, making them passive consumers of information. One-way communication depresses learning and alienates intended recipients of communication (Fischhoff, 2005).

Universally accepted principles of extension education that can have impact include focus on people, interests, needs and available resources, organisation and mobilisation of people at the grassroots level, and people's participation in formation and implementation of extension programmes (Dahama & Bhatnagar, 1985). The context, situation analysis, objective setting, alternative analysis, monitoring and evaluation are as such critical to extension education. However, most extension programs such as radio messaging ignore the philosophy and principles of communication (Das & Tripathi, 2014).

Radio programmes used to disseminate content on agriculture has both negative and positive effects on agricultural practices, depending on uptake of the information by audiences. Information received can either persuade or dissuade farmers from adopting technologies, it is therefore important that the right information is packaged well and appropriately delivered through programmes such as *Mugambo wa Murimi.*

2.6 Theoretical Framework

This study assessed effects of radio programme MWM in uptake of information on soil fertility management technologies. The study evaluated the factors influencing performance of radio as source of agricultural information to farmers through programmes aired. The successes or failure of most development projects are often determined by two crucial factors, that is communication and people's involvement (Fraser & Restrepo-Estrada, 1998; Freire, 1983). Communication for development approaches have been suggested as a tool for assessing people's perception and building consensus in development planning.

Communication for development is the planned use of strategies and processes of communication in achieving development and behaviour change (Srampickal, 2006).

Communication for development is concerned with re-engineering diffusion to a process of innovation and identificatication of dependable solutions to a given challenge through participatory planning and feedback mechanism. Identifying the problem, stakeholder mapping, stakeholder engagement, critical evaluations and reviews as well as addressing the social costs in a participatory manner are some of the prerequisites in re-engineering the processes (Rodgers, 2004).

2.6.1 Diffusion of Innovation Theory

In 1962, Everett Rogers developed the diffusion of innovation theory by combining the information flow research findings with studies about the flow of information and personal influence in several fields including, anthropology, sociology and rural agricultural work (Baran 2006). The diffusion of innovation model assumes that a proper combination of mass mediated and interpersonal communication strategies can move individuals through a process of awareness of a new technology to interest, evaluation, trial and finally adoption of that technology (Melkote, 2001)

Diffusion of innovation is the process by which an innovation is communicated through certain channels over time among members of a social system. DOI explains how an idea or even product spreads through a specific population. For it to spread, there has to be a channel through which it is communicated to audiences. This channel can be a radio, television or any other suitable medium.

According to Oakley and Garforth (1985), in agricultural extension, adoption of new ideas involves individual farmers, groups of farmers or whole communities. Such individuals or groups have norms, social statuses and hierarchy that influence behaviour and adoption habits (Chi & Yamada (2002).

Rogers put together data from numerous empirical studies to show that when new technological innovations are introduced they pass through a series of stages before being widely adopted. Baran (2006) describes five stages that new technological innovations pass through before being widely adopted. In the first stage most people become aware of a particular innovation

often through information from the mass media. In the second stage the innovation becomes adopted by a very small group of innovators or early adopters. After this, opinion leaders learn from the early adopters and try the innovation themselves. If they find the innovation useful, they encourage others to adopt it. In the final stage most people adopt the innovation and a group of laggards or late adopters also make the change.

The main characteristic of innovation which determine how an innovation is responded to by farmers are:

1. Relative advantage of the innovation. The degree to which an innovation is seen as better than the one it replaces. Farmers will most likely put to use an innovation that promises better results. For example, use of organic fertiliser with a promise of better food crop yields with little or no side effects on health.
2. Complexity of an innovation determines its uptake. When farmers can understand an SFM technology, they are more likely to put it to use. Soil fertility management technologies that can easily be prepared and applied such as compost can be adopted faster than manure from bio digesters. The latter is more complex and labour intensive.
3. Compatibility of an innovation influences its adoption. It refers to how consistent an innovation is with values, experiences and needs of intended users. Farmers will most likely adopt an SFM that will blend with their farming needs; take up a SFM technology that will address the specific soil fertility such as water holding capacity or maintenance of soil PH.
4. Trial ability refers to an adoption undergoing tests before intended users are sure of its success is when a decision to adopt is made. Farmers can only take up SFM technologies that have assurances of having been tested, tried and successful.
5. Observability is a case where adoption will depend on whether the innovation will provide tangible results. Farmers will most likely adopt SFM technologies once harvests increase and have food surplus.

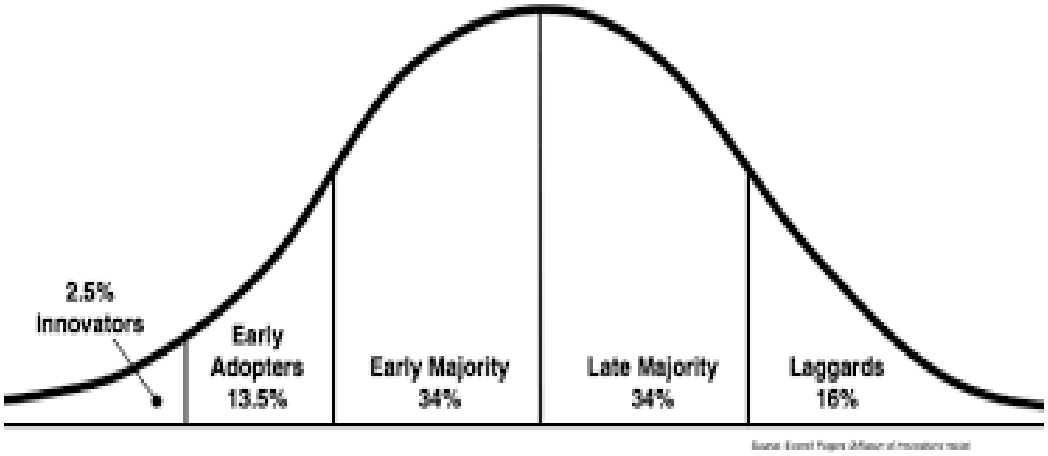

Figure 2.1: Diffusion Of Innovations

Source: Adopter categorisations on the basis of innovativeness – Rogers, E. M. (2003). Diffusion of innovations (5th ed.). New York: Free Press

Diffusion studies indicated a great difference among the adopters in terms of their personal characteristics, media behaviour and position in the social structure (Melkote 2001). The early adopters used mass media more and had more opinion leadership characteristics

Denis & Defleur (2002) observe that some innovations spread swiftly through society and are taken up by virtually everyone while others spread slowly and are adopted by only a fraction of the population. Melkote (2001), attributes such adoption rates to the characteristics of an innovation as perceived by the individuals in a social system.

DOI was quite influential in the 1950s and 60s and according to Baran (2006), the United States Agency for International Development (USAID) used the strategy to spread agricultural innovations in the Third World in the 1950s and 1960s. The theory became a training manual for new agricultural innovations around the world. Though successful in spreading agricultural innovations around the world the diffusion of innovation theory has some limitations as it emphasises more on adoption and underemphasises on recipient input in to development decisions and programmes (Melkote 2001).

The theory, according to Baran (2006), however, underestimates the power of the media especially contemporary media. It assigns a very limited role to mass media. The media mainly

creates awareness of new innovations. Its role ends there and only the early adopters are directly influenced by media content. Other people adopt innovations after being influenced by others, so they do not get the information directly from the media. The theory's strength is that it assumes that a proper combination of mass mediated strategies can move individuals to awareness of a new technology to adoption.

The problem of diffusion and implementation of innovations in agriculture should not be considered simplistic, in that the process of diffusion and implementation of innovations will take place successfully if there are sufficient financial resources, agricultural experts, awareness of adopters and access to innovation. Rijn et al., (2012) posits that adoption of innovations in agriculture is positively correlated with the level of education of the adoption unit (farmer), the experience and the property of holdings (measured in assets of the farm) and the economic advantage of the innovation.

According to DOI, an innovation should meet certain criteria in order to be (easily) adopted. One of them is obvious economic advantages. Radio is an important channel of communication that can be used to communicate economice advantages of new or those perceived new agricultural innovations such as SFM technologies among rural farmers.
Farmers in rural Kenya listen to vernacular radio programmes such as MWM for information, education and entertainment. Local language radio stations have agricultural programmes which teach farmers various farming practices. Radio as a mass medium can be used to create awareness of SFM technologies through its programming targeting farmer audiences. This calls upon communicators on radio to use the best approach in their programmes so as to move their audience from awareness to adoption of new farming technologies. The diffusion of innovation model assumes that a proper combination of mass mediated and interpersonal communication strategies can move individuals from awareness of a new technology to adoption of the technology.

Studies indicate that farmers who listen to the programmes learn technologies firsthand and probably adopt them (FAO, 2011). They eventually become early adopters of the innovations.

Afterwhich they may pass on the innovations to others who also adopt them, growing the number of those adopting the innovations.

This theory has in the past been used by extension services in understanding underlying reasons for uptake or rejection of new agricultural practices among farmers. It therefore provides a general understanding on the impact of the extension programme by assessing the extent of adoption of a particular innovation. The theory guided this study in understanding effects of *Mugambo Wa Murimi* radio programme on uptake of SFM. Though radio could be critical in dissemination of information, its effect is likely to be impacted on by personal and technology characteristics in the adoption cycle. Linearity in the coding, transmission and decoding can lead to substantial disengagement and distortion of the disseminated messages in radio programming, an angle that should be given attention.

CHAPTER THREE

METHODOLOGY

3.0 Overview

This chapter discusses research approach and design employed. It further describes the study area, population, sampling technique, study instrumentation applied as well as ethical consideration.

3.1 Introduction

The study utilised mixed method approach comprising cross sectional survey design, key informant and focus group discussions as detailed below.

3.2 Research Design

Research design ensures a study is executed in a manner that safeguards validity of the conclusions and that results are optimised. It ensures proper planning, execution of the study objectives and exclusion of obvious threats to validity (Babbie, 2010).

Cross sectional survey design was used at household level to collect information on parameters such as, respondents' sources of information on soil fertility management, the relevance of the information, perception and perceived effects of MWM programme on uptake of SFM.

3.3 Research Approach

The mixed methods approach used in the study was appropriate because in assessing the current status in terms of uptake of information on soil fertility management, it was important to triangulate data from various respondents and sources. The mixed method balances both strengths and weaknesses of qualitative and quantitative research (Creswell, 2006). Thus, collection of qualitative and quantitative data ensured that there was thorough triangulation of findings.

Qualitative methods allow for probing and in-depth explorations of a particular view (Babbie, 2010). They are suited to capturing the insider perspective of respondents. Quantitative

methods lend themselves much more to standardisation and application across more sites (Babbie, 2010). Triangulation enhances credibility of data in that what one method is unable to capture is complemented by the other method.

The study used questionnaires to collect farm level data on variables such as farmer demographics, sources of information, relevance of information, perception on *Mugambo wa Murimi* radio programme and perceived effects of the radio programme on farming activities relating to SFM. Focus group discussions and key informant interviews were undertaken to elicit, triangulate and supplement the collected information from households.

3.4 Study area

Kandara Sub-county is located 62 km north east of Nairobi. According to GoK (2014), the sub-county covers an area of 239 km^2 with approximately 193km^2 being potential agricultural land The sub-county lies in the upper agro-ecological zones of Lower Highland one (LH1) – Tea dairy zone, Upper Highland one (UH1) – Sheep and Dairy zone, Upper Midland one (UM1) – Coffee-tea zone, Upper Midland two (UM2) – Main coffee zone and Upper Midland three (UM 3) – Marginal coffee zone (Jaetzold et al., 2007).

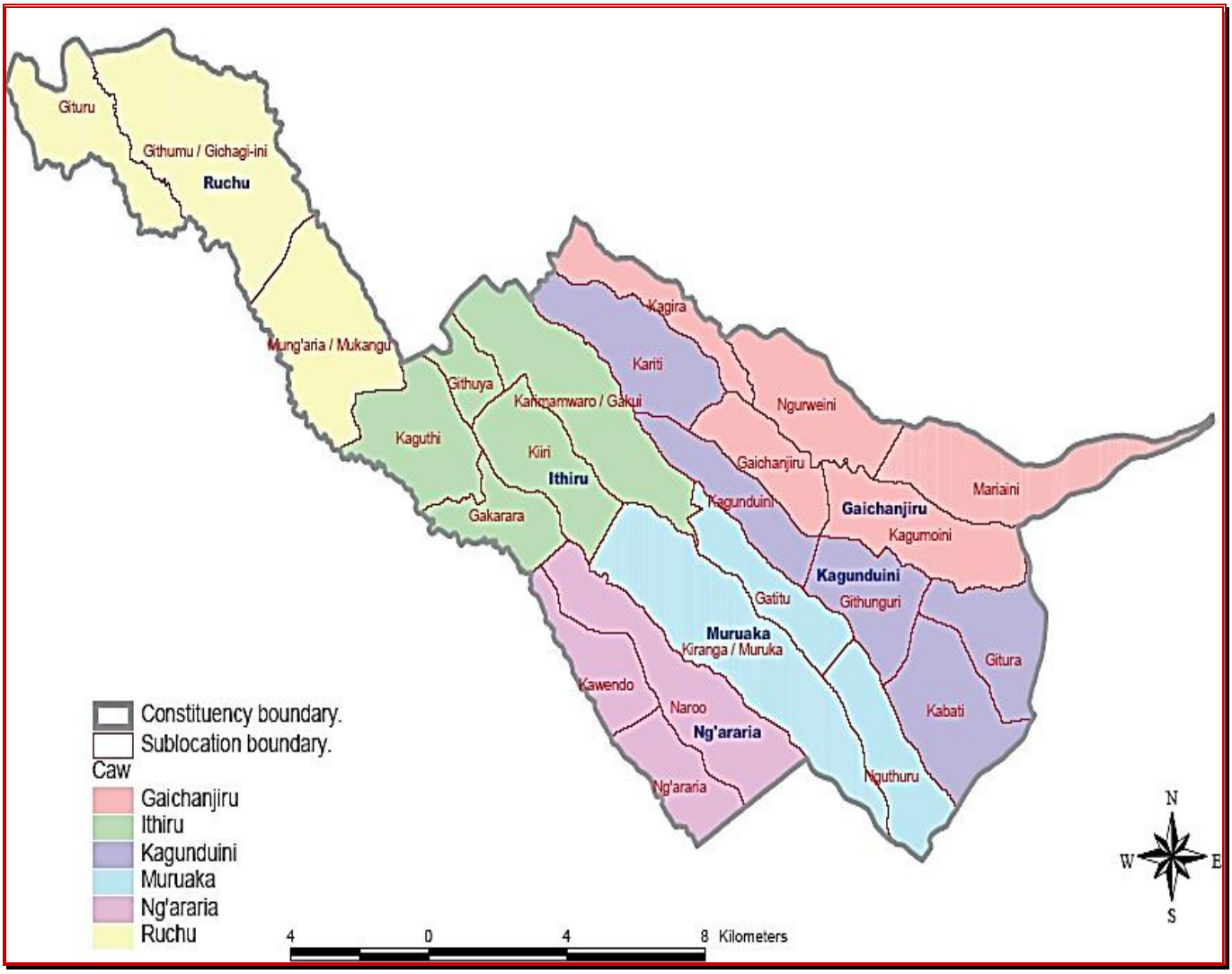

Figure 3.1: Map of the Study Areas in Kandara Sub-County

The sub-county receives total annual rainfall of 900 to 2000 mm with a mean annual temperature of 26.3ºC (Jaetzold et al., 2007). It lies at an altitude of 14000 – 1075m above sea level. The main land use activities in the sub-county are cash crop farming, subsistence farming, livestock keeping and forestry (GoK, 2014). The main cash crops are coffee and tea while maize and beans are planted for food. Farmers in the area often practice mixed farming. The main livestock bred in the sub county are cattle, pigs, goats, sheep and chicken.

The average farm size per household is 0.5 acres with 62.1% of the farmers having title deeds (GoK, 2014). The predominant soil type in the sub-county is *Nitisols* which are well drained, extremely deep, dusky red to dark reddish brown, friable clay, with acid humic topsoil.

Based on the 2009 National Population and Housing Census, Kandara sub-county had a total population of 156,663 people in 30,213 households and a population density of 243 persons per km^2 (KNBS, 2009). With a population growth rate of 0.4%, it is projected the total population will reach 183,927 by the end of 2019 (KNBS, 2009).

The research was carried out in Ithiru, Ruchu and Ng'araria wards of Kandara sub-county of Murang'a County as shown on the map above. Three (3) out of six (6) wards were sampled for study. The area was found suitable for this study because it is in central highlands, a region affected by high rates of soil fertility decline and where soil fertility management efforts have been ongoing. Any sub-county in the region chosen randomly would still yield the same results, a simple random sampling was conducted and Kandara was therefore picked for this study.

3.5 Study Population

A population is defined as a complete set of individuals, cases or objects with some common observable characteristics (Mugenda & Mugenda, 2003). The target population for this study was drawn from Kandara sub-county consisting of smallholder farmers, agricultural extension officers, a crops officer and a radio program manager.

3.6 Sampling

Sampling is the process of selecting units, for example, people from a population of interest (Trachoma, 2006). It would not be possible for the researcher to collect data from all smallholder farmers in Kandara sub-county, thus, there was a need to select a sample.

3.6.1 Sampling techniques

Analysing the entire population would be too costly for the researcher in terms of time and resources. It was therefore necessary to apply sampling technique to reduce the number of cases.

This study therefore used the purposive sampling technique to select a crops officer, extension officers and a *Mugambo wa Murimi* radio programmer as key informant respondents for the study. Participants for the focus group discussion were also purposively sampled. This technique was most suitable because it focused on specific characteristics of a population that is of interest to this study and thus able to answer the research questions. According to Engel and Schutt (2010) purposive sampling method is useful in surveys that target individuals who are knowledgeable about issues under investigation.

To get the household heads for survey, systematic random sampling technique was used to sample 139 farmer households. Systematic random sampling is a type of probability sampling in which sample members from the larger population are selected from a random starting point but with a fixed periodic interval. This sampling technique ensured that the population is evenly sampled.

3.6.2 Sample Size

A total sample size of 139 farmer households was surveyed in this study, 125 gave complete responses. Four (4) focus group discussions as well as four key informant interviews were conducted. The study employed Fishers (1983) formula in determination of sample size as below:

$$n = Z^2 (p\ q)/d^2)$$

Where

n = projected desired sample size

Z = the Standard normal deviation with a 95% level of confidence = 1.96

P= proportion of target population estimated to have the characteristic under investigation (10% or .1) to maximise sample size (precision)

q= proportion of target population without the characteristic (1-p = 90% or .9)

d= significance level of .05 or 5%

Substituting for the values;

$n = Z^2 (p\ q)/d^2) = 1.96^2 (.1* .9)/ (.05)^2 = 3.8416 (.25)/.0025 = 138.29$ hence 139 farmers. To take care of non-response and key informants, 139 respondents were sampled.

