ASSESSING THE EFFECTS OF INFORMATION AND COMMUNICATION ON THE USE OF ORGANIC RESOURCE INPUTS TO BUILD SOIL FERTILITY IN THE CENTRAL HIGHLANDS OF KENYA

By

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STUDENT'S DECLARATION

I declare that this project is my original work and has not been presented before in any forum of any nature by any individual or group of individuals

SIGN……. DATE…….

LANGAT K. WALTER
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SUPERVISOR'S DECLARATION

I declare that this work has been prepared under my supervision and is presented with my approval

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ABSTRACT

This study sought to assess the effects of information and communication on the use of organic resource inputs in the Central Highlands of Kenya. To achieve this purpose, the study set out to identify the available sources of information and innovations on organic resources by farmers, determine whether farmers' socio-economic status influence communication processes and information access regarding the adoption of the inputs, investigate the effects of community groups and associations on the communication and adoption of these inputs, and assess the effects of communication on the their uptake. The study used phenomenology qualitative research and participatory research designs. Two sub-counties from two different counties in the region were purposively selected. Stratified random sampling was then used to select two villages from each sub-county. Thirty farmers, 15 from each sub-county, were randomly selected as respondents of the study. Interview schedules and Participatory Rural Appraisal (PRA) tools were used to collect data. The collected data were analysed qualitatively. The key findings of the study revealed that information and communication have significantly improved farmers' knowledge on animal manure, organic and inorganic fertilisers and crop rotation and scaled up the use of animal manure, organic and inorganic fertilisers, and crop rotation by farmers. Additionally, the study established that farmer's age, income, education level and gender influence information access of organic resource inputs and their subsequent uptake. The study also found out that government extension staff and vernacular radio are the most available and preferred sources of organic resource inputs by farmers. The study recommends that researchers should consider how extension agents can be made more useful in dissemination of information about organic resource inputs since they are one of the main sources of this kind of information.

DEDICATION

I dedicate this project to my late grandparents, the *Miteis*. In the world where access to education was bedeviled by endless obstacles, my grand mum and dad fought for my education; they ignited my academic dream. Although they have left us, their legacy lives on.

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AGRA	Alliance for Green Revolution in Africa
CAN	Calcium Ammonium Nitrate
CAW	County Assembly Ward
CBO	Community-Based Organisation
CGIAR	Consultative Group on International Agricultural Research
DAP	Di-Ammonium Phosphate
FAO	Food and Agricultural Organisation
FFD	Farmer Field Days
FFS	Farmer Field School
ICIPE	International Centre of Insect Physiology and Ecology
ICT	Information and Communications Technology
ISFM	Integrated Soil Fertility Management
KALRO	Kenya Agricultural and Livestock Research Organisation
KNBS	Kenya National Bureau of Statistics
KTDA	Kenya Tea Development Agency
LH	Lower Highland
NGO	Non-Governmental Organisation
NPK	Nitrogen Phosphorous Potassium
ORM	Organic resource Management
PPT	Push Pull Technology
PRA	Participatory Rural Appraisal
RMF	Role Model Farmer
SACCO	Savings And Credit Co-operative
SFM	Soil Fertility Management
SOM	Soil Organic Matter
SSA	Sub-Saharan Africa
TTM	Transtheoretical Model of Change
UH	Upper Highland
UM	Upper Midland

CHAPTER 1

INTRODUCTION

1.1 Background to the Study

Soil fertility degradation is a major threat to agricultural production and livelihoods of smallholder farmers in Sub Saharan Africa (SSA) (Douthwaite et al., 2002; Henao and Baanante, 1999; Kang, 1993; Stoorvogel and Smaling, 1990; Wheeler and von Braun, 2013). Poor soil fertility and nutrient depletion in the region contribute to drops in crop yields which have declined significantly since the 1970s (FAO, 2001; Kimaru-Muchina et.al, 2011).

Accordingly, poor soil fertility has become a major challenge to farmers and agriculturists in Africa. This problem is attributed to poor cultivation practices which has resulted in the reduction of soil organic matter (SOM), and increase in occurrence of acidified soils (Mugendi et al., 2012). Several studies (for example by Douthwaite et al., 2002; Henao and Baanante, 1999; Kang, 1993; Stoorvogel and Smaling, 1990; Wheeler and von Braun, 2013) point out that the low level of soil fertility is a major threat to the agricultural production of food, feed and fiber especially in the arid and semi-arid climate zones of SSA.

Consequently, there is growing interest in preventing further deterioration of soils as well as in ameliorating its fertility. This drive is key to the enhancement of food security and poverty alleviation (FAOSTAT, 2002). It is important to invest a lot of resources in soil fertility restoration in SSA because per capita arable land in the region has shrunk from 0.53 to 0.35 hectares between 1970 and 2000 (Place, 2003).