Table 3.1: Population and number of households in Kandara sub-county

Ward	Size (Area) Km^2	AEZ	Population	No of households
Ruchu	70	LH 1, UM1	42720	7461(35)
Ithiru	36	UM2	27908	5529(25)
Ng'araria	24	UM3	20838	3524(16)
Muruka	35	UM3	24051	4121(19)
Gaichanjiru	35	UM2-3	20121	4530(21)
Kagunduini	39	UM2-3	25747	5046(23)
	239		156,663	30,213(139)

Source (KNBS 2009); figures in paranthesis indicate targeted sample size per ward by proportion to size

3.6.3 Sampling Frame

The sampling frame was obtained from a list of all farmer households issued by the agricultural extension officer.

3.7 Data Collection tools and Procedures

The data collection methods utilised in this survey entailed use of qualitative and quantitative methods, targeting various respondents. These were:

3.7.1 Use of Questionnaire

Household interviews targeted the farmer household heads and were guided by a well-structured farmer questionnaire with closed and open ended questions (see appendix 1). The questionnaires were printed and issued to enumerators to administer to household heads to ensure accurate management of data quality and data integrity. The researcher took part in the exercise. The questionnaires enabled the researcher gather data from smallholder farmers.

The table below gives a summary of data collection procedures used in the field.

Table 3.2: Summary of Data Collection Procedures

Study population unit	Design	Sampling Method	Size (N)	Data collection instrument
Household heads	Cross sectional survey	Systematic random sampling	139	Questionnaire
Participants	FGD	Purposive	4FGDs	Interview Checklist
Programme managers/Producer for Mugambo wa Murimi programme	KI	Purposive	1	Interview checklist
Extension officer and crops officer	KI	Purposive/Census	2	Interview checklist

Source: Field Survey 2019

3.7.2 Interviews

Key Informant Interviews (KII) targeted the relevant and knowledgeable stakeholders on agricultural issues in the study area. These included the extension officers, crops officer and the sub county agricultural officer. One extension officer and crops officer were accessible and willing to have an interview with the researcher. Another interview was scheduled and conducted with a radio programmer of *Mugambo wa Murimi* radio programme. Both interviews were guided by a Key Informant Interview Guide (see appendices 3 and 4). A total of three key informant interviews were conducted.

3.7.3 Focus Group Discussion

The focus group is a strategy for understanding peoples' attitudes and behaviours (Wimmer & Dominick, 2011: 89). Participants in this type of research are, therefore, selected on the criteria that they would have something to say on the topic, are within the age-range, have similar socio-characteristics and would be comfortable talking to the interviewer and to each other (Richardson & Rabiee, 2001).

Focus groups can provide information in a relatively short time span about a range of ideas and feelings that individuals have about certain issues, as well as illuminating the differences in perspective between groups of individuals. One of the distinct features of focus-group interviews is its group dynamics, hence the type and range of data generated through the social interaction of the group are often deeper and richer than those obtained from one-to-one interviews (Thomas et al., 1995).

Krueger & Casey (2000) suggest between six and eight participants for a focus group, as smaller groups show greater potential. However, the number generally suggested as being manageable can be between six and ten participants; large enough to gain a variety of perspectives and small enough not to become disorderly or fragmented.

For the purpose of this study, participants were purposively selected. Participants were selected in consultation with extension officers using homogeneous sampling, which is an approach of purposive sampling. The selected participants were knowledgeable on soil fertility issues. The discussions entailed in-depth deliberations on selected topics. To ensure that the FGDs were manageable and to allow a healthy discussion, the discussions were limited to a total of 13 participants per FGD slightly above the recommended number as some invited participants came accompanied by curious friends.

FGDs were conducted using a guide (appendix 2). Group discussions were steered by facilitators (the researcher and an assistant) who described the process and outlined the purpose of the exercise to the participants. A guide (Appendix 2) was used to obtain information on soil fertility and related issues. Four FGDs were achieved in the study area. FGDs enabled the researcher to obtain detailed and broad range of information about personal and group feelings, perceptions on *Mugambo wa Murimi* radio programme and other opinions relevant to this study.

3.8 Pretesting the Research Instruments

An important component in the data collection process is that of the pilot study, which is ". . . a small-scale trial run of all the procedures planned for use in the main study" (Monette et al.,

2002; 9). This study undertook a pilot study before the final fieldwork. Questionnaires were administered to a small sub-set of the population in Muruka ward. This was critical in ensuring the research instruments were tested for reliability and validity before the real data collection. The researcher was thus able to ensure that the questions are well articulated, responses comprehensive and relevant to the study. The sub-set of the population that was used for piloting was not included in the final sample for the study. The pretest was conducted on five respondents.

3.9 Ethical Considerations

This study relied on primary data generated in the field by way of administering questionnaires with open and close ended questions to smallholder farmers. Trained research assistants under supervision of the researcher administered the questionnaires to household heads. The study put into consideration issues of ethics. Key informants who were accessible were interviewed one on one while those who wished to respond to further questions via mail had the guide mailed to them. FGDs were guided by a list of questions and conducted at a time convenient to all participants.

The major ethical issues to be addressed by the researcher, include informed consent, privacy and confidentiality, anonymity and responsible conduct (c.f Mack et al, 2005, p. 53). The identity of the respondents was protected by including a confidentiality clause and informing respondents about the purpose of the study. Accordingly, the participants of the study were provided with adequate information about the study. Some of the information supplied included the purpose of the study; the expected duration of participation and the procedures to be followed; the benefits of the study and the extent of privacy and confidentiality to be maintained. This formed the basis upon which the selected respondent made an informed decision on whether to participate in the study. See Certificate of Field work, Certificate of Originality and Certificate of Corrections attached as appendices 5,6 and 7.

3.10 Data Analysis and Presentation

Quantitative data collected from the field was cleaned, coded and typed into Statistical Product and Service Solutions (SPSS) tool. Data from the open-ended questions were processed and coded to facilitate analysis. The findings were then summarised and presented as frequencies, pie charts, percentages, tables and graphs.

Qualitative data collected from the focus group discussions and interviews with key informants was used to further explain the findings received from the questionnaires and therefore acted to supplement information obtained.

3.11 Validity and Reliability

Validity refers to the degree to which results obtained from the analysis of the data represent the phenomenon under investigation. Muhammad et al. (2008) refers to validity as the extent to which the data is plausible, credible and trustworthy; and thus can be defended when challenged. Neuman (2011) defines reliability as the degree of dependability or consistency of results. Perfect reliability and validity are virtually impossible to achieve, hence they are ideals that researchers strive to achieve because they (validity and reliability) help to achieve truthfulness, credibility, or believability of findings.

To achieve both validity and reliability, the study used triangulation to increase the chances of validity and reliability of the findings. Triangulation strengthens a study by combining several methods or data, including qualitative and quantitative approaches (Patton, 2001).

Subsequent to the selecting respondents for the study, consent to participate in the research study was requested. The purpose of the research study was explained to the respondents and they were also assured of confidentiality. Anonymity of their identities was assured through the use of pseudonyms and every effort was made to respect the wishes of the participating farmer.

CHAPTER FOUR
DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.0 Overview

This chapter presents findings by study objectives, namely, to: determine sources of information on soil fertility management; assess the relevance of information on soil fertility management aired on *Mugambo wa Murimi* radio programme; examine smallholder farmers' perceptions of *Mugambo wa Murimi* radio programme on soil fertility management; and assess the perceived effects of *Mugambo wa Murimi* radio programme on the uptake of information on soil fertility management technologies in Kandara sub-county.

4.1 Introduction

Data were analysed to identify, describe and explore the relationship between the information on soil fertility aired on *Mugambo wa Murimi* radio programme and its effects on the uptake of soil fertility management technologies by smallholder farmers in Kandara sub-county. Results are presented hereunder.

4.1.1 Response rate

Questionnaires were administered to smallholder farmers in Ng'araria, Ruchu and Ithiru wards of Kandara sub-county. The study targeted a population of 30,213 households as indicated in Chapter Three with a sample size of 139 surveyed. Of the questionnaires distributed, 125 questionnaires were found to be complete. Figure 4.1 indicates that 48% of the respondents were from Ruchu ward, while 26.4% and 25.6% were from Ng'araria and Ithiru wards respectively. Overall, there was a response rate of 89%. This was achieved because the research assistants administered the questionnaires and hence eliminated the risk of non-return as it was possible to recover the questionnaires once they were complete. Frequencies are presented in Table 4.1.

Table 4.1: Questionnaire Response Rate

Ward	Frequency	Percentage
Ng'araria	33	26.4%
Ruchu	60	48.0%
Ithiru	32	25.6%
Total	125	100

Source: Field Survey 2019

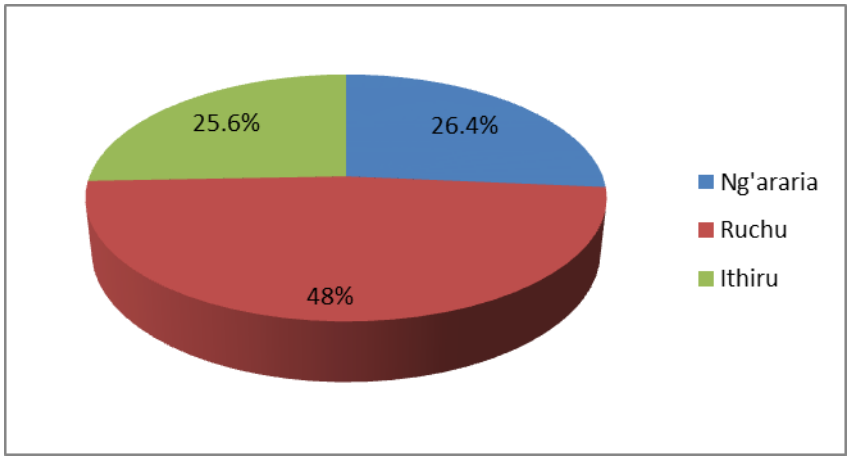

Figure 4.1: Questionnaire Response Rate

Four focus group discussions were conducted in the three wards with 2 being held in Ruchu while one FGD was held in Ithiru and Ng'araria respectively. During the FGDs the few available youth were not keen on the discussions and participated passively. This was partly because of them having fewer years of using soil fertility management technologies and their assumption that issues on SFM are light and quite straight forward to them. Further, the study conducted three key informant interviews with agricultural officers and the producer for Inooro FMs *Mugambo wa Murimi* programme. Face to face interviews were conducted with all the key informants.

4.2 Respondents Data

Respondent's data collected included age, gender, education, farm size, duration of farming, crops planted, animals reared and decision making on agricultural activities. The results are presented in the sections below.

4.2.1 Gender

The gender of the respondents was important for this study as gender relations influence control over the assets and resources that are needed to derive benefits from interventions(Meinzen-Dick et al., 2011). In some instances norms that limit either gender from control over decisions about productive assets and resources have deeply restrictive effects on uptake of all types of agricultural innovations such as SFM.

The results of gender of respondents is presented in Table 4.2 and Figure 4.2.

Table 4.2: Gender Of Respondents

Gender	Frequency	Percent
Male	71	56.5%
Female	54	43.5%
Total	125	100

Source: Field Survey 2019

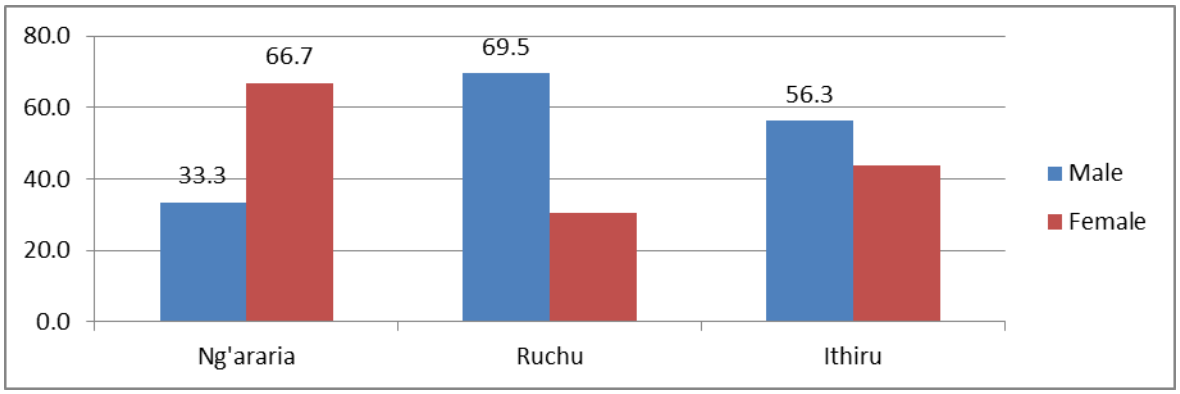

Figure 4.2: Gender of Respondents

The respondent's information based on **Figure 4.2** indicates that 33.3% in Ng'araria, 69.5% in Ruchu and 56.3% in Ithiru were male with female respondents being 66.7% in Ng'araria,

30.5% in Ruchu and 43.8% in Ithiru. This translated to 56.5% of the respondents being male while 43.5% female (Table 4.2).

4.2.2 Age Distribution and Education Level

During data collection, respondents stated their age and level of education and the results presented in Figures 4.3, 4.4, 4.5 and 4.6. Frequencies are presented in table 4.3 and 4.4 respectively.

The following figures and tables indicate ages of respondents.

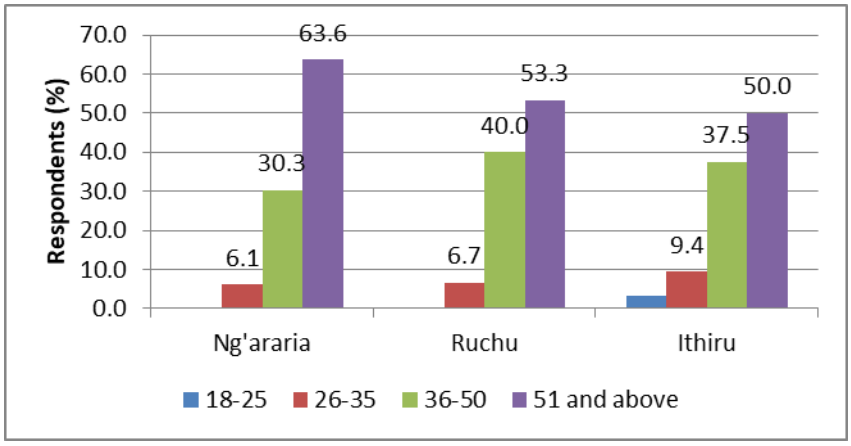

Figure 4.3: Distribution of Farmers by Age per Ward

Figure 4.3 presents the ages of farmers per ward in the sub-county. It shows that majority of respondents were above the age of 50 years as represented by 63.6% in Ng'araria, 53.3% in Ruchu and 50% in Ithiru.

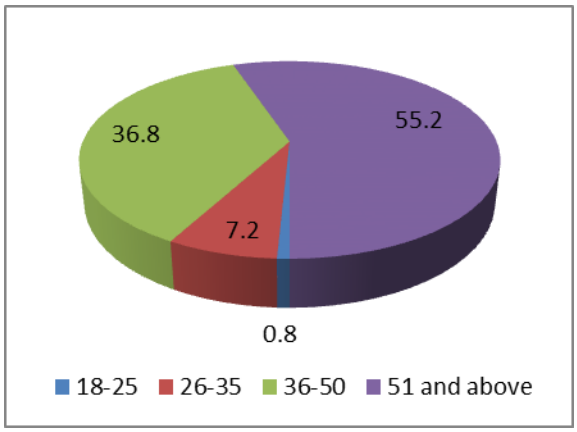

Figure 4.4: Distribution of Farmers by age in the study area

This translated to 55.2% of the respondents in the study area being above the age of 50 years (Figure 4.4). Notably, less than 10% of the respondents were 25 years old and below. This may be attributed to the movement of the younger generation towards areas closest to urban centres due to rapid urbanisation and in search of better livelihoods (Oucho, Oucho, & Ochieng, 2014). Land ownership is also still under the older population hindering freedom of younger farmers on farm use.

The age differences are also assumed to contribute to experience in farming gained over many years in occupation with younger farmers having lesser experience compared to those older. Table **4.3** presents the frequency of the age of respondents.

Table 4.3: Age of Respondents in the Study Area

Age group of Respondents	**Frequency**	**Percent**
18-25 years	1	0.8
26-35 years	9	7.2
36-50 years	46	36.8
51and above	69	55.2
Total	**125**	**100**

Source: Field Survey 2019

On matters education, more than 50% of the respondents in all wards were found to have attained secondary or tertiary level of education (Figures 4.5 and 4.6). It is assumed that farmers with formal education tend to be innovative and well suited to implement agricultural innovations (Barefoot 2006). Soil fertility management technologies requires the ability to read and write for ease of comprehension of information and application on farm. This means that over 50% of farmers in the sub-county are able to take up and use information on soil fertility management aired on *Mugambo wa Murimi* because of their educational background. Frequencies are presented on Table 4.4.

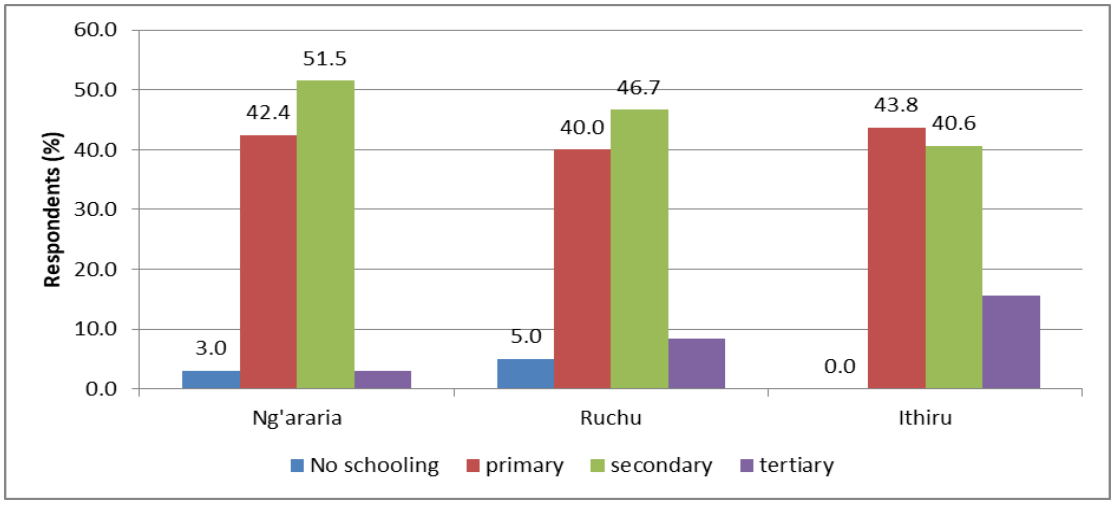

Figure 4.5: Distribution of farmers by level of education per ward

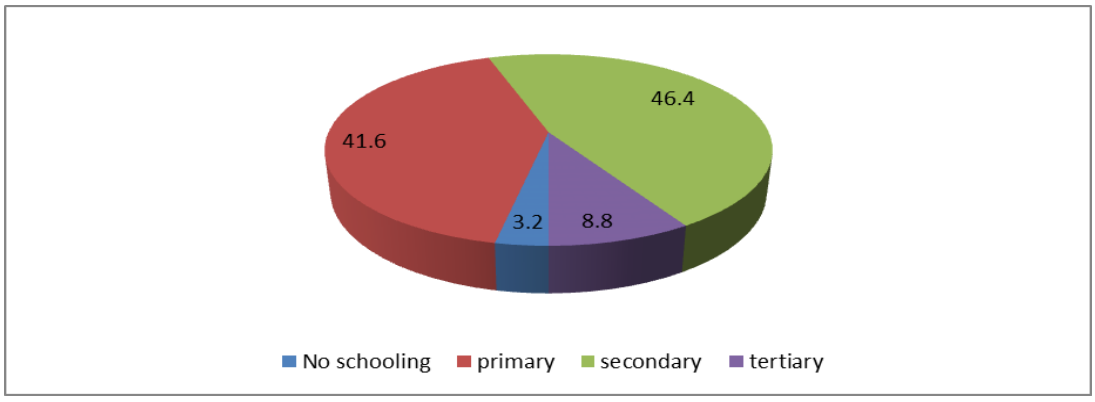

Figure 4.6: Distribution of Farmers by Education on Average in the Study Area

Table 4.4: Distribution of Respondents by Level of Education Per Ward

Level of education of respondents	Ng'araria	Ruchu	Ithiru	Total
No formal schooling	1	3	0	4
Primary	14	24	14	52
Secondary	17	28	13	58
Tertiary	1	5	5	11
Total	33	60	32	125

Source: Field Survey 2019

4.2.3 Land size and Farm Size under Agriculture

As indicated by Lavison, (2013), farm size can affect and in turn be affected by other factors influencing adoption. It was important that the land size of respondents are documented since it has effects on the uptake of SFM technologies. Respondents were therefore asked to indicate the size of land one owned and the size of farm put under agriculture and results presented in Figure 4.7 and Table 4.5.

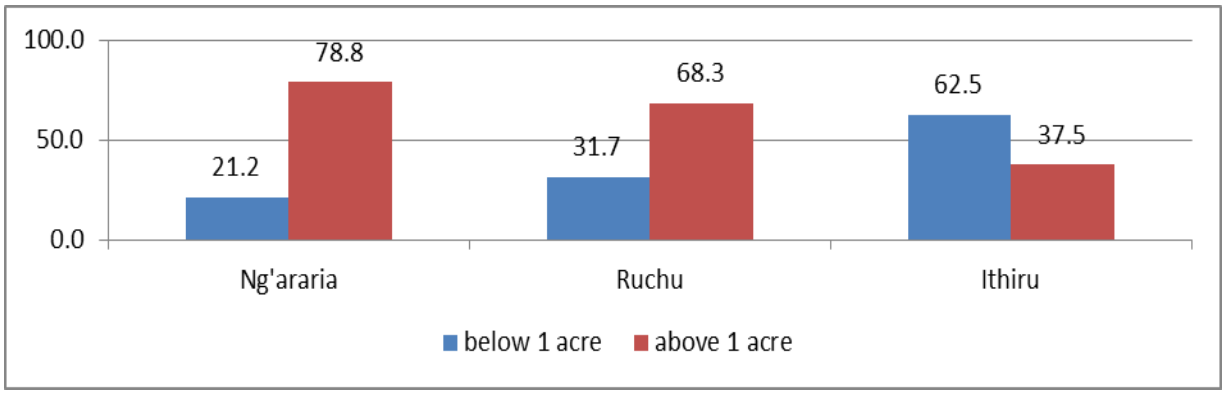

Figure 4.7: Land Size Owned Per Ward

The respondent's information based on Figure 4.7 indicates that 78.8% of respondents in Ng'araria, 68.3% in Ruchu and 37.5% in Ithiru owned land above one (1) acre. In the study area, 63.2% of the respondents owned above one acre of land while 36.8% only owned land below 1 acre (Table 4.5).

Table 4.5: Land Size of Respondents in the Study Area

Land Size	Frequency	Percentage
Below 1 acre	46	36.8%
Above 1 acre	79	63.2%
Total	125	100

Source: Field Survey 2019

Although the majority of the respondents own more than one acre piece of land, few allocated more land for agricultural use. Findings revealed that 75.8% in Ng'araria, 65% in Ruchu and 37.5% in Ithiru had put less than one (1) acre under agriculture which translated to 60.8% in the whole study area (Table 4.6). The percentage of respondents allocating less than one acre of land for agriculture could be attributed to increased population densities in the region or drop in yields due to decline in soil fertility resulting from continuous cropping as earlier cited by Bationo and Waswa (2011).

Table 4.6: Farm Size Under Agriculture in the study area

Farm size	**Frequency**	**Percent**
Above 1 acre	49	39.2%
Below 1 acre	76	60.8%
Total	125	100

Source: Field Survey 2019

The size of the farm plays a crucial role in the uptake of technologies according to Uaiene *et al* (2009). Farmers with large farm sizes are likely to adopt a new soil fertility management technology as they can afford to devote part of their land to try the new technology before uptake and rolling it out in their entire farm. This unlike those with lesser farm sizes who are the majority in the sub-county. Accordingly, such farmers lack the opportunity to try the strengths of various SFMs and select what works for their particular problem of soil fertility. In agreement with this, focus group discussions revealed that majority had allocated less than an acre to agricultural activities. Part of land, they said had been used for other ventures such as

construction of houses for rent and businesses which they deemed more profitable than farming.

In an interview with the extension officer, on the same, it was indicated that most farmers relied on demonstration plots located at Karlo Thika and in select public primary schools within the sub-county. He indicated that indeed the plots especially in public primary schools have 'come in handy', in demonstrating SFM technologies for treatment of soils with varying fertility status.

4.2.4 Decision making on Agricultural Activities in the Household

Figure 4.8 present respondents' views regarding decision making on agricultural activities at household level.

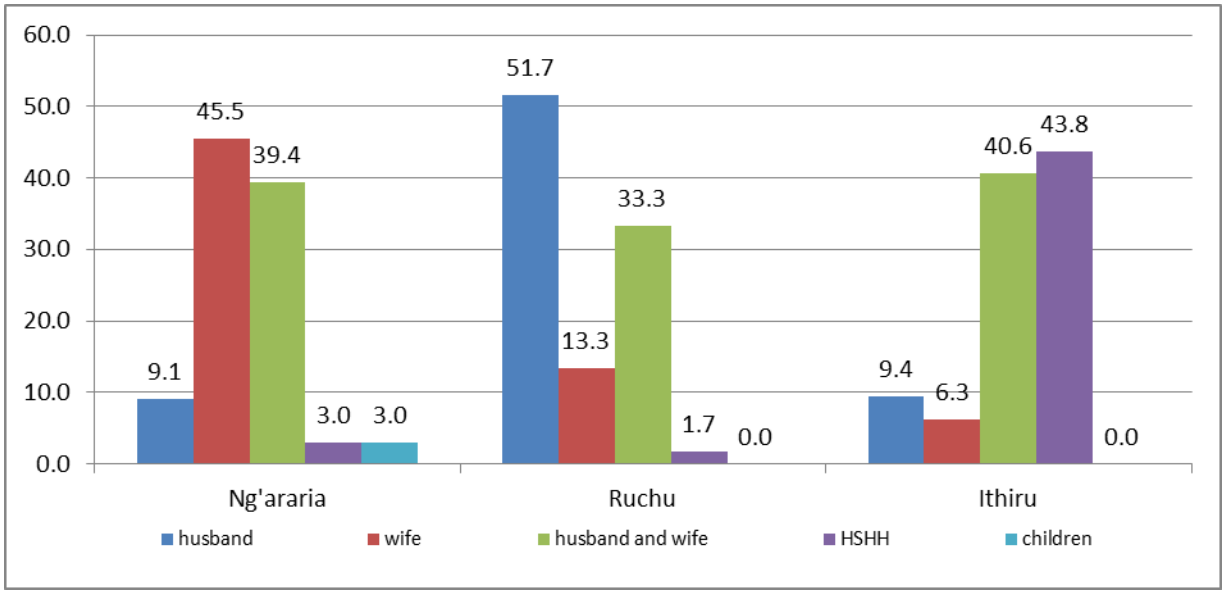

Figure 4.8: Decision Making on Agricultural Activities per Ward

Figure 4.8 indicates that most of the decisions concerning farming activities are made by the wife (45.5%) in Ng'araria, the husband (51.7%) in Ruchu and by heads of single headed households(HSHH) (43.8%) in Ithiru. Overall, in the study area, 36.8% of the respondents indicated that the decisions on agricultural activities were made by the husband and wife whereas the children made 1% of the decisions, a minimal percentage. These findings agree

with those from the KII and focus group discussions, that most agricultural decisions were made jointly by husband and wife of a household. This what member KO said.

> I cannot do anything on our farm if my husband has not agreed, neither can he, although he is the head of the family".
> How will my husband buy fertilizer or even pay workers without me giving him money, I keep all the money, am the house treasurer

According to the KIIs with agricultural officers, it is very common in most households for spouses to make joint decisions. And this waiting on joint decisions, had on various occasions caused delays on timely implementation of farm activities such as application of fertilizer on crops. The extension officer pointed out the following.

> These farmers can be interesting, I once requested them to dig pits in readiness for manure preparation, a week later, only four out of a group of around 10 had done it. On asking, one said ooh, my wife disagreed, with another claiming the husband was away attending a seminar so there was nothing she can do on her own

> I have told farmers time and again to sit down and make joint annual plans on application of fertilizers so that if the wife or husband is away, whoever is around implements the activity, but this never happens

Joint decision-making can have both positive and negative impact in uptake of information on SFM technologies. If a couple can agree without wasting much time on taking up say information on SFM aired on *Mugambo wa Murimi* the better since seasons change. Delays on decision-making can have negative effects on farming such as more costs on SFM and eventually poor yields occasioned by new farming seasons.

4.2.5 Duration of farming experience among smallholder farmers in the sub-county

Figure 4.9 and Table 4.7 present farmers' response in regard to their farming experience. In Ng'araria, Ruchu and Ithiru respondents reported to have been farming for between five to thirty years at 66.7%, 71.7% and 43.8% respectively (Figure 4.9).

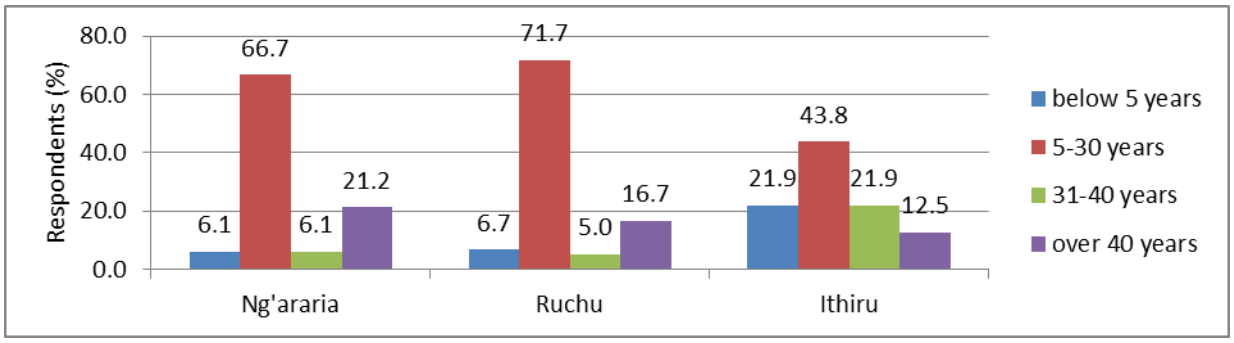

Figure 4.9: Average Duration of Farming Experience per Ward

Table 4.7: Farming Duration in the Study Area (Average)

	Frequency	Percent
below 5 years	13	10.4
5-30 years	79	63.2
31-40 years	12	9.6
over 40 years	21	16.8
Total	125	100

Source: Field Survey 2019

Overall, in the study area, as shown in Table 4.7, 89 % of the farmers had at least 30 years and above experience in farming with 11 % having less than 5 years. This indicates that farming is practiced predominantly by older farmers. This could be due to a number of reasons, such as, limited land and land ownership being in the hands of parents (farmers). It is also evident that the majority of the farmers could have inherited land from their forefathers as many in the focus groups kept referring to SFMs such as use of chicken droppings to enrich kitchen gardens which had been passed down from previous generation living on same piece of land-. Farmer N said "this kitchen garden has been kept alive for many years by chicken droppings, all we do is

collect the droppings and sprinkle on the vegetable garden, like our parents and grand parents did".

Farming experience plays a critical role in the uptake of information on soil fertility management (cf. Wendland & Sills, 2008). Experienced farmers with years of experience of using soil fertility management technologies are better placed to select or change a soil fertility technology based on experience of use of previous technologies or experience from farming. Farming experience helps in detecting change in soil by looking at indicators such as soil color (Odendo et al., 2010).

In an interview with the programmer of the *Mugambo wa Murimi* programme, it was indicated that it is mainly successful farmers who are invited to the show to share their experiences on their challenges and how they were able to overcome to be successful.

This sentiment agrees with that of FGDs where a farmer complained on the choice of farmers to the radio talk show. The reason as to such choice as explained by programmer at *Mugambo Wa Murimi* is to encourage farmers to learn from those who have made it despite their previous struggles. The programmer said.

> With the help of the research team on the ground, farmers
> and projects that serve the purpose of the show are identified.
> The farmers are experienced and with proper knowledge based
> on the environment they farm on

The youth mainly fall under this category of those who are left out yet they are the future of farming and soil fertility management in this region.

Vernacular radio programmes like *Mugambo wa Murimi* need to take into account this observation in the design of their interventions so as to cater for the interests of the marginal youthful farmers with limited experience in farming while meeting information needs of the majority farmers who are older.

4.2.5 Types of crops

Table 4.8 and Table 4.9 present response on the crops respondents have planted on their farms.

Table 4.8: Food Crops Planted Per Ward

Food crops farming	Ng'araria (N)	Ruchu	Ithiru	Total
Yes	32	60	32	124
No	1	0	0	1
Total	33	60	32	125

Source: Field Survey 2019

Table 4.8 indicates that almost all respondents surveyed (124) plant food crops in the study area, that is; 32 in Ngararia, 60 in Ruchu and 32 in Ithiru, cumulatively 124 of 125 respondents indicated that they plant food crops. The food crops on their farms include beans, maize, potatoes, bananas, vegetables, and fruits such as passion. From the findings it is clear that the majority of the respondents rely on food from their farms hence the need to have fertile soils that can sustain food productivity. This finding was confirmed by interviews with agricultural officers who agree with these findings that most farmers consume food from their own farms and sell the surplus for income.

Table 4.9: Cash Crops Planted per Ward in the Study Area

Ward	Yes		No		Total (N)
	Frequency	Percentage	Frequency	Percentage	
Ng'araria	30	90.9	3	9.1	33
Ruchu	56	93.3	4	6.7	60
Ithiru	29	90.6	3	9.4	32
Total	115	92.0	10	8.0	125

Source: Field Survey 2019

Table 4.9 shows that more than 90% of respondents practise cash crop farming in the study area. This was in agreement with findings from focus group discussions, which revealed that majority of farmers plant cash crops to generate income. Moreover, avocado was reported by

respondents as a cash crop that was fast replacing tea and coffee due to its low maintenance cost and ready market in China. It was also revealed that the county government of Murang'a was in the process of constructing a collection point for avocado at Ng'araria town. This they said had encouraged most of them to venture into farming the new variety of early maturing hass avocado which they hope will change their fortunes and lead to more tree cover in the county. Additionally avocado farming according to the extension officer contributes to soil fertility in that once planted, no tillage is required giving soil time to 'rest' and replenish lost nutrients.

4.2.6 Availability of trees and shrubs on the farm

Agroforestry forms part of the soil fertility improvement technology suite. Buresh and Tian (1998), posit that fertilizer trees have potential to provide nitrogen in quantities sufficient to support moderate crop yields through fixation and retrieval of nitrate from deep soil layers and cycling of nitrogen from plant residues and manures. The study thus included items on identification of types of agroforestry shrubs and trees grown by smallholder farmers on their farms

Results are presented on Table 4.10 and 4.11

Table 4.10: Trees and Shrubs Planted per Ward

Ward	Trees and shrubs in farm					
	Yes		No		Total	
	Freq (N)	Perc (P)	Freq (N)	Perc (P)	Freq (N)	Perc (P)
Ng'araria	30	90.9	3	9.1	33	100
Ruchu	55	91.7	5	8.3	60	100
Ithiru	22	68.8	10	31.3	32	100
Total	107	85.6	18	14.4	125	100

Source: Field Survey 2019.

Table 4.11: Trees and Shrubs in the Study Area

Response	Frequency	Percent
Yes	107	85.6
No	18	14.4
Total	125	100

Source: Field Survey 2019

The findings from the study area reveal that the majority of the farmers had planted trees and shrubs in their farms (90.9% in Ngararia, 91.7% in Ruchu and 68.8% in Ithiru) as shown in the Table 4.10. Of the 125 respondents, 107 said they have trees and shrubs that can be used for soil fertility management, while 18 said they have not planted trees or shrubs in their farms (Table 4.11).

Trees and shrubs grown or that grew on their own as indicated by respondents were tithonia, *Mathete, Mukigi maigoya* and *muchatha*. Participant LX said.

> Lantana has been growing on its own along land boundaries

The various uses of trees and shrubs as listed by respondents were; production of timber, firewood, fencing posts, providing shade, preventing soil erosion, making mulches and producing green manure.

Various challenges were shared by participants on preparation and use of green manure. And this was evident from responses from the focus groups where each of farmer gave a different version on using tree shrubs for soil fertility. Farmer J and V said.

> I chop leaves and spread on the farm when nothing is planted
> so that it can rot on its own and make my soil fertile.

> I do what I saw being done in Tharaka, so I dig a hole bury
> the shrubs, once they start rotting I use them on my farm

The above practice though common among farmers as indicated by the extension officer was not the right process. Many farmers were said to prefer it as it requires less labour.