One of the ways of improving soil fertility is to undertake better and improved management of soil using organic resources. Organic resource management (ORM) for soil fertility is guided by the philosophy of "feed the soil to feed the plant" (Gaskell et al., 2007 p. 1). This principle is implemented through a series of practices designed to increase SOM, biological activity, and nutrient availability. Adding organic materials such as cover crops, crop residues, green manure and composts to cultivated soils over time builds SOM and improves the ability of soil to supply nutrients and thus better productivity. In an early study (Bationo, 2004), it was shown that

modern agroforestry systems (planting of nitrogen fixing trees, leguminous shrubs together with food crops), as well as the use of mulch and crop rotation are other ORM practices that increase and maintain soil fertility. According to Hossner and Juo (1999), common organic nutrient sources in tropical SSA include plant (crop) residues, leguminous cover crops, green manures, animal manure, mulches and household wastes.

Organic resources can be a good source of phosphorus, calcium, iron, copper and zinc which are useful elements in plant growth (Gaskel et al, 2007). It is equally important to note that organic resource inputs also improve soil fertility by imparting favourable physical attributes to soil. The goal of ORM is to create a healthy soil environment which helps soil retain balanced nutrient status such that its fertility is maintained over time.ORM, using modern practices and technologies such as mulching, crop rotation, cover crops, farmyard manure application and agro forestry, is found to improve soil fertility (Kimani et al., 1998; Gaskell et al., 2007; Chukwuka and Otomayo, 2009).

Despite the benefits discussed above, it is evident that farmers have failed to adopt ORM technologies (Murage et al., 2012; Adolwa et al., 2012). According to Sanginga and Woomer (2009), poor, insufficient or lack of information on these technologies is thought to be one of the reasons why known and tested agricultural technologies, developed in order to raise the low level of soil fertility, are not adopted in SSA. Given the fact that communication plays a critical role in society (Rogers, 1995; Sanginga and Woomer, 2009), it becomes critical that the sharing of ideas, information and knowledge might aid the uptake of ORM technologies. Accordingly, because agriculture is the lifeblood of many Kenyans (GoK, 2014; Brooks et al., 2009), lack of information on, for example, soil fertility and the application of modern technologies to raise and preserve soil quality, means people are oftentimes unable to identify reasons and understand falling agricultural production. Information on recommended soil fertility management is an important factor influencing its adoption (Fischler, 2010), in which interpersonal communication, extension services including NGOs, scientific institutions, and mass media are involved. A significant change in the field of information about agricultural innovations was the shift from the uni-linear expert-to-lay model to participatory models (White, 2009). The former top-down approach to extension and communication usually neglects that farmers have their own criteria assessing new technologies before decisions on adoption or non-adoption are taken.

Effective communication may give farmers and agricultural stakeholders platforms to share information and experiences on various issues relating to soil management and fertility and organic resource input, production and application in cropping farming systems. This research project, therefore, aims at identifying communicative factors that promote the dissemination and adoption of organic resources for the improvement of soil fertility in SSA

1.2 Statement of the Problem

Declining soil fertility is a threat to agricultural production in SSA (Douthwaite et al., 2002; Henao and Baanante, 1999; Kang, 1993; Stoorvogel and Smaling, 1990; Wheeler and von Braun, 2013). In addition, there is evidence of accelerated soil degradation in SSA due to the use of non-sustainable farming practices. A study done by Henao and Baanante (1999) in 44 SSA countries found that total nutrient balance was negative in the all the countries. Deforestation and the use of marginal land for crop production also caused a significant decline in SOM content and nutrients. In West Africa, long term experiments show a range of over 5% loss of SOM per annum on sandy soils to around 2% on better textured soils (Bationo and Buerkert, 2001; Pieri, 1989).

According to Kimani et al., (1998), Gaskell et al., (2007), and Chukwuka and Otomayo (2009), ORM using modern practices and technologies such as mulching, crop rotation, cover crops, farmyard manure application and agro forestry is found to improve soil fertility. However, farmers are yet to embrace these technologies due to poor, inadequate or lack of information on the same. In addition, farmers' perceptions and attitudes towards emerging technologies are influenced by a number of factors, among them the nature of information sources (Murage et al., 2012). Adolwa et al. (2012) and Sanginga and Woomer (2009) point out that there is lack of awareness of ORM technologies among farmers and attribute it to lack of access to reliable and current information, wide communication gaps between researchers and farmers, and partial utilization of ORM knowledge to addressing soil fertility management problem. It has also been observed that the channels through which the technologies are communicated to farmers are grossly inefficient and thus lead to the ineffectiveness in the adoption of the recent agricultural technologies (Ahmed-Akinola, 2004).