According to the extension officer, many farmers, due to ignorance assume that they know it all especially when it comes to preparation and application of organic manure. He said

> Most of them think that it is about chopping shrubs and throwing on farms and they are sorted. They ignore the simple instructions that we give We tell them to clean cow sheds, majority do not clean yet this affects the quality of cattle manure

4.2.7 Livestock and Chicken rearing Per Ward

Farmers' response on the number of livestock and chicken owned in their farms is presented in Figure 4.10.

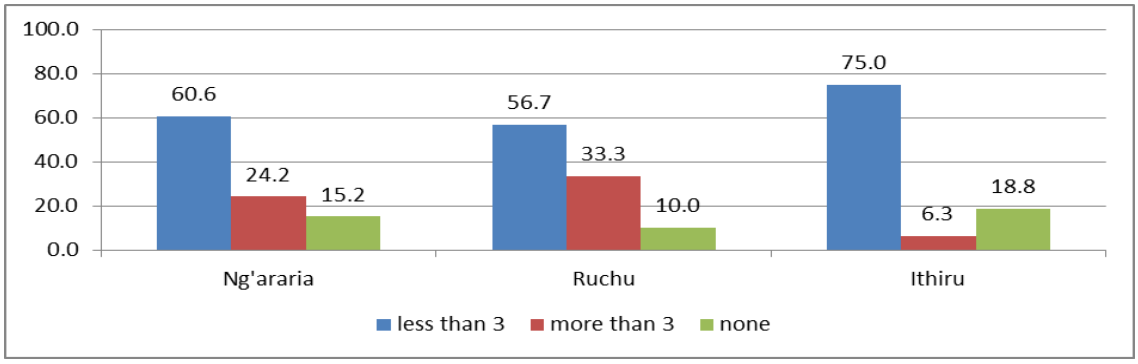

Figure 4.10 Livestock kept per ward

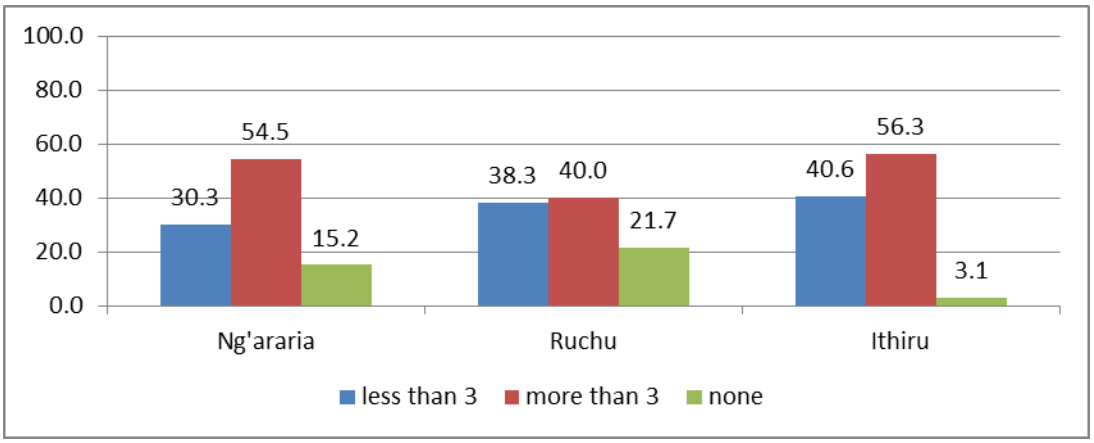

Figure 4.11 Chicken reared per ward

Figure 4.10 indicates that 60.6%, 56.7% and 75% of the respondents were rearing less than 3 livestock (cattle, goats, dairy cows and pigs) in Ng'araria, Ruchu and Ithiru respectively. On average, 62.4% of the farmers kept less than three livestock in the study area.

In terms of chicken rearing Figure 4.11 indicates that, 54.5% in Ngararia, 40% in Ruchu and 56.3% in Ithiru kept more than three chicken which translates to 48% in the study area. Animal manure is used for soil fertility management hence owning livestock by farmers is an indication of availability of dung used as animal manure that can be harvested for use in the farm as posited by Strom et al., (2018).

4.3 Sources and Frequency of Information on Soil Fertility Management Technologies

The study collected data on sources and frequency of information on soil fertility management in the study area. This variable was important in indicating where the respondents got information on SFM.

4.3.1 Sources and Frequency of information

During data collection, respondents were asked to name their sources of information on agriculture and especially on soil fertility management technologies. Various sources were listed. Respondents were also requested to indicate whether the source named met their information needs by rating it, the results are presented below. **Table 4.24 and Table 4.25 gives the overall presentation of all sources, rating and frequency of information on SFM as named and rated by respondents in the study area**.

4.3.1.1 Agricultural Extension officer

The extension teaching method can be very effective in the transfer of knowledge on SFM from extension officers to smallholder farmers. Usually, it involves mostly practical work and farmers observe the benefits for themselves. The extension education process works with the principle of 'learning by doing and seeing is believing approach'.

Table 4.12 presents responses based on extension officers' availability when needed by farmers to offer information on soil fertility management in the study area. The results revealed that 25.6% of the respondents were able to access information on soil fertility from extension officers while the majority (74.4%) indicated that they did not receive soil fertility management information from extension officers as needed. Figure 4.12 further shows that although information was not sufficient as indicated by 74.4%, some 67.2% respondents said the

information was relevant. The insufficient response can be explained by the fact that there is less contact time with extension officers where farmers had more queries in the course of implementing SFM technologies and the extension officers were unavailable to give answers. This can be attributed to the ratio of agricultural officers to farmers, which stands at 1:2294 as revealed by KIIs, brought about by non-replacement of retired officers. " To reach majority of the farmers, we have requested them to join groups or form them where there are non existent. It is easier attend to them as a group than as individuals, but the insist on household visits, that is not possible " said the extension officer. The low access to extension was found to be related to lower access to information on SFM. Respondents who are constantly intouch with the extension services are gained more information and implemented SFM technologies with ease.

Table 4.12: Extension officers as source of information on Soil Fertility Management

Extension officers	Frequency	Percent
Yes	32	25.6%
No	93	74.4%
Total	125	100

Source: Field Survey 2019

Figure 4.12 presents respondent's rating of the information on SFM received from extension officers.

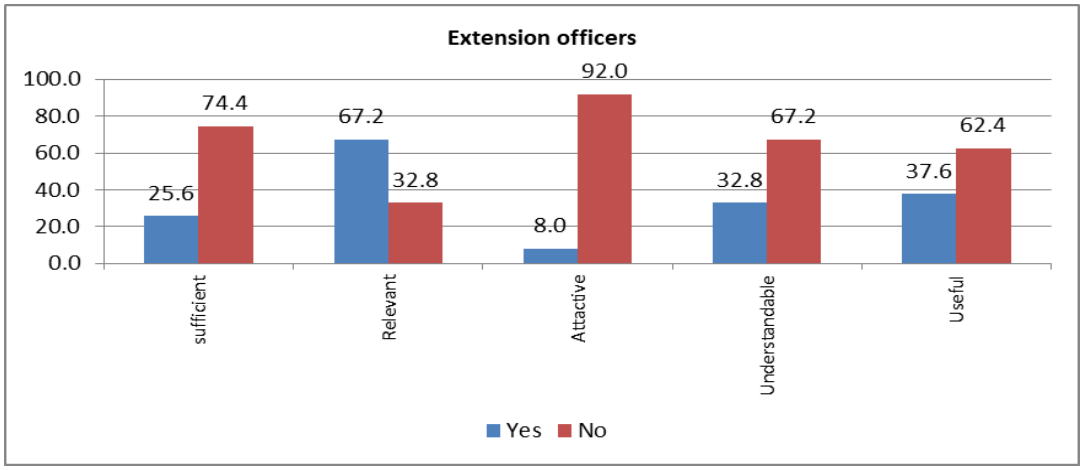

Figure 4.12: Extension officers as source of information

Table 4.24 presents findings per ward which shows that 63.6% of the respondents in Ngararia, 6.7% in Ruchu and 21.9% in Ithiru received sufficient information from extension officers.

Further, 78.8% in Ngararia, 56.7% in Ruchu and 75% in Ithiru received relevant information from the extension officers. However, over 81% of the respondents indicated that the information received from the extension officers was not attractive. Moreover, 75.8% in Ngararia, 10% in Ruchu and 31.3% Ithiru noted that the information received from the extension officers was understandable. The study also found out that 78.8% of respondents in Ngararia, 6.7% in Ruchu and 53.1% in Ithiru acknowledged that the information received from extension officers was useful. These findings agree with Garforth (1993) who posits extension officers as a source of information on agriculture for farmers. The extension officer said:

> I meet farmers on a needs basis, through field days or demonstration since we are few and hence overwhelmed by the big number. I cannot conduct door to door visits, the year might end before reaching majority of farmers

He further stated that their efforts to reach out to farmers with information on agriculture and soil fertility management is constrained by farmer: extension officer ratio, farmer ignorance and minimal resources such as fuel. Farmers are encouraged to seek for information instead of sitting and waiting for extension officers or any other agricultural officers to take the information to them. Worth noting is the low response from Ruchu on extension services. Findings revealed that the area extension officer had recently retired and they were yet to get a replacement. They relied on extension officers from other sub-locations for information and other extension services.

During data collection, respondents were asked to indicate the frequency that they receive information on soil fertility management from extension services and the results are presented below. On average, up to 32% indicated that they received information from extension officers on a monthly basis (Table 4.13 and Table 4.25). This finding agrees with the key informant interview with the extension officer where he indicated visiting farmers on weekly basis for those in farmer support groups or monthly during farm visits and daily for those who farmers who go to see him in office early in the morning before leaving for scheduled field visits. Participant X in the focus group discussion said

> I only see him pass here occasionally on his motor bike, I hope he will come to see my farm

Table 4.13: Frequency of Information from Extension Officers

Period	Frequency	Percent
Daily	3	2.4
Weekly	1	.8
Monthly	40	32.0
Quarterly	26	20.8
Annually	22	17.6
None	33	26.4
Total	**125**	**100.0**

Source: Field Survey 2019

At ward level, Table 4.25 shows that respondents in Ngararia (54.5%) and Ruchu (35%) received information from extension officers on monthly basis whereas 40.6% in Ithiru received information from extension officers annually. Farmers in Nga'raria have access to government extension officer as well as several private extension officers who are advocating for planting of avocados in the area as stated in the FGD. A cooling plant for avocados was said to be under counstruction in Ngararia ward.

4.3.1.2 Farm visits

The respondents were asked if they obtained information on soil fertility during farm visits. The summaries of the responses for the sub-county are presented in Table 4.14. The results showed that 8.8% of the respondents obtained soil fertility information from farm visits whilst 91.2% did not receive soil fertility information from farm visits. This can be attributed to smallholders lack of motivation, being unable to afford to attend the farm visits due to financial and time constraints.

Table 4.14: Farm Visits as Source of Information on Soil Fertility Management

Farm visits	Frequency	Percent
Yes	11	8.8
No	114	91.2
Total	**125**	**100**

Source: Field Survey 2019

At the ward level, Table 4.14, shows that 18.8% of the respondents in Ngararia, 1.7% in Ruchu and 9.4% in Ithiru received sufficient information from farm visits. Further, 66.7% in Ngararia, 38.3% in Ruchu and 50% in Ithiru received relevant information from the farm visits. However, over 81.8% of the respondents indicated that the information received from the farm visits was not attractive. Findings from the focus group discussions confirmed that information from farm visits was unattractive since what they expected most of the time is not what they ended up seeing. "we go hoping to see better farms, only to find worse farms than ours, what is the point of wasting money to go there, nothing worth learning". On attractiveness lady YT said " I once went to Njuguna's farm to see for myself if his farm was better off but to be honest mine was much better and attractive. The color of my crops attract everyone passing by my home, some feel jealous thinking that I have magic to make crops green."

Moreover, 24.2% in Ngararia, 8.3% in Ruchu and 15.6% Ithiru noted that the information received from the farm visits was understandable. The study also found out that 72.7% of respondents in Ngararia, 25% in Ruchu and 31.3% in Ithiru acknowledged that the information received from farm visits were useful. The majority of farmers although in agreement that they learn from the farm visits lamented that when visits are hosted in far places from their homes can be expensive and time consuming and hence they chose to miss them.

Figure 4.13 shows the information received by respondents from farm visits was insufficient (91.99%), relevant (51.2%) unattractive (89.6%) and useful (39.2%). Generally, those finding the information insufficient are those respondents who rarely go on farm visits, while those finding it unattractive are those who indicated that they hoped to see better results in farms they visited only to be disappointed.

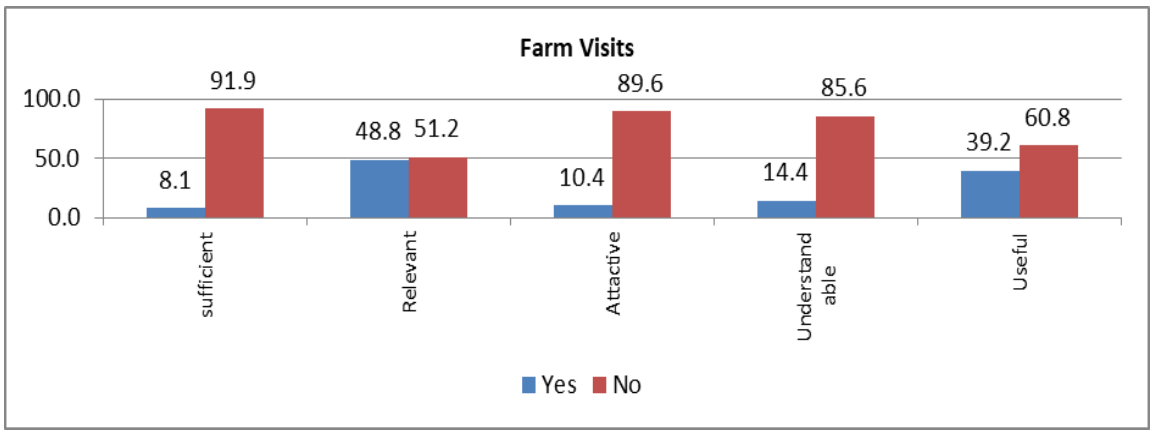

Figure 4.13: Farm visits as source of Information

With regard to farm visits, findings as presented on Table 4.25 shows that majority of respondents in Ngararia (42.4%) and Ruchu (37.5%) received information from farm visits on weekly and quarterly basis respectively whereas 43.8% of the respondents in Ithiru did not receive any information. Overall, a majority of up to 34.4% in the survey area, indicated that they were not receiving information from farm visits (Table 4.15).

Table 4.15: Frequency of Information From Farm Visits

Period	Frequency	Percent
Daily	1	.8
Weekly	15	12.0
Monthly	16	12.8
Quarterly	33	26.4
Annually	17	13.6
None	43	34.4
Total	125	100.0

Source: Field Survey 2019

4.3.1.3 Peers and Neighbours

The respondents were asked whether they obtained information on soil fertility management technologies from their peers. The results are presented below in Table 4.14. Out of the 125 respondents, 4% obtained information on soil fertility management from peers while the

majority (96%) did not obtain the information from their peers and neighbours. Focus group discussion findings indicate that peers are unfriendly and see one as a threat, some neighbours were said to give misleading information on use of inorganic fertilizer, therefore most preferred to seek information from sources that they felt give truthworthy information such as *Mugambo wa Murimi* radio programme or extension officers. Participant LO said "sometimes I ask what he did to overcome fall army worms or green manure use in his farm but he keeps promising to tell me in future. I know he does not want to share the secret".

Table 4.16: Peers and Neighbours as source of information for Soil Fertility Management

Peers	**Frequency**	**Percent**
Yes	5	4
No	120	96
Total	125	100

Source: Field Survey 2019

Table 4.16 shows that 6.1% of the respondents in Ngararia, 1.7% in Ruchu and 6.3% in Ithiru received sufficient information from peers and neighbors. Further, 12.1% in Ngararia, 43.3% in Ruchu and 84.4% in Ithiru received relevant information from the peers and neighbors. However, over 68% of the respondents indicated that the information received from peers and neighbors was not attractive. Moreover, 9.1% in Ngararia, 35.0% in Ruchu and 34.4% Ithiru noted that the information received from the peers and neighbors was understandable. The study also found out that 54.5% of respondents in Ngararia, 83.3% in Ruchu and 53.1% in Ithiru acknowledged that the information received from peers and neighbors were useful. Figure 4.14 gives a presentation of responses where information from peers and neighbours was found to be sufficient at 4%, relevant at 45.6% and useful at 68.0%. This finding agrees with Manfre and Nordehn (2013) who posit that farmers rely heavily on information gathering through often complex social networks such as fellow farmers, family and peers. It also agrees with findings from KII who indicated that peers more often gave misleading information on weather patterns and preparation of animal manure with lady participant complaining

> "my friend once told me to top dress during the dry season to kill weeds, all my seeds failed to germinate"

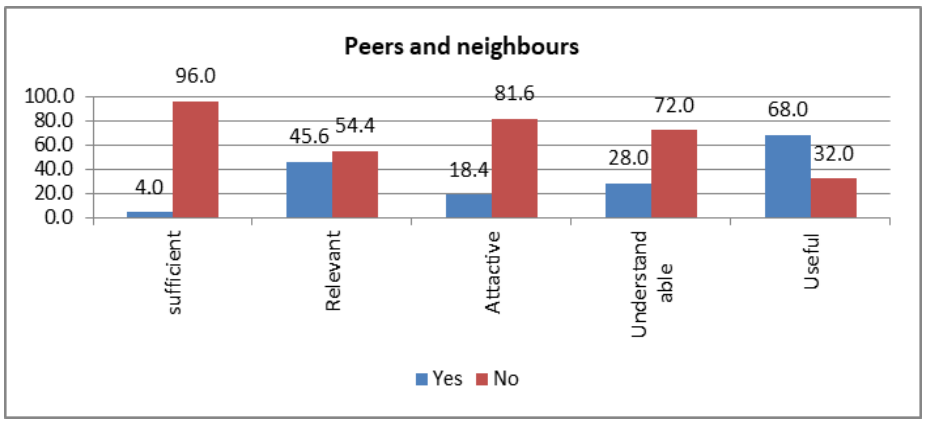

Figure 4.14: Peers and neighbours as Source of information;

Findings revealed that respondents in Ngararia (36.4%) and Ruchu (33.3%) received information from peers and neighbors on weekly basis whereas 37.5% in Ithiru received information from peers and neighbors on monthly basis as presented on Table 4.25 with Figure 4.14 giving a graphical presentation of the ratings. Overall, a majority of up to 27.2% indicated that they were receiving information from peers and neighbors on weekly basis (Table 4.17).