Notably, organisations working in agriculture hardly investigate the effectiveness of communication with farmers. Granted, this has become important in the last few years (Amudavi et al.,2009; Kimaru-Muchai et al., 2011; Lynam, 2011; Murage et al., 2012; Nyambo and Ligate, 2013; van Schagen etal., 2011).Therefore, there was a great need identify communication factors influencing the adoption of soil fertility in Kenya and assess the effects of communication on the uptake of ORM techniques by farmers

1.3 Objectives of the study

The general objective of the study was to assess the effects of information and communication on the use of organic resource inputs to build soil fertility in the central highlands of Kenya. Specifically, the study sought to:

i. Identify the available sources of information and innovations on organic resource inputs directed to farmers.
ii. Determine whether farmers' socio-economic status influence communication processes and information access regarding the adoption of organic resource inputs.
iii. Investigate the effects of community groups and associations on the communication and adoption of organic resource inputs by farmers.
iv. Assess the effects of communication on the uptake of ORM techniques by farmers.

1.4 Research Questions

The following questions guided this study;

i. What are the available sources of information and innovations on ORM technologies directed to farmers?
ii. Does farmers' socio-economic status influence communication processes and information access regarding the adoption of ORM techniques?
iii. What are the effects of community groups and associations on the communication and adoption of soil fertility innovations by farmers?
iv. What are the effects of communication on the uptake of ORM techniques by farmers?

1.5 Significance of the Study

Information access is critical as it underpins a community's development growth and facilitates the uptake of knowledge among community members. The findings of this study are crucial in understanding the effects of information and communication in improving soil fertility through the use of organic resource inputs. The findings of the study will improve understanding on the most effective communication channels and approaches in the dissemination of information about ORM inputs so that agricultural stakeholders can employ the use of these channels and approaches to scale up the use of the inputs and subsequently improve soil fertility. Improved soil fertility leads to increased crop production which is a remedy to food insecurity in SSA. This study is also important since it provides recommendations on how to improve information and communication approaches for improved adoption of the inputs by farmers in the region.

1.6 Scope of the Study

The study focused on information and communication channels and approaches and their effects on the use of organic resource inputs. This study covered two counties – Tharaka Nithi and Murang'a – in the central highlands of Kenya. The two counties were chosen for the study based on difference in rainfall amount and distribution, cropping patterns, soil types, and the type of crops grown as well as socio-economic conditions. Small-scale farmers from two villages from each of the two counties were sampled for the study. Literature focusing on communication and information on adoption of agricultural technologies by smallholder farmers in SSA were reviewed.

1.7 Limitations of the Study

This study is limited in scope and methodology. It focuses on smallholder farmers from only two counties in Kenya that form a relatively small area of the wider SSA region. Furthermore, only four villages in both counties were used meaning that most parts of the counties were not covered. Though a multi-method research design was used, phenomenology was the main design used thus requiring only a small number (30) of respondents. Therefore, based on this, the findings cannot be generalized for the entire SSA.

Language barriers and time constraints were some of the notable challenges during the course of this study. To overcome the challengers, a research assistant who understands and speaks the local language was engaged to help the researcher. Moreover, the researcher worked extra hard to collect all the required data within the stipulated timeframe.

1.8 Operational Definitions of Terms

Soil Fertility Management

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 o how to adapt these practices.

Organic Resource Inputs

These are organic materials – such as manure – that supply important nutrients to crop inaddition to increasing and maintaining soil organic matter.

Soil Organic Matter

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

Laggard

A laggard refers to a person who makes slow progress and rarely adopts an innovation.

Baraza

A public meeting held and chaired by a local area chief or village elder and in which the area locals attend.

Self Efficacy

This is described as the situation-specific confidence that enables an individual to cope with high-risk situations and not relapse back to the problem behaviour.

Decisional balance

Decisional balance refers to the individual's weighing of the pros with the cons, the benefits of changing the behaviour, and the costs of changing that behaviour.

1.9 Chapter Summary

The first chapter provided a background to this research. It acknowledged that there is a problem of soil infertility in SSA since most farmers have failed to adopt ORM technologies owing to poor information and communication access. The research stated the objectives and questions that would help understand the effects of information and communication on the use of organic resources to improve soil fertility. Challenges experienced during the study were also mentioned. The next chapter provides a critical review of literature on the effects of information and communication on the adoption of ORM technologies in SSA.

CHAPTER 2

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Introduction

This chapter discusses important scholarly work and recent studies on the role of information and communication in rural development and particularly the use of media and communication to improve soil fertility and agricultural development. This chapter also looks at soil fertility management (SFM) in SSA and reviews a variety of literature on ORM information and different approaches of disseminating ORM communication.

This review also helps in identifying research gaps on the effect of information and communication on the use of organic resource inputs to build soil fertility.

2.1.1 Role of Information and Communication in Rural Development and Agriculture

Moseley and Malcolm (2003) define rural development as the process of improving the quality of life and economic well-being of people living in relatively isolated and sparsely populated areas. Communication plays an important role in the process of rural development. The communication linkages built between public institutions, rural organizations and people create the opportunities that ensure that information, knowledge and experience needed for rural development are shared.

Ors (2008) says that communication serves several functions in rural development. These functions include facilitation and exchange of views and information between farmers and rural organizations; contributions to the implementation and coordination of the rural development projects; embracing and spreading innovations in rural areas; awareness raising in the rural areas to promote participation; education support and facilitation of cooperation and coordination among the rural and agricultural organizations.