Table 4.17: Frequency of Information From Peers and Neighbours

Period	Frequency	Percent
Daily	11	8.8
Weekly	34	27.2
Monthly	32	25.6
Quarterly	26	20.8
None	22	17.6
Total	125	100.0

Source: Field Survey 2019

4.3.1.4 Radio

Out of 125 respondents, only nine of the respondents indicated that they do not receive information on soil fertility management from radio whilst the majority (116) of the respondents indicated that they receive information on soil fertility information from the radio as shown in Table 4.18. These high numbers can be attributed to radio being accessible to most

smallholder farmers in the study area. Furthermore information on agriculture is broadcast in the local language through *Mugambo wa Murimi*, a programme that majority of the farmers listen to.

Table 4.18: Radio as a Source of Information on Soil Fertility Management

Radio	**Frequency**	**Percent**
Yes	116	93.3
No	9	6.7
Total	125	100

Source: Field Survey 2019

Table 4.18 shows that 39.4% of the respondents in Ngararia, 6.7% in Ruchu and 34.4% in Ithiru received sufficient information from radio. The information, according to the respondents given was not good enough due to the short time the programme airs. Further, 90.9% in Ngararia, 73.3% in Ruchu and 90.6% in Ithiru received relevant information from radio. Although the information was insufficient as earlier indicated, majority said it was very relevant but needed more expansion. Participant NV said "what is said on this programme is good but I get scarce knowledge. If more information would be given I would be contended". The extension in agreement added "oftentimes topics are not exhaustively covered due to limited time."

Figure 4.15 shows that respondents in the study area found information from radio to be insufficient at (77.6%), 82.4% relevant, 37.4% understandable and 76.8% useful. However, over 57% of the respondents indicated that the information received from radio was not attractive. Reason being they only imagine what the presenter says, nothing else, which is in agreement with findings from FGD where farmers blamed radio for the wrong portions when using pesticides. Many are unable to tell the exact portions as explained on radio, which they termed 'quite confusing at times' with respondent SDQ saying

> I once tried to follow procedures of measuring inorganic fertilizer, got it all wrong like I did with those of harvesting animal manure, I had to consult the extension officer to explain more

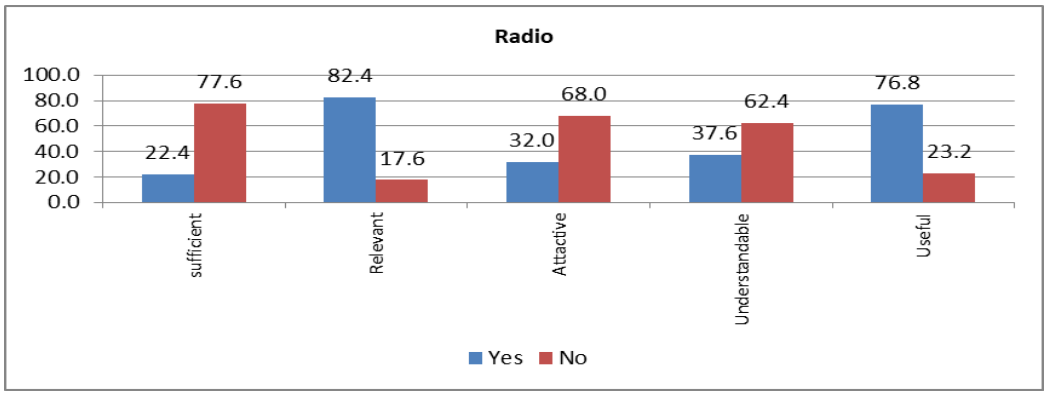

Figure 4.15: Radio as Source of Information on Soil Fertility Management

Findings as presented in Table 4.24 show that 51.5% in Ngararia, 21.7% in Ruchu and 53.1% Ithiru noted that the information received from radio was understandable. The study also found out that 93.9% of respondents in Ngararia, 68.3% in Ruchu and 75% in Ithiru acknowledged that the information received from the radio was useful especially on the topics of planting trees especially the fruit tree hass avocado. Overall this was the best rated source of information with strengths on information being relevant and useful and only needs to be made sufficient to fulfill the information needs of farmers. This agrees with Yahaya (2002) who terms radio as the most potent source of information for farmers and farmers' companions.

On radio, findings revealed that this is the most sought after source of information with findings revealing higher frequencies of accessing information from this medium compared to other sources of information. Table 4.25 shows that the majority of respondents in Ngararia (63.6%) and Ithiru (62.5%) received information from radio on weekly basis whereas 58.3% in Ruchu received information from radio on daily basis. Overall, a majority of up to 52.8% indicated that they were receiving information from radio on weekly basis (**Table 4.19).**

Table 4.19: Frequency of Information From Radio

Period	**Frequency**	**Percent**
Daily	58	46.4
Weekly	66	52.8
Monthly	1	.8
Total	**125**	**100**

Source: Field Survey 2019

4.3.1.5 Television

Television was named as another source of information on agriculture. Respondents were therefore asked whether they obtained information on soil fertility management through watching the television. 87.2% of the respondents reported that they did not received soil fertility information from the television. Out of the 125 respondents, minority (12.8%) reported that they received information on soil fertility from the television (Table 4.20) due to the fact that they do not own television sets while those who own television sets were not aware of programmes discussing issues on soil fertility management.

Findings from FGDs revealed that some areas have no electricity connection to power televisions therefore they felt there was no need of owning televisions. Asked whether they could use alternatives such as solar or batteries, some indicated that these alternative power sources are expensive and beyond their reach.

Table 4.20: Television as source of Information on Soil Fertility Management

Television	Frequency	Percent
Yes	16	12.8
No	109	87.2
Total	125	100

Source: Field Survey 2019

Table 4.20 shows that 39.4% of the respondents in Ngararia, 1.7% in Ruchu and 6.3% in Ithiru received sufficient information from television. Further, 60.6% in Ngararia, 38.3% in Ruchu and 56.3% in Ithiru received relevant information from television. However, over 57.6% of the respondents indicated that the information received from television was not attractive. Moreover, 30.3% in Ngararia, 16.7% in Ruchu and 25.8% Ithiru noted that the information received from the television was understandable. The study also found out that 69.7% of respondents in Ngararia, 63.3% in Ruchu and 40.6% in Ithiru acknowledged that the information received from the television was useful.

Regarding television, findings as shown in Table 4.25 show that in Ngararia, 45.5% respondents, while in Ruchu, 55% respondents and finally in Ithiru, 40.6% of respondents

received information from television on a weekly basis. Overall, 48.8% indicated that they were receiving information from television on weekly basis (Table 4.21).

Table 4.21: Frequency of Information From Television

	Frequency	Percentage
Daily	25	20
Weekly	61	48.8
Monthly	9	7.2
Quarterly	1	0.8
Annually	0	0
None	29	23.2
Total	125	100

Source: Field Survey 2019

4.3.1.6 Print media

This source of information was found to be unpopular source of information on agricultural information and especially on soil fertility management. Respondents were asked to indicate whether they received soil fertility information from newspaper, journals, books or pamphlets. Summaries of the responses are presented in Table 4.22. Out of 125 respondents, the majority 92.8% of the respondents reported that they did not receive soil fertility management information from newspaper, journals or books while 7.2% receive soil fertility information from the new papers especially the *Saturday Nation*.

Table 4.22: Print Media as Source of Information on Soil fertility Management

Print media:News papers, Journals, books	Frequency	Percent
Yes	9	7.2
No	116	92.8
Total	125	100

Source: Field Survey 2019

Findings as presented in Table 4.22 shows that 15.2% of the respondents in Ngararia, 3.3% in Ruchu and 6.3% in Ithiru received sufficient information from print media. Further, 12.1% in Ngararia, 20% in Ruchu and 15.6% in Ithiru received relevant information from print media. However, over 81% of the respondents indicated that the information received from print media was not attractive. Makinen's (2007) observation agrees with this finding that only a few Kenyans can afford to buy newspapers. Other limitations to reading according to findings from KII are unavailability of journals on agriculture on sale in the study area and poor reading culture which makes them find the bulky information on newspapers unattractive.

Figure 4.16 gives the graphical presentation of ratings based on whether print media was found insufficient, relevant or attractive.

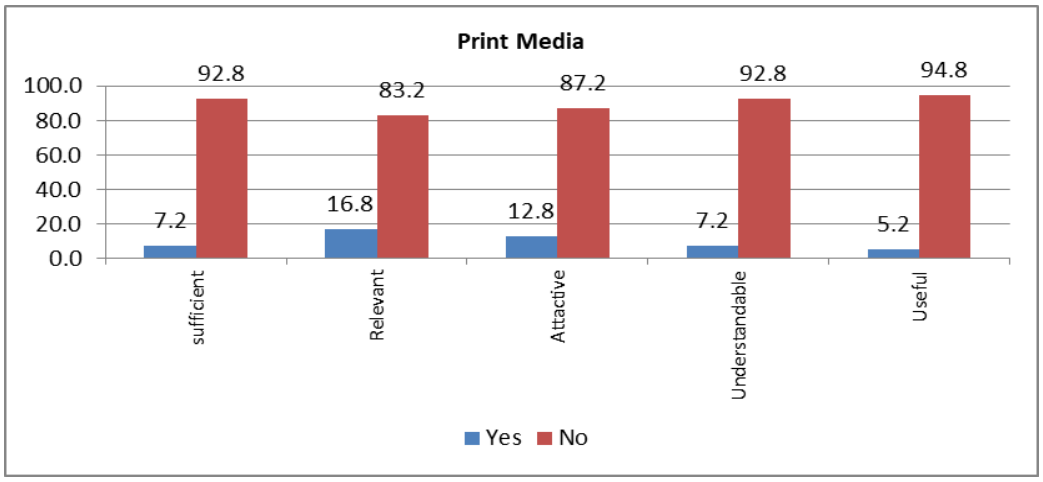

Figure 4.16: Print Media as Source of Information

Findings further as presented in Table 4.24 revealed that information on agriculture from print media was found to be understandable at 12.1% in Ngararia, 5% in Ruchu and 6.3% in Ithiru. Reasons given were that more time is spent reading and analysing the contents in the newspaper and whenever need arises on reference, one can always go back to the newspaper. The study also found out that 12.1% of respondents in Ngararia, 7% in Ruchu and 10.2% in Ithiru acknowledged that the information received from the print media was useful a finding that agrees with studies by Rogers(1995).

Table 4.25 shows that the majority of respondents in Ngararia (91%), Ruchu (51.7%) and Ithiru (75%) indicated that none of them received information from print media. Overall, in the survey area, a majority of up to 68% indicated that they were not receiving information from print media (Table 4.23).

Table 4.23: Frequency of Information from Print Media

Period		Frequency	Percent
	Daily	2	1.6
	Weekly	13	10.4
	Monthly	11	8.8
	Quarterly	3	2.4
	Annually	11	8.8
	None	85	68
	Total	125	100.0

Source: Field Survey 2019

Table 4.24: Sources of Information Presented in Percentage per Ward in the Study Area

Rating	Ward	Extension officers		Farm Visits		Peers and neighbours		Radio		Television		Print Media	
		Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Sufficient	Ng'araria	63.6	36.4	18.8	81.3	6.1	93.9	39.4	60.6	39.4	60.6	15.2	84.8
	Ruchu	6.7	93.3	1.7	98.3	1.7	98.3	6.7	93.3	1.7	98.3	3.3	96.7
	Ithiru	21.9	78.1	9.4	90.6	6.2	93.8	34.4	65.6	6.3	93.8	6.3	93.8
Relevant	Ng'araria	78.8	21.2	66.7	33.3	12.1	87.9	90.9	9.1	60.6	39.4	12.1	87.9
	Ruchu	56.7	43.3	38.3	61.7	43.3	56.7	73.3	26.7	38.3	61.7	20.0	80.0
	Ithiru	75.0	25.0	50.0	50.0	84.4	15.6	90.6	9.4	56.3	43.8	15.6	84.4
Attractive	Ng'araria	18.2	81.8	18.2	81.8	3.0	97.0	42.4	57.6	42.4	57.6	12.1	87.9
	Ruchu	3.3	96.7	6.7	93.3	31.7	68.3	26.7	73.3	31.7	68.3	18.3	81.7
	Ithiru	6.3	93.8	9.4	90.6	9.4	90.6	31.3	68.8	21.9	78.1	3.1	96.9
Understandable	Ng'araria	75.8	24.2	24.2	75.8	9.1	90.9	51.5	48.5	30.3	69.7	12.1	87.9
	Ruchu	10.0	90.0	8.3	91.7	35.0	65.0	21.7	78.3	16.7	83.3	5.0	95.0
	Ithiru	31.3	68.8	15.6	84.4	34.4	65.6	53.1	46.9	25.8	74.2	6.3	93.8
Useful	Ng'araria	78.8	21.2	72.7	27.3	54.5	45.5	93.9	6.1	69.7	30.3	12.1	87.9
	Ruchu	6.7	93.3	25.0	75.0	83.3	16.7	68.3	31.7	63.3	36.7	7.0	93.0
	Ithiru	53.1	46.9	31.3	68.8	53.1	46.9	75.0	25.0	40.6	59.4	10.2	89.8

Source: Field Survey 2019

Table 4.25: Frequency of Information from various Sources of Information Per Ward

Source of information	Frequency	Ng'araria	Ruchu	Ithiru	Total
Extension officers	Daily	0.0	3.3	3.1	2.4
	Weekly	0.0	1.7	0.0	0.8
	Monthly	54.5	35.0	3.1	32.0
	Quarterly	9.2	26.7	21.9	20.8
	Annually	12.1	8.3	40.6	17.6
	None	24.2	25.0	31.3	26.4
Farm Visits	Daily	0.0	1.7	0.0	0.8
	Weekly	42.4	1.7	0.0	12.0
	Monthly	9.1	18.3	6.3	12.8
	Quarterly	12.1	36.7	21.9	26.4
	Annually	9.1	8.3	28.1	13.6
	None	27.3	33.3	43.8	34.4
Peers and neighbours	Daily	18.2	8.333	0	8.8
	Weekly	36.4	33.33	6.25	27.2
	Monthly	9.1	28.33	37.5	25.6
	Quarterly	3.0	18.33	43.8	20.8
	Annually	0	0	0	0
	None	33.3	11.67	12.5	17.6
Radio	Daily	36.4	58.33	34.4	46.4
	Weekly	63.6	41.67	62.5	52.8
	Monthly	0	0	3.1	0.8
	Quarterly	0	0	0	0
	Annually	0	0	0	0
	None	0	0	0	0
Television	Daily	39.4	15	9.4	20
	Weekly	45.5	55	40.6	48.8
	Monthly	0	10	9.4	7.2
	Quarterly	0	1.7	0	0.8
	Annually	0	0	0	0
	None	15.1	18.3	40.6	23.2
Print Media	Daily	3.0	1.7	0	1.6
	Weekly	6.0	13.3	9.4	10.4
	Monthly	0	18.3	0	8.8
	Quarterly	0	3.3	3.1	2.4
	Annually	0	11.7	12.5	8.8
	None	91.0	51.7	75	68

Source: Field Survey 2019

4.3.2 Relevance of Information on various Soil Fertility Management Technologies to Smallholder Farmers

The study collected data to show whether the information received on soil fertility management technologies from different sources was relevant or irrelevant and results presented on **Table 4.26**. Respondents gave their opinion based on the level they agreed that topics on SFM were relevant especially on radio. The information was deemed relevant if it had a positive impact on farm activities and if it did not contribute much to the activities that promote soil fertility then such information was classified irrelevant by respondents.

Table 4.26: Relevance of information on various soil fertility management technologies to smallholder farmers

Farm activities involving SFM	Relevance	Ng'araria	Ruchu	Ithiru	Total
Increase food productivity	Relevant	93.9	98.3	100.0	97.6
	not relevant	6.1	1.7	0.0	2.4
Learn how to prepare animal manure	Relevant	93.9	95.0	84.4	92.0
	not relevant	6.1	5.0	15.6	8.0
Organic and inorganic fertilizer combination knowledge	Relevant	90.9	90.0	78.1	87.2
	not relevant	9.1	10.0	21.9	12.8
Trees and shrubs plantation	Relevant	90.9	85.0	62.5	80.8
	not relevant	9.1	15.0	37.5	19.2
Soil erosion prevention techniques	Relevant	69.7	83.3	78.1	78.4
	not relevant	30.3	16.7	21.9	21.6

Source: Field Survey 2019

Findings reveal that information on various soil fertility management technologies was found to be relevant as it contributed to proper use of animal manure in the three wards at 97.6% (Table 4.26). The information received was also found to relevant in guiding farmers in combining organic and inorganic fertilizers thus increased food productivity. However information on soil erosion prevention techniques was rated lower at 69.7% in Nga'raria. Participant VM said "information on managing soil erosion especially in sloppy areas was irrelevant as it had not helped us prevent soils from being washed downhill whenever it rains heavily." This sentiments were also echored by youth U.

> we need more tact on how prevent chunks of soil being swept away, sometimes it is so serious that huge holes are left behind. Sometimes the water waves during heavy rains are strong that all crops and homesare swept down hill leaving huge gulleys!

4.3.2.1 Rating of various sources of information

Respondents rated information on SFM from various sources based on how they perceived the sources and results are presented below.

Table 4.27: Ratings of sources of information on soil fertility management per ward

Source	Ratings	Ng'araria	Ruchu	Ithiru	Total
Extension officers	poor	27.3	30.0	21.9	27.2
	fair	12.1	5.0	15.6	9.6
	good	51.5	43.3	18.8	39.2
	best	3.0	20.0	28.1	17.6
	excellent	6.1	1.7	15.6	6.4
Farm Visits	poor	36.4	41.7	24.9	36.0
	fair	42.4	15.0	25.0	24.8
	good	12.1	30.0	21.9	23.2
	best	3.0	11.7	18.8	11.2
	excellent	6.1	1.7	9.4	4.8
Peers and neighbours	poor	39.5	20.0	12.5	23.2
	fair	54.5	41.7	34.4	43.2
	good	3.0	23.3	46.9	24.0
	best	0.0	15.0	3.1	8.0
	excellent	3.0	0.0	3.1	1.6
Radio	poor	0.0	0.0	3.1	0.8
	fair	36.4	8.3	3.1	14.4
	good	12.1	65.0	50.0	47.2
	best	9.1	25.0	34.4	23.2
	excellent	42.4	1.7	9.4	14.4
Television	poor	15.2	25.0	37.5	25.6
	fair	51.5	16.7	28.1	28.8
	good	3.0	46.7	25.0	29.6
	best	0.0	11.6	6.3	7.2
	excellent	30.3	0.0	3.1	8.8
Print Media	poor	87.9	61.7	71.9	71.2
	fair	6.0	33.3	15.6	21.6
	good	0.0	5.0	9.4	4.8
	best	0.0	0.0	3.1	0.8
	excellent	6.1	0.0	0.0	1.6

Source: Field Survey 2019

It was important for the researcher to know how information from sources were perceived by respondents to get to know where radio the media being studied is perceived by respondents.