Media are important vehicles for dissemination of information to the rural people as they ensure publication and popularization of rural issues in the general public (Ors, 2008). It supports the

educational and awareness activities and specifically contributes to facilitating the technical information.

In traditional rural areas, interpersonal communication is the prevalent communication method for most people. Gailhard et al. (2015) and Fischler (2010) argue that interpersonal communication is more effective than the mass media in the adoption of farming innovations at the village level.

However, the South African Institute for Distance Education (2004, pp. 45) stated that radio remains the key media to which most rural people have access and that educational radio initiatives in South Africa were effective in providing topical programmes and reaching large numbers of learners rapidly. Going further, they stated that the impact of the radio programmes was greater when used with other text-based materials, such as posters and comics (p. 36).

According to Türkdoğan (2006), there are four major channels to convey the innovation from the researchers to the farmer: peers and neighbors (informal communication), seller and wholesalers (commercial communication), public institutions and agriculturally specialised university units, public communication, mass media devices (mass communication). The farmers become aware of the innovations and develop interest in learning and adopting them via these channels (Türkdoğan, 2006 p. 500 – 501).

On the other hand, field extension workers are the central agents of change in rural villages as they have been successful in convincing farmers to adopt new farming practices (Rodriguez, 2015; Muyanga and Jayne, 2008; Darr and Pretzsch, 2008). Meera, Jhamtani, and Rao, (2004) argue that information and communication technology helps the extension system in re-orienting itself towards the overall agricultural development of small production systems. With the appropriate knowledge, small-scale producers can even have a competitive edge over larger operations. Information and communication can also play an important role in bringing about sustainable agricultural development when used to document both organic and traditional cultivation practices (Meera, Jhamtani, and Rao, 2004).

2.1.2 Impact of Low Soil Fertility on Food Security in SSA

Food security, poverty and environmental degradation in the context of climate change are high on the global policy agenda (Garnett et al., 2013). The World Food Summit of 1996 identified sub-Saharan Africa as the only region in the world with decreasing food production per capita with worst levels of poverty and malnutrition in the world. Accordingly, the decline of soil fertility is a major threat to agriculture and food security in SSA. Various research works have found out that because food is mainly produced on land and soil, soil health and productivity determine the performance and sustainability of farming (HLPE, 2012; Jalloh, 2013; Jie et al., 2002; Jones et al., 2013; Lal, 2009; Lal and Stewart, 2013; Töpfer et al., 2013).

Food insecurity encompasses food scarcity as well as the inability to purchase food, a poverty-related issue. Although food insecurity occurs throughout the developing world, it is most acute in sub-Saharan Africa where the attainment of food security is intrinsically linked with reversing agricultural stagnation, safeguarding the natural resource base, and reducing population growth rates (Cleaver and Schreiber, 1994).

With increasing human population, and the worsening state of the soil in SSA, it can be projected that devastating food deficit is in the offing. Thompson et al. (2010) report that with the exception of mid- to high-latitude regions of Africa, it is projected that mean crop productivity will decrease across sub-Saharan Africa. These arguments are supported by studies done by FAO (2001) which conclude that Africa's average cereal yield during the period 1991 to 1998 was stagnant, at about 1.2 tonnes/ha. It is thus likely that by 2020, even assuming optimistically that national average cereal yields increase to 1.8 tonnes/ha, Africa will need to import between 25 and 32 percent of its cereal to meet demand. .

Although food insecurity occurs throughout the developing world, it is most acute in sub-Saharan Africa where the attainment of food security is intrinsically linked with reversing agricultural stagnation, safeguarding the natural resource base, and reducing population growth rates (Cleaver and Schreiber, 1994).Sub-Saharan Africa remains the only part of the world that did not fully benefit from the effects of the green revolution experienced in Asia in the 1960s (Adesina and Chianu, 2002).Food accessibility, affordability and availability are the major concerns for Africa and primary challenges for human well-being and economic growth (Bationo

et al., 2004). According to FAO (2001), food production can be increased through: (i) Increasing land under cultivation; (ii) Recycling manure, use of crop residues, use of green manures and cover crops, and adoption of agroforestry; (iii) Use of mineral fertilizers; (iv) Changing the farming systems to become more productive and sustainable; (v) Increasing investments for land improvement and promoting a conducive land tenure system; and (vi) Efficient water use.

Agriculture in SSA needs to grow by four percent per year to meet the food requirements of the growing population (FAO, 2001). The conservation, recapitalization and maintenance of soil fertility are prerequisites to improved efficiency of inputs and higher productivity.

2.1.3 Organic Resource Management Practices

According to Sanginga and Woomer (2009), organic resources are abundant in Africa because they are derived from both cultivated and natural lands and AGRA (2007) notes that they have been used by farmers for years. Sanginga and Woomer (2009) identify four organic resources available for farmers in SSA as crop residues, green manure, animal manure and agro-industrial wastes.