The overall rating (**Table 4.27)** showed that information from extension officers, and television were rated good at 39.6% and 29.6% respectively, information from farm visits and print media were rated poor at 36% and 71% respectively whereas information from peers and neighbors was fair at 43.2%. However due to the infrequency of information other sources which were rated relatively low, information from radio was found to be more reliable as it provided them with information frequently where 14.4% rated it fair, 47.2% good, 23.2 best while 14.4% rated it as the best source of information.

Respondents who listen to Inooro FM indicated that they received information on various topics on agriculture on weekly basis from *Mugambo wa Murimi* radio programme. This agrees with the information from the interview with Inooro FM's program officer who indicated that the programme airs every morning at 7:50am with a repeat in the evening between 7:40pm and 8:00pm making it the most frequent source of information for smallholder farmers in the study area.

4.4 Farmer's Perception of *Mugambo Wa Murimi* radio programme on SFM technologies

The study collected data on farmer's perception of *Mugambo Wa Murimi* programme on SFM technologies in the study area and the results are presented in the section below.

4.4.1 Listening to *Mugambo wa Murimi* radio programme

The study collected data on radio ownership and whether the respondents were listening to *Mugambo wa Murimi* radio programme through any other types of devices as well as the frequency of listening to this programme and the results are presented in Table 4.28 and Figure 4.17- 4.19. This information was vital as it was important for the researcher to know that farmers have gadgets to access information from *Mugambo wa Murimi* radio programme.

Table 4.28: Radio Ownership

Ward	Yes	No
Ng'araria	100	0
Ruchu	100	0
Ithiru	100	0
Total	100	0

Source: Field Survey 2019

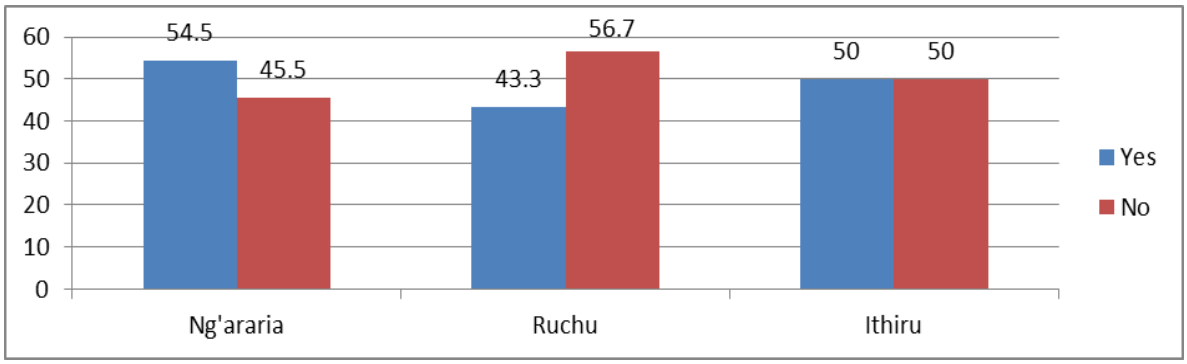

Figure 4.17: Listening to MWM radio programme using other devices per ward

Table 4.28 shows that all of the farmers owned radios in Ngararia, Ruchu and Ithiru wards of Kandara sub-county. Figure 4.17 indicated that of the total respondents, 54.5% in Ngararia, 43.3% in Ruchu and 50% in Ithiru indicated that they can also access radio using other devices such as mobile phones and televisions . Overall, in the survey area, Figure 4.18 shows that 48% of the respondents listened to the radio programme *Mugambo wa Murimi* using other devices. This finding is in agreement with that of Bussart (2007) whose study revealed that radio can be listened to through many modern devices such as phones.

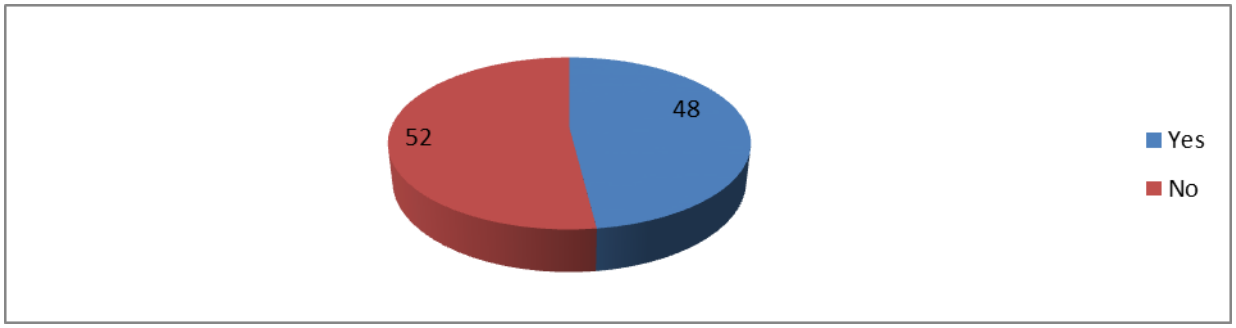

Figure 4.18: Listening To *Mugambo Wa Murimi* Radio Programme Using Other Devices

On radio listernship, Table 4.29 shows that majority of farmers in Ngararia (42%), Ruchu (60%) and Ithiru (34%) listened to *Mugambo wa Murimi* radio programme whenever it was aired while 57.6%, 38.3% and 59.4% in Ngararia, Ruchu, and Ithiru respectively listened to radio on a weekly basis. In overall, Figure 4.19 shows that 98% of the respondents listened to *Mugambo wa Murimi* programme either weekly or whenever it was aired.

Table 4.29: Frequency of listening to radio per ward

Ward	Whenever it is Aired	Weekly	Monthly	Totals
Nga'araria	14	19	0	33
Ruchu	36	23	1	60
Ithiru	11	19	2	32
Total	61	61	3	125

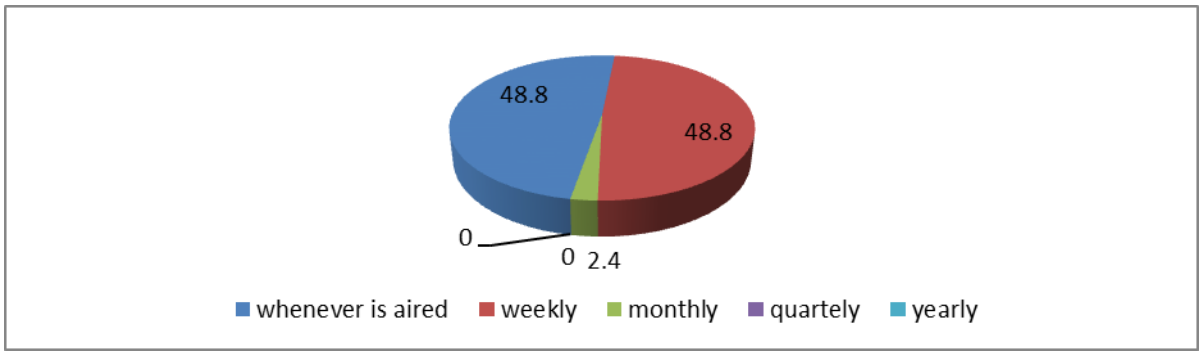

Figure 4.19: Frequency of Listening to Radio in the Study Area

4.4.1.1 Respondents' Opinion on the Radio Programme *Mugambo wa Murimi*

The study sought to find out whether the respondents found it useful listening to the programme and whether the programme was worth their time.

Findings revealed that respondents in Ngararia (30), Ruchu (60) and Ithiru (28) regarded MWM radio programme worth their time to listen (Table 4.30). This translated to an overall

percentage of over 97.6% of respondents who said that listening to *Mugambo wa Murimi* radio programme was worth their time (Figure 4.20).

Table 4.30: Worthiness of Listening to *Mugambo wa Murimi* Radio Programme per ward

Ward	Yes	No	Total
Ng'araria	32	1	33
Ruchu	60	0	60
Ithiru	30	2	32
Total	118	7	125

Source: Field Survey 2019

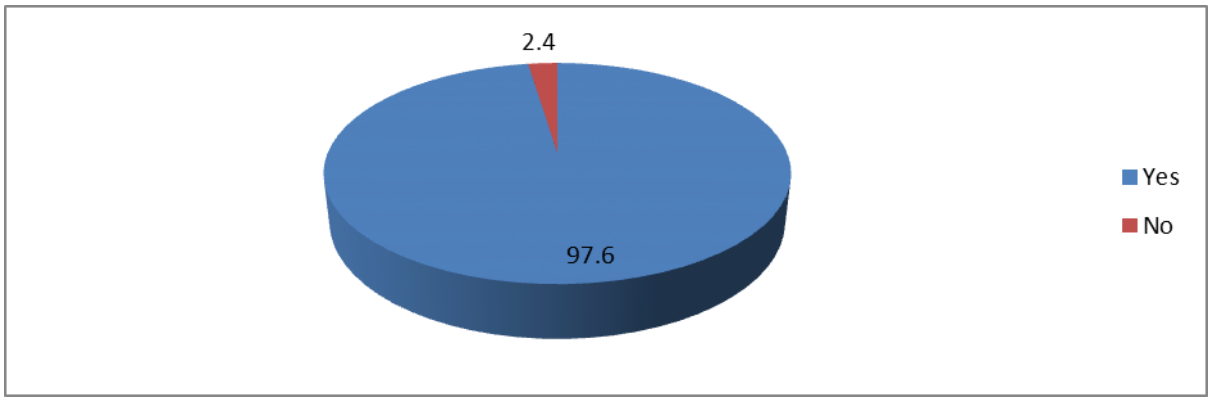

Figure 4.20: Worthiness of Listening to Mugambo *wa Murimi* in the study area

4.4.1.2 Motivation for Listening to the Programme *Mugambo wa Murimi*

The researcher asked respondents the motivation behind listening to the programme *Mugambo wa Murimi*. It was important to get the real reason behind listening to this programme whether it was just the advertisements that are run in the course of the programme or the content on agriculture.

Findings revealed that all the respondents were motivated to listen to *Mugambo wa Murimi* programme because of its content on agriculture (Table 4.31 and Figure 4.21) whereas very few respondents (39.4% in Ngararia, 6.7% in Ruchu and 9.4% in Ithiru) indicated that they were motivated to listen to the programme because of advertisements (Figure 4.22). Participants this to say.

Advertisements on farm inputs such as fertilizers, seeds confuse us since each marketer claims their fertilizer or seeds work better than their competitor's. Every seller wants us to buy their fertilizer, how do we know if all are lying or telling the truth, the programme should save us this confusion by allowing only one advertiser

The table below presents respondents' motivation for listening to the programme in the study area based on content. The Figures presents findings in percentages on motivation based on advertisements aired in the course of the programme.

Table 4.31: Motivation to Listen to Programme *Mugambo wa Murimi* based on Content on Agriculture

Ward	Yes	No
Nga'araria	100	-
Ruchu	100	-
Ithiru	100	-

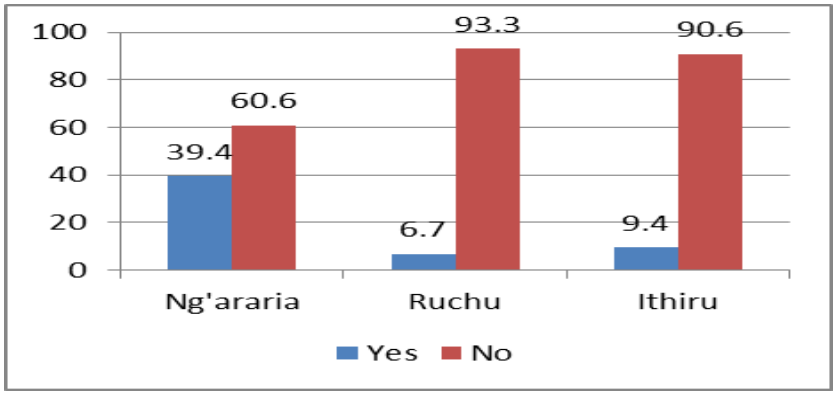

Figure 4.21: Motivation to listen to *Mugambo wa murimi based* on advertisements

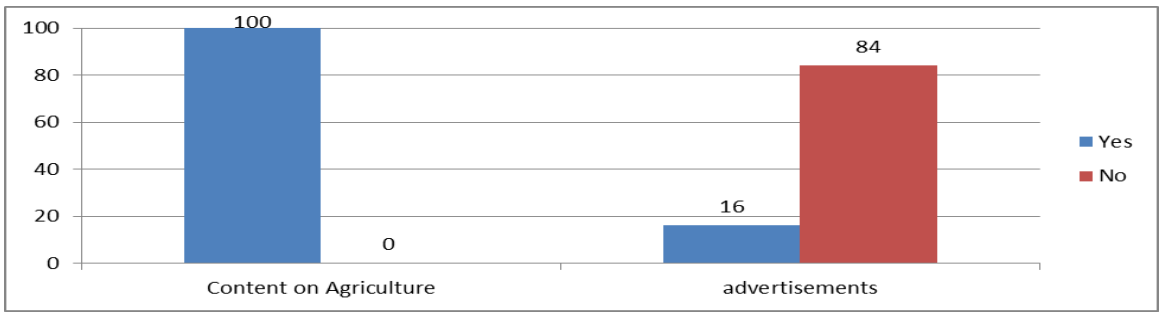

Figure 4.22: motivation to listen to *Mugambo wa murimi based on* content on agriculture and advertisements

4.4.2 Information received on SFM technologies

The study was interested in knowing whether respondents received information on soil fertility management technologies through the radio programme *Mugambo wa Murimi.*

Table 4.32 this confirms that indeed farmers receive information on various soil fertility management technologies through the programme *Mugambo wa Murimi*. Although those in focus groups contradicted this by saying that some SFM technologies were just mentioned but not discussed and those discussed were presented fast hence the topics are not well covered. Farmer Y said;

> Wanapitia juu juu hata hatushiki sana kama ile ya cowdung, walisema tuoshe nyumba ya ng'ombe mara ngapi kwa wiki?

Table 4.32 shows that 69.7% of the respondents in Ng'araria received information on green manure while 50% and 12.5% of the respondents in Ruchu and Ithiru respectively received information on green manure. Overall only 45.6% of the respondents acknowledged receiving information on green manure from *Mugambo wa Murimi* programme.

Regarding animal manure, majority of respondents, (65.6% in Ngararia, 95% in Ruchu and 87.5% in Ithiru) had received the information through *Mugambo wa Murimi* programme. The total percentage of respondents who had received information on animal manure was 85.5% in the study area.

Regarding cover crops, Table 4.32 shows that majority of respondents in Ngararia (69.7%) and Ruchu (68.3%) had received the information from *Mugambo wa Murimi* while 84.4% of respondents in Ithiru indicated that they had not received any information on cover crops. Based on Table 4.32, findings show that up to 55.2% of the respondents had received information on cover crops.

As indicated in Table 4.32, the study found that the majority of respondents in Ruchu (80%) had received information related to agroforestry compared to Ngararia (57.6%) and Ithiru (50%) and this translated to 66.4% of the respondents who had received agroforestry information in the study area . Moreover, over 80% of the respondents in Ngararia and Ruchu had received information on mulching compared to 46.9% of the respondents in Ithiru. This

means that up to 72% of the respondents in the study area had received information on mulching from *Mugambo wa Murimi*.

Notably, Table 4.32 shows that a higher number of respondents agreed that they received information on compost making in Ngararia (63.6%), Ruchu (70%) and Ithiru (81.3%) which meant that over 71.2% of the respondents had received the information on compost making from *Mugambo wa Murimi* programme in the study area. Further, Table 4.32 indicates that less than 50% of the respondents had received information on crop rotation from *Mugambo wa Murimi* programme in Ngararia compared to 78.3% in Ruchu and 65.6% in Ithiru. This meant that over 66.4% of respondents in the study area in Kandara sub-county had received information on crop rotation from *Mugambo wa Murimi* programme

Overall, in the study area, respondents agreed that they received information on various soil fertility management technologies from *Mugambo wa Murimi* radio programme.

Table 4.32: Information received on SFM technologies on *Mugambo Wa Murimi* radio Programme per Ward

SFM technologies	Response	Ng'araria(%)	Ruchu(%)	Ithiru(%)
Information on green manure	Yes	69.7	50.0	12.5
	No	30.3	50.0	87.5
Information on animal manure	Yes	65.6	95.0	87.5
	No	34.4	5.0	12.5
Information on cover crops	Yes	69.7	68.3	15.6
	No	30.3	31.7	84.4
Information on agroforestry	Yes	57.6	80.0	50.0
	No	42.4	20.0	50.0
Information on mulching	Yes	81.8	80.0	46.9
	No	18.2	20.0	53.1
Information on compost	Yes	63.6	70.0	81.3
	No	36.4	30.0	18.8
Information on crop rotation	Yes	45.5	78.3	65.6
	No	54.5	21.7	34.4

Source: Field Survey 2019

The researcher also learnt through the KIIs that other than topics on soil fertility management, content on cattle keeping, pig rearing, chicken rearing and information on availability of markets for produce are among other topics discussed on the programme. These sentiments concur with those of focus groups where farmers mentioned topics covered on the programme as those touching on availability of government subsidised fertilizer, chicken rearing, weather and rabbit rearing for production of garden fertiliser.

Farmers in focus groups proposed that the topics be discussed in detail especially on green manure which they said need it more often during the rainy season to remind them on green manure preparation. They had this to say.

> When there is so much rain shrubs and leaves are in plenty, we can use this to make manure, we are able to plant more trees when it rains. Trees grow fast during the rainy season, so constant reminders help us at our age, we need these frequent reminders

4.4.2.1 *Mugambo Wa Murimi* Radio Programme Coverage of Topics on SFM

The study sought to know from respondents whether the topics on SFM are sufficiently covered and whether the information was well understood. The results as presented on Table 4.33. Table 4.33 shows that majority of the respondents in Ngararia (66.7%), Ruchu (81.7%) and Ithiru (87.5) received relevant but insufficient information on soil fertility management. Further, Table 4.33 indicates that majority of respondents in Ngararia (81.8%), Ruchu (85%) and Ithiru (78.1%) understood the information on soil fertility management. However findings from FGDs suggest otherwise, with most of the farmers saying the information was not well understood as it was insufficient as the time was not enough to explain all the details as concerning the SFM technologies and hence they proposed that the programme be allocated more time. On relevance both the respondents and participants concur that information aired on the programme is relevant.

Table 4.33: Sufficiency and Understanding of Information on Soil Fertility Management per ward on MWM

Information on soil fertility management	Response (%)	Ng'araria	Ruchu	Ithiru
Insufficiency of information on *Mugambo Murimi* radio programme	Yes	66.7	81.7	87.5
	No	33.3	18.3	12.5
Understanding of information on Mugambo wa Murimi	Yes	81.8	85.0	78.1
	No	18.2	15.0	21.9

Source: Field Survey 2019

4.5 Perceived Effects of *Mugambo wa Murimi* programme on farming practices Relating to Adoption of SFM technologies

4.5.1 Influence of *Mugambo wa Murimi* Radio Programme

This study sought to find out whether the programme *Mugambo wa Murimi* had prompted the respondents to practice the information they heard on the programme on select SFMs namely; compost making, use of crop residues, preparation of animal manure, organic farming, proper farming methods and agroforestry. Results are presented in Table 4.34 and Figure 4.23. Further, the respondents were to indicate whether any challenges were encountered in course of implementing what they heard on the programme on SFMs. Table 4.34 and Figure 4.23 present results on SFM practiced after listening to the programme *Mugambo wa Murimi*.

As shown in Table 4.34, the study found that the respondents who practiced compost making after hearing about it on *Mugambo wa Murimi* were 72.7% in Ng'araria, 65% in Ruchu and 40.6% . Further, out of the total respondents in the study, 84.8% in Ngararia, 66.7% in Ruchu and 28.1% in Ithiru indicated that they utilised crop residue after hearing abou it on *Mugambo wa Murimi*. Moreover, 87.9%, 88.3% and 78.1% of the respondents in Ng'araria, Ruchu and Ithiru respectively, were found to be preparing animal manure basing on information heard on the programme.

Regarding organic farming, the majority of respondents in Ngararia (84%) of the respondents practiced organic farming compared to less than 50%(Table 4.34) in both Ruchu and Ithiru wards of Kandara sub-county.

Moreover as shown in Table 4.34, 76.7% of the respondents in Ruchu practiced agroforestry compared to less than 50% in both Ngararia and Ithiru ward. Figure 4.23 shows that out of the total respondents in the study area, 60.8% said they practise compost making, 61.6% utilised crop residues, 85.6% used animal manure, 55.2% practiced organic farming, 87.2% adopted proper farming methods while 57.6% were undertaking agroforestry as a result of hearing the information on *Mugambo wa Murimi* radio programme. This result agrees with what was said in the FGDs where those who were already using locally available SFM technologies indicated improving on preparation of manures. For many years they had prepared it in the same way assuming that it was how it is done. Majority in FGDs also agreed that adopting use of organic SFM has been beneficial to them after continuous encouragement from the programme. Participant TY and Farmer SI had this to say.

Is there any technique in gathering manure other than just sprinkling it on farms, we have done it for long"
There are so many benefits like consuming vegetables freeof chemicals from inorganic fertilizers to living a healthierlife.

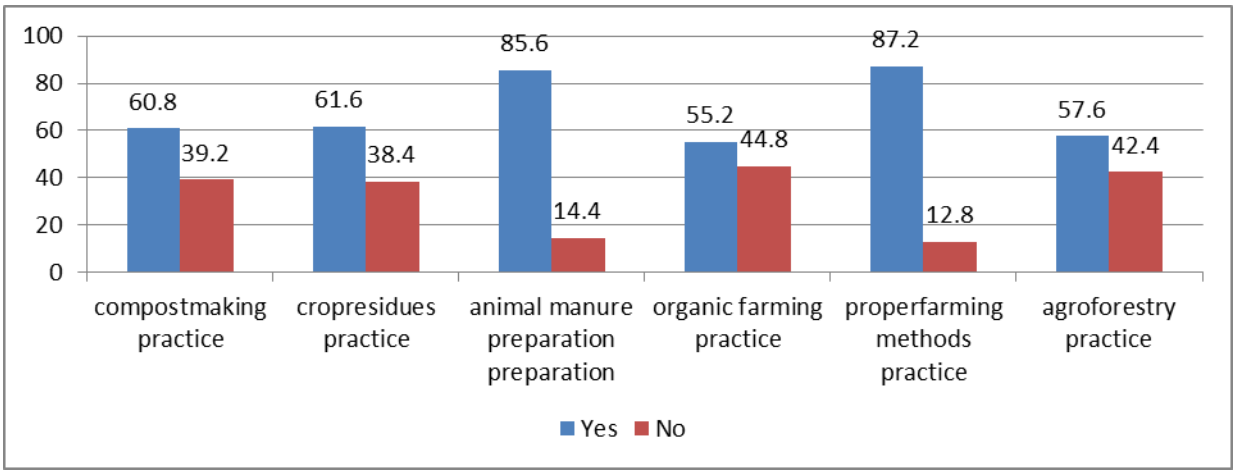

Figure 4.23: SFM Practiced From Information Received On *Mugambo Wa Murimi*

On challenges, the majority of respondents said that they were faced with challenges of estimating the ratios of SFM technologies. From the KIIs, the agricultural officers indicated that many farmers are reminded of the ratios but they keep forgetting about this. It was revealed that farmers were very economical when using fertilizer, many apply very little hoping to see wonders instead of applying as advised on radio or by the agricultural officials. The extension officer had this to say.

> Oftentimes we remind them of the ratios to be used
> but we realise this was not followed" retorted the officer.

The other challenge as revealed by respondents is that of mixed information from advertisements on *Mugambo wa Murimi* programme. From the FGDs, respondents stated that too much information on some occasions had resulted in them not being able to implement what they hear on the programme.

Table 4.34: SFM Uptake From Information Received On *Mugambo Wa Murimi*

SFM technology	Response	Ng'araria	Ruchu	Ithiru
Compost making practice	Yes	72.7	65.0	40.6
	No	27.3	35.0	59.4
Crop residues practice	Yes	84.8	66.7	28.1
	No	15.2	33.3	71.9
Animal manure preparation	Yes	87.9	88.3	78.1
	No	12.1	11.7	21.9
Organic farming practice	Yes	84.8	46.7	40.6
	No	15.2	53.3	59.4
Proper farming methods practice	Yes	93.9	91.7	71.9
	No	6.1	8.3	28.1
Agroforestry practice	Yes	45.5	76.7	34.4
	No	54.5	23.3	65.6

Source: Field Survey 2019

4.5.2 Sharing of information heard on *Mugambo wa Murimi* radio programme

The researcher was interested in knowing whether the information received from *Mugambo wa Murimi* programme was communicated to fellow farmers, workers on the farm, neighbours, on farm visits and via social media.

Table 4.35 shows that 72.7%, 88.3% and 65.6% of the respondents received information on SFM technologies from radio and shared with fellow farmers in Ngararia, Ruchu and Ithiru respectively. Moreover, information received on SFM technologies on Mugambo wa Murimi was shared with workers on the farm and accounted for by 72.7% in Nga'raria, 88.3% in Ruchu and 37.5% in Ithiru. The respondents in Ngararia (27.3%), Ruchu (81.7%) and Ithiru (68.8%) also indicated that they received information about SFM technologies and shared with their neighbors although they have little confidence in them. The information from the programme was said to be more reliable and trustworthy since they heard on Mugambo wa Murimi a programme many believe in unlike that from peers, hence was shared more confidently compared to sharing information from peers or neighbours.

The respondents in Ngararia (54.5%), Ruchu (43.3%) and Ithiru (37.5%) also said that they had received information on SFM technologies from the programme but had not shared the information during farm visits. This can be attributed to non attendance of farm visits especially when the farm visits are far from their homesteads, many find it costs. More than 88% in Ngararia, Ruchu and Ithiru noted that they had received information about SFM technologies but had not shared via mobile phone and social media since majority do not use social media.

Table 4.35: Sharing of Information on SFM Technologies received from MWM Programme

Variable	Response	Ng'araria	Ruchu	Ithiru
Fellow farmers	Yes	72.7	88.3	65.6
	No	27.3	11.7	34.4
Workers on farm	Yes	72.7	88.3	37.5
	No	27.3	11.7	62.5
Neighbors	Yes	27.3	81.7	68.8
	No	72.7	18.3	31.3
Others on farm visits	Yes	54.5	43.3	37.5
	No	45.5	56.7	62.5
Through mobile phone and social media	Yes	9.1	11.7	9.4
	No	90.9	88.3	90.6

Source: Field Survey 2019

Overall, Figure 4.24 shows that most of the respondents had shared information with fellow farmers 78.4%, workers on the farm 71.2% and neighbors 44.8%.

On the contrary, few respondents had shared information received via *Mugambo wa Murimi* on SFM technologies through mobile phone and social media 10.4%, farms visits 44.8% in Kandara sub-county.

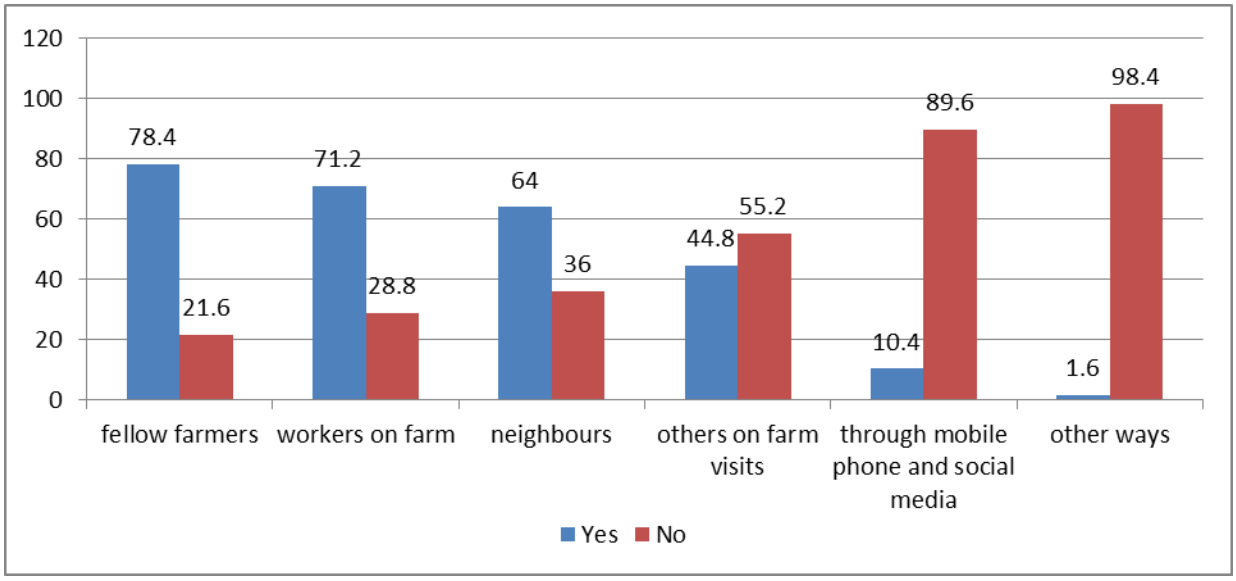

Figure 4.24: Sharing of Information on SFM Technologies Received From *Mugambo Wa Murimi* Radio Programme

4.5.3 Search for More Information on Listening to *Mugambo wa Murimi* Programme

It was important for this study to know the effects the programme has on other channels of communication. Respondents were therefore asked to indicate whether they seek for more knowledge and information from other sources of information to fill in information gaps brought about by the programme *Mugambo wa Murimi*. The results are presented in Table 4.36.

As shown in Table 4.36, 66.7%, 86.7% and 37.5% of the respondents in Ngararia, Ruchu and Ithiru respectively indicated that *Mugambo wa Murimi* programme prompted them to seek more knowledge on SFM from extension officers. Further, 69.7%, 86.7% and 56.3% of the respondents in Ngararia, Ruchu and Ithiru respectively sought more knowledge from farm

visits and field days after listening to *Mugambo wa Murimi*. Only 54.5%, 46.7% and 15.6% of the respondents in Ngararia, Ruchu and Ithiru respectively sought more knowledge from ASK. Worth noting, is that less than 44% of the respondents in Ngararia, Ruchu and Ithiru indicated that they sought more knowledge from seminars and marketers who sell fertilizers. Table 4.36 shows that 68.8% and 74.4% of the respondents in the study area sought knowledge from extension officers and farm visits/field days respectively.

However, as indicated in Table 4.36, 59.2%, 66.4% and 72.8% of the respondents in the study area indicated that they did not seek more knowledge from ASK, seminars and marketers who sell fertilizers respectively after listening to *Mugambo wa Murimi*. ASK shows were said to be expensive and inaccessible to many smallholders.

> I cannot afford to go to Nairobi show, it is quite far, at my age let me get information from *Mugambo*" complained farmer VB.

Marketers of farm inputs according to focus group discussions were said to mislead farmers for their own selfish gains therefore most respondents felt their information was not trustworthy Regarding seminars very few recalled attending any seminar on agriculture in the recent past. Farmer LO lamented.

> We get rare invites to seminars, here and outside Kandara

Table 4.36: Information Seeking Behaviour of Respondents After Listening MWM

Source of Information	Response	Ng'araria	Ruchu	Ithiru
From extension officers	Yes	66.7	86.7	37.5
	No	33.3	13.3	62.5
From farm visits and filed days	Yes	69.7	86.7	56.3
	No	30.3	13.3	43.8
From ASK	Yes	54.5	46.7	15.6
	No	45.5	53.3	84.4
From seminars	Yes	27.3	33.3	40.6
	No	72.7	66.7	59.4
From marketers who sell fertilizers	Yes	6.1	43.3	18.8
	No	93.9	56.7	81.3

Source: Field Survey 2019

4.5.3.1 Follow up on SFM Information on other Media Platforms

The researcher sought to find out whether respondents were prompted to follow up on topics on SFM discussed on *Mugambo wa Murimi* programme in other media platforms such as television, social media, journals, books and newspapers. The results are presented in Table 4.37.

Findings as presented in Table 4.37 show that 97% in Nga'raria, 88% Ruchu and 87.5% in Ithiru did not make a follow up on topics discussed on *Mugambo wa Murimi* on SFM on social media. Follow up on print media was the lowest with 3%, 15% and 6.2% of respondents in Nga'raria, Ruchu and Ithiru seeking for more information from newspapers. Like the "Saturday Nation" shouted farmer TU. Many participants in the FGDs kept mentioning the Saturday Nation as having content that is helpful in farming.

The majority of respondents in Nga'araria (97%) followed up on information on SFM on *Mugambo wa Murimi* by watching farmer television programmes. Ruchu and Ithiru ward respondents recorded follow up on television at 45% and 50% respectively.

Table 4.37:Follow up information on SFM on Other Media Platforms

Media Platforms	Response	Ng'araria	Ruchu	Ithiru
Social media	Yes	3.0	11.7	12.5
	No	97.0	88.3	87.5
News papers	Yes	3.0	15.0	6.2
	No	97.0	85.0	93.8
Television	Yes	97.0	45.0	50.0
	No	3.0	55.0	50.0

Source: Field Survey 2019

From the aforementioned, it is clear that information is available and farmers are accessing information on SFM through *Mugambo wa Murimi* radio programme, however, there exist gaps between level of information received and implementation at farm level. The observation is consistent with Mu et al., (2018), who state that gaps between information dissemination and level of implementation could be as a result of subjective limits or considerations of factors that impact profit and or/ cost in adoption of technologies.

Factors that lower profits or increase expenses are sources of risk (technical, price, legal, social and human), that adversely impact the economic performance hence farmers' decision making (Bailey, 2001; Ullah, Shivakoti, Zulfiqar, & Kamran, 2016). The finding underscores Howden et al. (2007) and Koundouri et al. (2019**)** observation that policy makers need to pay attention to the role of risk attitude in technology adoption. Though information is critical in uptake of technologies, other farmer characteristics such as risk attitude are equally critical in programming.

CHAPTER FIVE

SUMMARY, CONCLUSION & RECOMMENDATIONS

5.0 Overview

This section summarises the findings of this study based on the objectives. Consequently, the study aimed at suggesting possible solutions to the constraints identified based on the study's findings. Conclusions arrived at and recommendations based on information from respondents made thereof are summarised. Finally, areas for further research are proposed.

5.1 Summary

The study found that the majority of farmers are male (56.5%) aged 50 years with less than 10% of farmers being 25 years or younger. Over 50% had secondary or above level education. Although most own more than an acre of land at 63.2% the majority of those in the study area 60.8% had allocated less than an acre to farming due to among other reasons increased population, change of land uses and urbanisation.

Results also revealed that farm decisions concerning agriculture are made jointly by both husband and wife by 36.8% of the respondents, compared to those made by either couple separately; wife (20%) or husband (29.6%). This particular reason contributes to frequent communication among couples in the study area translanting to more farm decisions on SFM. Being small holder farmers a large number practice integrated farming. It was revealed that 99.2% plant food crops, 90% plant cash crops while 48% rear chicken and 62.4% rear livestock. Food crops such as beans, maize, peas, fruits and vegetables are common in most farms, while tea, coffee and avocado especially the Hass variety are the main cash crops. This finding reveals that the study area is at least food secure because the majority of respondents want to meet their food needs through planting it in their own farms.

On media use in communicating information on soil fertility, the findings revealed various strengths and weaknesses of various sources. Though a traditional media that has been used for decades, extension in the study area was ranked unreliable by many farmers who are not able to access the officers as often as they would wish to. Given the high number of farmers, extension

services can be integrated into radio for the benefit of farmers by linking the source and the end user, that is the extension and the farmer by use of the programme *Mugambo wa Murimi*. This can be done in two ways as explained below.

The extension officers can encourage farmers to listen to *Mugambo wa Murimi* programme, either in their own homes or in groups. After each programme, they can set a meeting to discuss the contents of the SFM aired, answer each other's questions and decide whether any action can be taken in response to the information they have heard. They can also stimulate smallholder farmer's habit of listening to *Mugambo wa Murimi* radio programme, and the expectation of gaining useful information from it.

The other way is to have the *Mugambo wa Murimi* radio producer localise the programmes on soil fertility management by engaging agricultural officers within the locality to become more closely involved in content production especially of topics on soil fertility. Extension officers can help make the information on SFM attractive by sending information and stories to the producers of the programme and by inviting them to interview farmers in Kandara sub-county who have successfully improved their farms using SFMs and report on upcoming farm visits and agricultural shows.

Radio is a useful mass medium and was found to be the best medium for spreading awareness of SFM to large numbers of smallholder farmers. As revealed by the findings, the majority of smallholder farmers own the radio sets or gadgets and use them to listen to the programme *Mugambo wa Murimi.*

Despite the limitation of programmes being inflexible and the casual way in which farmers generally listen to radio it still remains as the best source of information in Kandara sub-county. The reason being that programmes are being tailored to remain relevant to the problems being faced. And this can further be improved if farmers are taught how to record the programmes using their phones and to listen to them later.