Crop residues are made up of the non-harvested portion of crop plants and are relatively low in nutrients but high in lignin (Sanginga and Woomer, 2009). A big impediment to the use of crop residues as an organic resource is its alternative use as livestock feed, cooking fuel and structural or handicraft material (Sanginga and Woomer, 2009). However, crop residues fed to livestock improve the availability of manure.

Residues used as mulch offer protection to the soil surface and those incorporated with other, higher quality materials serve as substrate to composting operations (Sanginga and Woomer, 2009). One difficulty in the management of crop residues as mulch is their loss from the feeding activities of termites and other soil macrofauna (Wood, 1988) particularly when the material is transported by insects to nests beyond the root zones of cultivated plants.

Green manuring, another organic resource, involves the cultivation of fast-growing leafy plants and their incorporation into the soil as a source of nutrients to succeeding crops (Hudgens, 2000). Leguminous green manures are actively symbiotic and accumulate large amounts of biologically-fixed nitrogen. In addition, green manures establish litter layers and prolific root

systems that serve as inputs to the preceding crop. Sanginga and Woomer (2009) argue that incorporation of green manures is best practised prior to seeding because they accumulate a lot of biomass and have a threat of introducing a weedy competitor. Green manures may also provide nutritious fodders that complement bulky, less palatable cereal residues, and regular pruning may extend their lifetime in the field (Mureithi et al., 2002). Green manure also suppresses weeds, disrupts pest and disease cycles, maintains SOM and improves soil porosity (Eilittä et al. 2004) in addition to recovering nutrients from lower soil horizons – if characterised by deeper rooting – that would otherwise be lost to field crops (Jama et al. 1998; Shepherd et al. 2001; Young 1989; Gathumbi et al. 2003).

Animal manure is another important organic resource for SSA farmers. Livestock provide sources of soil organic inputs from their waste products (Mugendi et al., 2012; Sanginga and Woomer, 2009). Livestock deposit their waste products into the soil as they graze thus recycling nutrients from crop stubble, weeds and boundary plants. Plant residues and livestock manures decompose rapidly in moist and warm climates, causing nutrient release to be poorly timed with crop demand (Myers et al. 1994), suggesting that the timing and placement of organic resources must be carefully considered. In many cases, organic resources available to farmers have low nutrient concentrations (Vanlauwe et al. 2006) with limited potential to improve crop yields when applied as the sole source of nutrients.

Agro-industrial wastes are also considered as an organic resource. These are by-products from agriculturally-processed goods. These by-products are potentially important sources of organic materials. Sanginga and Woomer (2009) argue that it usually follows that agricultural raw materials are produced by small-scale out-grower farmers, transported to processing plants and then utilised by the central processing facility or nuclear plantation and not returned to the fields and farms of origin. Examples of these products include sugarcane bagasse, coffee husks, tea powder, rice husks and coconut husks.

Compost manure is another organic resource at the disposal of some SSA farmers. Mugendi et al. (2012) argue that compost making is the process of turning organic material – crop residues, garden weeds, kitchen and household weeds, hedge cuttings, and any other vegetative material –

into humus. According to their study, humus naturally improves soil water holding capacity, soil structure, and is a source of soil structure.

Organic resources contribute directly to the building of soil organic matter (SOM), which itself performs diverse functionary roles in improving the physical, chemical and biological composition of the soil. The maintenance and management of SOM are central to sustaining soil fertility on smallholder farms in SSA (Woomer and Swift, 1994).

Despite the availability of organic resources, however, its use has been hampered by numerous factors among them their alternative uses as fuel, feed and fibre, and the labour required to collect and process these materials.

2.1.4 Sources of Information on ORM

Rogers (1995) defines the message source as an individual or institution that produces the message, and these can vary from country to country.

From previous research, there is a dearth of evidence that different sources of information on ORM exist. However, different scholars use different approaches to illustrate these sources. According to Adolwa et al. (2012), sources of ORM knowledge and information include agricultural research institutions, learning institutions, community-based organisations (CBOs), websites, non-governmental organizations (NGOs), churches, provincial administration, agricultural companies, extension workers and agro-dealers, among others.

Sanginga and Woomer (2009) classify channels available for the dissemination and communication of ORM into community-based or cosmopolite interpersonal, local interpersonal, print-based, mass media and Information and Communications Technologies (ICT) based audio-visual systems. Community-based channels include demonstrations and field days, farmer field schools, and farmer-to-farmer training. Local interpersonal channels comprise songs, poems, and exchange with neighbours, relatives and friends or peers whilst print-based channels are extension brochures and booklets.

Notably, farmers utilise different information sources differently and in varying degrees. Kimaru-Muchina et al. (2011) found out that in Mbeere South and Maara districts in central

Kenya, farmers use extension officers, researchers, radio, agro-input dealers, exhibitions and their own experience to access ORM information. On the other hand, Goldberger (2008) found out that NGOs, school, government, social networks and family are used by farmers in Kibwezi in Eastern Kenya as sources of information on ORM methods.