With an advantage of combining vision with sound, television is a medium that can transmit information on SFM directly to a mass audience in Kandara sub-county. However, television transmission and sets are still restricted to areas with electricity and to those who can afford to buy the set and pay subscription since most television channels airing agricultural content are not free of charge.

Print media that combines words, pictures and diagrams to convey accurate and clear information could have made them one of the best sources of information on soil fertility management in the study area. This is because of their great advantage in that farmers can look at them for as long as they wish, and can refer to them again and again. This source was however rated as a poor source of information due to unaffordability, unavailability and probably lack of reading and writing skills on the side of those illiterate. Print media are of little use if they are not affordable, distributed and cannot be read and understood.

Concerning accessing the programme *Mugambo wa Murimi*, 100% of farmers indicated that they own radios while 48% said that they can listen to radio using alternative devices like the mobile phone. 48% listen to the programme on a weekly basis or whenever it is aired. Most farmers indicated that they have benefited from this programme in one way or the other with others positing that they have been able to grow mushrooms, new pepino mellon variety and grafted passion fruits, learnt of new fertilizer varieties by listening to the programme.

5.1.1 Sources of information on soil fertility management for smallholder farmers in Kandara sub-county

This objective was to determine sources of information on soil fertility management for smallholder farmers. Farmers in the study area have access to a myriad of information sources. These include agricultural extension officers both public and private, peers, neighbours, print and electronic media such as radio. However, the radio is the most ubiquitous source of information that is accessible across the socio-economic strata with at least 80% of the respondents rating the radio positively as a source of information and robustness of the radio (48% could access radio through other devices such as mobile phones). Use of vernacular language in broadcast makes it easy for farmers to grasp information on SFM.

5.1.2 Relevance of information on soil fertility management technologies to smallholder farmers in Kandara sub-county aired on radio

The second objective was to assess the relevance of information on soil fertility management technologies to smallholder farmers in Kandara sub-county aired on radio. Majority of farmers considered the information on SFM technologies relevant as they noted increase in food productivity, learned how to prepare animal manure, how to combine organic and inorganic fertilizers for farm use and acquired knowledge on how to plant trees and shrubs for use as organic fertilizers. Overall, the information on soil fertility management technologies was found relevant in terms of increasing food productivity, learning how to prepare animal manure, organic and inorganic fertilizer combination knowledge on trees and shrubs and soil erosion prevention techniques respectively. However, farmers felt that the information was too basic and they needed more details.

5.1.3 Smallholder farmers' Perception of *Mugambo wa Murimi* radio programme on information on soil fertility management technologies in Kandara sub-county

The study assessed the farmer's perception in terms of how often they listen to the programme, whether they found it useful or worth their time and the motivation behind listening to it. Overall, 97 % of the farmers found *Mugambo wa Murimi* radio programme useful with 79% among those who found it useful rating information through it on agroforestry and compost as relevant against 89 % for green manure. Overall, 61% of the respondents regularly listened to *Mugambo wa Murimi* radio programme whenever it was aired but the percentage increased to over 92% when regularity of listenership is not taken into account. However, advertisement accounted only for 22% of the motivation for listening to *Mugambo wa Murimi* with content on agriculture being the real motivation as to why they listen to *Mugambo wa Murimi*. Although the content on SFM aired on *Mugambo Wa Murimi* was in some cases found to be insufficient it prompted them to seek for more information from other sources such as extension, television and peers.

5.1.4 Perceived effects of *Mugambo wa Murimi* Radio Programme on uptake of information on soil fertility management technologies in Kandara sub-county.

This last objective assessed the perceived effects of this programme on uptake of information on soil fertility management technologies in Kandara sub-county. The influence of *Mugambo wa Murimi* on soil fertility technologies uptake from studies is significant in that farmers indicated that they have been able to practice what they heard on the programme, and that they shared the information with neighbours, workers and peers. Further, when the information heard on *Mugambo wa Murimi* was scanty they were prompted to seek clarification from other sources such as television, social media or extension officers.

5.2 Conclusion

Though farmers receive information on soil fertility improvement from a myriad of sources, radio remains most ubiquitous source of information on agriculture and soil fertility management technologies in the study area. Majority of farmers attest to gaining information from *Mugambo wa Murimi* radio programme on use and availability of subsidised fertilizers, hass avocado seedlings, farm demonstrations, market for farm produce and more. With the ratio of extension officer to farmer standing at 1:2294 in the study area *Mugambo wa Murimi* has come in filling the information gap. The programme can therefore be said to have effects on uptake of information on soil fertility management technologies and with engaging experts during shows and participatory programming, the show will go a long way in helping farmers.

5.3 Recommendations

The study established that the programme *Mugambo wa Murimi* airs for about 7 minutes or so in the morning with a repeat in the evening with interruptions from advertisements and invited farmers to the show.

On this, the study suggests that the programme be allocated more time since topics on SFM require more time to explain to farmers as well to allow for interactive sessions so that farmers do not remain as passive audience throughout the programme. The programme managers should in future, consider engaging soil experts as they had indicated that they mostly invite

farmers deemed successful to the show. The farmers brought on show may not be in a position to tackle soil fertility issues to their satisfaction.

The other cited limitation of the programme during the study was linearity of information flows in programming and the tendency to bias the transmission to commercial interests that favoured the sponsors of the programmes. Participatory programming is thus recommended to improve the relevance of the content to be aired. Additionally, to reach its potential the programme has to be made more appealing to those in the age group 18-25 years and those with tertiary level of education.

5.4 Suggestions for further Studies

This study suggests a longitudinal study on effects of vernacular radio programmes on uptake of information on soil fertility management in Kenya.

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APPENDICES

APPENDIX 1: FARMERS' QUESTIONNAIRE

My name is Anne C Kaee, a Masters student at the University of Nairobi's School of Journalism and Mass Communication. I am currently conducting a study on soil fertility management in partial fulfilment of the requirements for the award of the degree of Master of Arts in Communication Studies. To help inform this research, you have been identified as a respondent. I am kindly requesting you to take a few moments to respond to the questions below. You are assured that any information that you provide shall remain confidential and shall be used exclusively for research purposes. If you have any questions, please contact the School of Journalism and Mass Communication or me on phone number 0720575209 or email annekaee2010@gmail.com. Thank you in advance for your assistance.

Date of interview:

Name/Contact: _____ (*Optional)*

Questions			**Results**
a. Personal and Farm Data			
1	Please state your age. o 18-25 o 26-35 o 36-50 o 51 and above		
2	What is your highest level of formal schooling?	No schooling, primary school, secondary school, tertiary (be specific)	
3	What is the size of your farm?	In acres	
4	Land size under agriculture?		
5	Who makes decisions on agricultural activities in this home?		
6	For how long have you or		

	your family been farming here?		
7.	What crops do you plant on your farm?	Food crops such as beans, maize, bananas, vegetables, fruits? Cash crop such as coffee, tea?	
8	Do you have trees or shrubs on your farm?	Please name	
9	Do you keep livestock on your farm?	How many of each? (Cattle, goats, dairy cows, chicken, other).	
b. Sources of information and soil fertility management technologies uptake			
10	What are your sources of information on soil fertility management technologies? And how do you rate these sources as indicated in the next column	Please mark where necessary **Extension officers** ☐ Sufficient information ☐ Relevant information ☐ Attractive format ☐ Understandable ☐ Useful **Farm Visits** ☐ Sufficient information ☐ Relevant information ☐ Attractive format ☐ Understandable ☐ Useful **Peers and neighbours** ☐ Sufficient information ☐ Relevant information ☐ Attractive format ☐ Understandable ☐ Useful **Radio** ☐ Sufficient information ☐ Relevant information ☐ Attractive format	

		☐ Understandable ☐ Useful **Television** ☐ Sufficient information ☐ Relevant information ☐ Attractive format ☐ Understandable ☐ Useful **Newspapers, Journals** ☐ Sufficient information ☐ Relevant information ☐ Attractive format ☐ Understandable ☐ Useful	
11	How often do you receive information on soil fertility management technologies from each of the selected source	*Please select from next column* a. Extension officer	☐ Daily ☐ Weekly ☐ Monthly ☐ Quarterly ☐ Annually ☐ None
		b. Farm visits	○ Daily ○ Weekly ○ Monthly ○ Quarterly ○ Annually ○ None
		c. Neighbours and peers	○ Daily ○ Weekly ○ Monthly ○ Quarterly ○ Annually ○ None
		D. Radio	○ Daily ○ Weekly ○ Monthly ○ Quarterly ○ Annually ○ None

		e. Television	○ Daily ○ Weekly ○ Monthly ○ Quarterly ○ Annually ○ None
		f. Print media like journals, newspapers	○ Daily ○ Weekly ○ Monthly ○ Quarterly ○ Annually ○ None
c. Relevance of information on soil fertility management technologies			
12	Please tick where applicable to indicate whether the information received from the above named sources was relevant	☐ Increase in food productivity on using SFM technologies thus food security	☐ Relevant ☐ Not relevant
		☐ Learn how to prepare animal manure	☐ Relevant ☐ Not relevant
		☐ Learn how to combine organic and inorganic fertilizers for farm use	☐ Relevant ☐ Not relevant
		☐ Know how to plant trees and shrubs for use as organic fertilizers	☐ Relevant ☐ Not relevant
		☐ Learn how to prevent soil erosion	☐ Relevant ☐ Not relevant
		☐ Learn how to preserve and process agricultural produce using new technology	☐ Relevant ☐ Not relevant
13	Please rate each of the sources of information on a scale of 1-5 using the scale below	☐ Extension officer ☐ Farm visits ☐ Neigbors and peers ☐ Radio ☐ Television	

	1-poor source 2-fair source 3-good source 4-Best 5. Excellent	□ Print media such as journals, newspapers, books	
d. Farmer's perception of *Mugambo Wa Murimi* on SFM technologies			
14	Do you own a radio?	□ Yes □ No	
15	Are you able to listen to radio through any other medium such as a mobile phone?	□ Yes □ No	
16	How often do you listen to *Mugambo Wa Murimi*	□ Whenever it is aired? □ Daily □ Monthly □ Quarterly □ Yearly	
17	Do you find it useful listening to *Mugambo Wa Murimi*?	Is it worth your time listening to the programme?	
18	What motivates you to listen to *Mugambo Wa Murimi*?	Content on agriculture? Advertisements? Please state any other	
19	Please state what is discussed during the programme with regard to SFM?		
20	State whether you receive information on the following SFM technologies on *Mugambo wa Murimi* radio	□ Green manure ( ) □ Animal manure ( ) □ Cover Crops ( )	

	programme	□ Agroforestry ( ) □ Mulching ( ) □ Compost ( ) □ Crop rotation ( )	
21	Has the information from the programmes convinced you to put to practice what you heard discussed?	□ Yes □ No	
22	Please state whether there is information from *Mugambo Wa Murimi* program that persuaded you to practice SFM for example use of locally available manure, use of shrubs from homesteads.	Is there a time you heard information on the program that might have dissuaded you to practice SFM or use SFM technologies?	
23	Do you think Mugambo wa Murimi sufficiently explains the topics on soil fertility management?	Do you understand the explanations on the application of the various soil fertility management technologies?	
24	Please suggest what you believe can improve this programme to serve your needs as a farmer?	Please suggest SFM technologies that you think can help improve soil fertilty.	
e. Perceived effects of radio on farming practices relating to adoption of SFM technologies			
25	Have you practiced what you hear on Mugambo wa Murimi on SFM technologies listed?	If Yes tick appropriately □ Compost making □ Use of crop residues □ Preparation and use of animal manure □ Organic farming □ Proper farming methods □ agroforestry	If NO please explain briefly here

26	Have you encountered any challenges implementing what you hear on radio on SFM?	Please explain	
27	Have you shared the information you receive about SFM technologies? *Tick appropriately in the next column.*	○ With fellow farmers ○ With those who work on your farm? ○ With your neighbours? ○ With others on farm visits or within groups? ○ Through the mobile phone and social media? ○ Any other way?	
28	Did the program *Mugambo Wa Murimi* prompt you to follow up with the following (next column) in search of more knowledge and information?	○ Extension officers ○ Attend farm visits or farm field days ○ Shows such as ASK ○ Seminars ○ Marketers who sell fertilisers	
29	Has Mugambo Wa Murimi prompted you to seek for more information on other media platforms like the newspaper, TV? And on social media?	○ Please list the media	
Last comments			
30	Do you have any comment or questions for me?		

Thank you very much for your time.

Appendix 2: Key Informant Interview Checklist

My name is Anne C Kaee, a Masters student at the University of Nairobi's School of Journalism and Mass Communication. I am currently conducting a study on soil fertility management in partial fulfilment of the requirements for the award of the degree of Master of Arts in Communication Studies. To help inform this research, you have been identified as a respondent. I am kindly requesting you to take a few moments to respond to the questions below. You are assured that any information that you provide shall remain confidential and shall be used exclusively for research purposes. If you have any questions, please contact the School of Journalism and Mass Communication or me on phone number 0720575209 or email annekaee2010@gmail.com. Thank you in advance for your assistance.

DATE:

1. What are the sources of agricultural information available to farmers in this area?
2. Do these sources meet the information needs of farmers?
3. What are the sources of information on soil fertility management available to farmers in this area?
4. Of the sources identified in 3 above, which ones do you think are the best for communicating with farmers?
5. How effective is radio when communicating with farmers?
6. How do you rate radio compared to other media as a source of agricultural information?
7. How do you rate radio compared to other media channels as a source of information on SFM?
8. Are you aware of specific radio programmes that target farmers?
9. Are you aware of *Mugambo wa Murimi*?
10. If your answer to the above question is yes, what is your view of *Mugambo wa Murimi* as a source of agricultural information? As a source of information on SFM?
11. Please rate the experience. Bad, fair, Good, best?
12. Did you share information based on what you heard on the programme?
13. Would you recommend radio for use when communicating information on soil fertility management technologies?
14. Any merits of radio in communicating agriculture?
15. What are the advantages of radio in communicating on agriculture? On SFM?
16. What are the challenges of radio in communicating on agriculture? On SFM?

Thank you very much.

Appendix 3: Focus Group Discussion Guide

My name is Anne C Kaee, a Masters student at the University of Nairobi's School of Journalism and Mass Communication. I am currently conducting a study on soil fertility management in partial fulfilment of the requirements for the award of the degree of Master of Arts in Communication Studies. To help inform this research, you have been identified as a respondent. I am kindly requesting you to take a few moments to respond to the questions below. You are assured that any information that you provide shall remain confidential and shall be used exclusively for research purposes. If you have any questions, please contact the School of Journalism and Mass Communication or me on phone number 0720575209 or email annekaee2010@gmail.com. Thank you in advance for your assistance.

DATE:

1. What are your sources of information for smallholder farmers on agriculture?
2. How would you rate these sources?
3. What are the advantages of the sources named above?
4. What challenges do these sources of information pose to farmers?
5. Is the information received from the above-named source/s adequate to your farming practices? Please explain.
6. How do you rate radio compared to these other sources of information?
7. Which radio channel do you prefer?
8. Do you listen to the radio programme *Mugambo wa Murimi*?
9. How often do you listen to this radio programme?
10. Why do you listen to this programme?
11. Does the programme *Mugambo wa Murimi* air content on SFM? Please explain
12. Does the programme provide sufficient information on SFM technologies?
13. Have you been able to practice the SFM technologies you heard discussed on radio? Please explain in detail

Appendix 4: Interview Schedule for *Mugambo wa Murimi* Programme Producers at Inooro FM

My name is Anne C Kaee, a Masters student at the University of Nairobi's School of Journalism and Mass Communication. I am currently conducting a study on soil fertility management in partial fulfilment of the requirements for the award of the degree of Master of Arts in Communication Studies. To help inform this research, you have been identified as a respondent. I am kindly requesting you to take a few moments to respond to the questions below. You are assured that any information that you provide shall remain confidential and shall be used exclusively for research purposes. If you have any questions, please contact the School of Journalism and Mass Communication or me on phone number 0720575209 or email annekaee2010@gmail.com. Thank you in advance for your assistance.

DATE:

1. Why did you start the programme?
2. What time does the programme broadcast and how long does it last?
3. What is your target audience?
4. What criteria do you use to select the experts who participate in this programme?
5. What topics are covered in the programme?
6. Have your presenters ever discussed SFM technologies?
7. Are they knowledgeable of SFM technologies?
8. Are the experts used conversant with or knowledgeable in SFM technologies?
9. Do they consider discussing SFM in future?
10. Do you receive any feedback from your listeners?
11. Do you receive any feedback from your listeners?
12. What kind of feedback do you receive?
13. Are you able to measure the effects of *Mugambo Wa Murimi* on your listeners?
14. What do you think has been the effects of the programme on farming practices and especially on the adoption of SFM technologies?

Thank you for your time.

Appendix 5: Certificate of Fieldwork

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REF: CERTIFICATE OF FIELDWORK

This is to certify that all corrections proposed at the Board of Examiners meeting held on 17.05.2019 in respect of M.A/PhD. Project/Thesis Proposal defence have been effected to my/our satisfaction and the project can be allowed to proceed for fieldwork.

Reg. No: K50/86624/2016

Name: KAEE C ANNE

Title: THE EFFECTS OF RADIO ON UPTAKE OF INFORMATION ON SOIL FERTILITY MANAGEMENT TECHNOLOGIES AMONG SMALLHOLDER FARMERS IN KAHDARA SUBLOCATION: THE CASE OF MUGAMBO WA MURIMI PROGRAMME

PROF GEORGE NYABUGA	GNyabuga	20.05.2019
SUPERVISOR	SIGNATURE	DATE
Dr Samuel Siringi		25/05/19
ASSOCIATE DIRECTOR	SIGNATURE	DATE
Prof Ndeti Ndati		30.5.19
DIRECTOR	SIGNATURE/STAMP	DATE

Appendix 6: Certificate of Originality

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An Assessment of InooroFm's Station Mugambo...By: Ann Kaee K50/86624/16

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Appendix 7: Certificate of Corrections

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REF: CERTIFICATE OF CORRECTIONS

This is to certify that all corrections proposed at the Board of Examiners meeting held on 30.10.2019 in respect of M.A/PhD. Project/Thesis defence have been effected to my/our satisfaction and the project/thesis can be allowed to proceed for binding.

Reg. No: K50/86624/2016

Name: AMME KAEE CHEPKWEMOI

Title: AN ASSESSMENT OF IMOORO FM'S MUGAMBO WA MWAIMI PROGRAMME ON THE UPTAKE OF INFORMATION ON SOIL FERTILITY MANAGEMENT TECHNOLOGIES AMONG SMALLHOLDER FARMERS IN KANDARA SUB-COUNTY, MURANGA COUNTY

PROF. GEORGE NYABUGA		15/11/2019
SUPERVISOR	SIGNATURE	DATE
Dr Samuel Siringi		04/12/2019
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Dr Samuel Siringi		06/12/2019
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