Availability of different information sources is fundamental in information access and adoption of ORM technologies (Adolwa et al., 2012; Sanginga and Woomer, 2009). Different sources of information are important as they make the farmer aware of alternatives from where they can choose the most desirable soil fertility technology suitable for their needs. Kimaru-Muchina et al. (2011) recommend that change agents, researchers, extension workers and policy makers need to identify the sources of information that farmers use most as this helps in appraising effective communication pathways in the dissemination of soil fertility management practices.

However, most of these studies (Kimaru-Muchina et al., 2011; Adolwa et al., 2012; Goldberger, 2008) focus mainly on the frequency of exposure to information and distinguish on the context of information (field days, farmer field schools), and hardly investigate the effects of such information on the use of organic resource inputs to improve soil fertility. This study therefore sought to find out the main sources of ORM information for farmers in Central Highlands of Kenya and what effect these sources have on the adoption of organic resource inputs in improving soil fertility in the region.

2.1.5 Hindrances to Access of ORM Information in SSA

Communication pathways used in dissemination of soil fertility management practices, especially in Central Kenya, are insufficient (Adolwa et al., 2012; Sanginga and Woomer, 2009; Kimaru-Muchina et al., 2011). Accordingly, the use of one information source to disseminate ORM technologies and promote their adoption is considered ineffective. Agbamu (1995) argues that extension contact alone may not promote adoption of any agricultural technology if used in isolation to other information approaches. Shanthy and Thiagarajan (2011) compare three modes of delivering information on ratoon management practices in India – (i) traditional mode; (ii) computer multimedia; and (iii) a combination of both traditional and computer multimedia. They argue that using one mode alone (traditional lecture alone or computer multimedia alone) has

little impact on the amount of knowledge gained by farmers. This is because the information delivered lacks reinforcement.

Interestingly, Yahaya (2003) argues that the personality of the key players in communication may also affect coding and decoding processes in communicating agricultural innovations to rural farmers. The appearance or modes of dressing or non-verbal cues are likely to send wrong signals, which, in addition to original concepts, could cause undesirable distractions.

What's more, Obidike (2011) discovered that poor radio and television signals, lack of rural electrification or constant power interruption in communities that have electricity supply, and lack of access roads for easy community visit by extension workers are the main obstacles to agricultural information access by rural farmers in Enugu State, Nigeria. The study also reveals that agricultural information on radio and television is always aired at odd hours when farmers who desire such information have gone to their farms. Another hindrance to agricultural information access by Enugu farmers is the unavailability of television and radio broadcasts in local dialects.

2.1.6 Role of Extension Services in Dissemination and Adoption of Agricultural Technologies

Van den Ban and Hawkins (1996, p. 7) define extension as "the conscious use of communication of information to help people form sound opinions and make good decisions)." According to Katz (2002), extension means advisory and other services that help rural families make the best possible use of the productive resources at their disposal. Davis (2008) says that traditionally, extension was regarded as the delivery of information and technologies to farmers. To Zossou et al. (2009), extension education is the process of helping people by means of education to put useful knowledge to work for them. In agriculture, extension services are key to communicating new knowledge and ideas to farmers and are often characterised as a link between the research community and the farmer as extension plays a significant role in introducing new ideas and innovations to the farmer during initial stages of adoption (Marsh, Pannell and Lindner, 2000).

Extension services are facilitated by extension agents through the process of extension education. Darr and Pretzsch (2008) note that extension agents enhance the diffusion of innovations and

allow knowledge to spread more equally by often employing personal interactions, field visits, demonstrations, outreach, workshops, etc. as mechanisms to transfer new knowledge and innovation. The agents stand as key sources of practical and technical information about farming and are mostly preferred by women in Africa, Asia and Latin America in satisfying agricultural information needs (Rodriguez et al., 2015).

Muyanga and Jayne (2008) argue that Kenya's smallholder farmers have traditionally benefited from government and private extension systems. The first is the government extension system whereby the ministry in charge of agriculture plays a leading role. This system focuses mainly on food crops and livestock.

The private extension system comprising private companies, non-governmental, community-based, and faith-based organisations (Nambiro et al., 2005; Rees et al., 2000) deals mainly, but not exclusively, with commercial crops such as coffee, tea and pyrethrum and is explicitly motivated by profits. Muyanga and Jayne (2008) point out that the main strength of the private sector extension system is attributed to adequate financial resources, lack of bureaucracies, and shorter channels of communication as compared to public extension systems. Such resources are said to keep their extension personnel motivated and ensure efficient and timely delivery of their extension services.

Kimaru-Muchina et al. (2011) established that most farmers in the central highlands of Kenya use government extension officers to receive information about green manure, and combined organic and inorganic manure. However, Muyanga and Jayne (2008) found out that a combination of both extension systems – government and private extension systems – is considered instrumental and effective. In Kenya, for example, Khan et al. (2008) establish that exposure to a variety of extension systems significantly influences the likelihood of PPT adoption. The study done by Khan et al. did not, however, assess the magnitudes these extension methods had on adoption. Therefore, part of this study sought to assess the effects of extension methods on adoption of organic resource inputs by farmers and whether these methods provide sufficient information necessary for inputs' adoption.

2.1.7 Role of Farmer Groups in Knowledge Sharing and Adoption of ORM Techniques

Sanginga and Woomer (2009) identify lack of participation of local people and their communities – especially working with and through groups and building upon their traditional knowledge – as one of the principal weaknesses in the development and dissemination of improved farming methods. In this regard, farmer participatory research and dissemination approaches are preferred in the development of soil fertility recommendations (Chambers et al. 1989; CGIAR 2006). These also help determine the acceptability and profitability of a technology before it is promoted at a larger scale. According to Defoer (2002), numerous participatory methods used in disseminating soil fertility technologies exist and include experiential learning, pro-poor market development initiatives and facilitated contract farming. These methods are facilitated using various group communication approaches such as farmer field days (FFDs), workshops, farmer field schools (FFSs), demonstrations, and informal social networks

FFDs are usually day-long events where interested farmers are invited to fields or plots where specific information about particular technology is shared and discussed. FFDs are particularly effective if the intent is to distribute samples of fertiliser to farmers. FFDs are an alternative to workshop trainings since many farmers do not attend such trainings. However, Kimaru-Muchai et al. (2011) note that women prefer workshops and men FFDs. This relates specifically to trainings on the use of animal manure to improve soil fertility. One possible reason why women prefer workshops is because they are more likely to give more detailed information on animal manure which women often lack (Kimaru-Muchai et al., 2011).

According to Okoth et al. (2006), FFSs have had profound impact on the empowerment of farmers with knowledge. FFS is a season-long training of farmers involving participatory activities, hands-on analyses and decision-making. FFS is suitable for farmers with relatively low levels of education as the method engages farmers directly in the knowledge discovery process and encourages greater knowledge retention and more sustainable farming practices (Escalada and Heong, 1993; Kenmore, 1991, van de Fliert, 1993). However, Rola et al. (2002) argue that FFS-acquired knowledge and information do not flow readily through the informal farmer-to-farmer interactions that take place in typical rural settings.

Field demonstration is an important group technique used for extension purposes. Demonstrations and field days are often organised by CBOs and supported by non-governmental organisations (NGOs) and local extension agents (Sanginga and Woomer, 2009). Demonstrations are established early in the season and become the main focus of the field day when strong differences in management are apparent. The efficacy of demonstrations lies in the fact that they are evidential and that they tend to convince and motivate extension clientele to try new practices, to set up long-term teaching-learning situations (Sanginga and Woomer, 2009). Dissemination of ORM technologies can also be achieved through intermediary organisations that link farmers to commodity markets. Alternatively, processors interested in the end product of each target group can be mobilised to assure farmers of markets and provide small grants that ensure produce quality (Sanginga and Woomer, 2009).

2.1.8 Importance of Stakeholders in Dissemination of Research Outputs

Sanginga and Woomer (2009) observe that partnerships and linkages with local stakeholders and service providers provide the means of sharing the best technologies and methods to wider areas. Participation of stakeholders in decision-making is recommended as a new approach in knowledge transfer adoption of agricultural technologies (Holderness and Global Forum on Agricultural Research, 2013).

According to White and Eicher (1999), NGOs have emerged as a powerful force for development in Africa because of their practical agendas and flexible operations. NGOs range in size from massive international humanitarian organizations to very small community focused operations. As the importance of integrated soil fertility management grows within rural development agendas, more, larger NGOs will incorporate its principles into their development activities and numerous, smaller NGOs will likely form around it. According to White and Eicher (1999), many smaller NGOs are often committed to rural transformation and simultaneously undertake the many services necessary to stimulate economic development although skeptics challenge their expertise and endurance. Farm input supply is one of these actions and farmers may be provided with the improved seeds, mineral fertilisers and other products required to raise their yields to a target level (Denning et al. 2009). On the other hand,

agro-dealers play critical roles in distributing the correct types of fertiliser and participating in credit and voucher programs (Sanginga and Woomer, 2009).

According to Bationo (2004), strengthening and sustaining networking of stakeholders is critical in enhancing the efficiency of ORM research in order to empower farmers to use organic and inorganic resources with optimal efficiency in addition to sustaining their capacity to generate, share and apply soil fertility and biology management knowledge and skills to contribute to the welfare of farming communities.

2.1.9 Socio-Economic Factors that Affect Farmers' Access to Agricultural Technology Information

Education is widely considered to be the most important form of human capital (Schultz, 2005). Low levels of formal education are a barrier to the dissemination of useful information although the rate of adoption varies from farmer to farmer depending upon the situation and availability of information sources (Taley and Khadase, 2006). In particular, many scholars agree that highly educated farmers tend to adopt productive innovations earlier than those who are relatively poorly educated (Basu et al., 2002). Knight et al. (2003) have found that the schooling of the head of the household reduces risk aversion and encourages the adoption of agricultural innovations in rural Ethiopia. In addition, Sanginga and Woomer (2009) claim that low levels of literacy among the smallholder farmers in SSA prevent effective communication and dissemination of soil fertility information.

Social systems need structures and operations in order to effectively encourage and empower farmers to adopt soil fertility techniques. For instance, farmers belonging to a local organisation have a higher chance of accessing information on soil fertility management (Katungi, 2006). Social organisations provide a forum for exchange of ideas.

2.2 Theoretical Framework

This study was guided by two theories: Diffusion of innovations theory, and Transtheoretical model of change.

2.2.1 Diffusion of Innovations Theory

Diffusion of innovations theory was developed by Everett Rogers in 1962 (Rogers, 2003). This theory seeks to explain how, why, and at what rate new ideas and technology spread through cultures. Rogers (2003) points out that diffusion is the process by which an innovation is communicated through certain channels over time among the participants in a social system. According to Ridwan, Suleiman and Fatonji (2014), the word 'innovation' refers to a new idea, product, technique or practice while the word 'diffusion' refers to the process of spreading such idea within a target group. The end result of diffusion is that people, as part of a social system, adopt a new idea, behaviour or product.

Innovation, adopters, communication channels, time and social system are the five key elements of the diffusion of innovations (Rogers, 2003). An innovation is an idea, practice, or project that is perceived as new by an individual or other unit of adoption (Rogers, 2003). An innovation may have been invented a long time ago, but if individuals perceive it as new, then it may still be an innovation for them. Adopters are individuals, but can also be organisations (businesses, schools, hospitals, etc.), clusters within social networks, or countries.

Communication channels form the third element of diffusion of innovations. Rogers (2003) defines communication as a process in which participants create and share information with one another in order to reach a mutual understanding. This communication occurs through channels between sources. Rogers (2003, p.204) states that "a source is an individual or an institution that originates a message while a channel is the means by which a message gets from the source to the receiver". Rogers (2003) states that diffusion is a specific kind of communication and includes these communication elements: an innovation, two individuals or other units of adoption, and a communication channel.

Mass media and interpersonal communication are two communication channels.Time is also critical in diffusion. This is the period between transfer of innovation and adoption of the same innovation. The passage of time is necessary for innovations to be adopted; they are rarely adopted instantaneously. This is illustrated by Ryan and Gross's (1943) study on hybrid corn adoption in which adoption occurred over more than ten years, and most farmers only dedicated a fraction on their fields to the new corn in the first years after adoption.

The social system is the last element in the diffusion process. Rogers (2003, p.23) defines the social system as "a set of interrelated units engaged in joint problem solving to accomplish a common goal". Since diffusion of innovations takes place in the social system, it is influenced by the social structure of the social system. The structure is the patterned arrangements of the units in a system (Rogers, 2003).

There are five established adopter categories according to Rogers (2003), namely innovators, early adopters, early majority, late majority and laggards.

Innovators are people who want to be the first to try the innovation. They are venturesome and interested in new ideas. These people are very willing to take risks, and are often the first to develop new ideas. Very little, if anything, needs to be done to appeal to this population.

Early adopters are people who represent opinion leaders. They enjoy leadership roles, and embrace change opportunities. They are already aware of the need to change and so are very comfortable adopting new ideas. Strategies to appeal to this population include how-to manuals and information sheets on implementation. They do not need information to convince them to change.

On the other hand, early majority are people whohave above average social status and much contact with early adopters and as a result adopt new ideas before the average person though they need to see evidence that the innovation works before they are willing to adopt it. Strategies to appeal to this population include success stories and evidence of the innovation's effectiveness.

The late majority are those who are skeptical of change, and will only adopt an innovation after it has been tried by the majority. Strategies to appeal to this population include information on how many other people have tried the innovation and have adopted it successfully.

The last category comprises laggards. These people are bound by tradition and they are very conservative. They are very skeptical of change and are the hardest group to bring on board. Strategies to appeal to this population include statistics, fear appeals, and pressure from people in the other adopter groups (Rogers, 2003).

Uncertainty is an obstacle to the adoption of innovations. An innovation's consequences may create uncertainty. "Consequences are the changes that occur in an individual or a social system as a result of the adoption or rejection of an innovation" (Rogers, 2003, p.436). To reduce the uncertainty of adopting the innovation, individuals should be informed about its advantages and disadvantages to make them aware of all its consequences. Rogers (2003) says this is done through innovation-decision process which involves five steps: (1) knowledge – exposing an individual to an innovation; (2) persuasion – readily availing related information/details to the individual; (3) decision – individual decides whether to adopt or reject the innovation after weighing its advantages and disadvantages; (4) implementation – employing use of innovation; and (5) confirmation – confirming whether one has made the right decision to adopt.

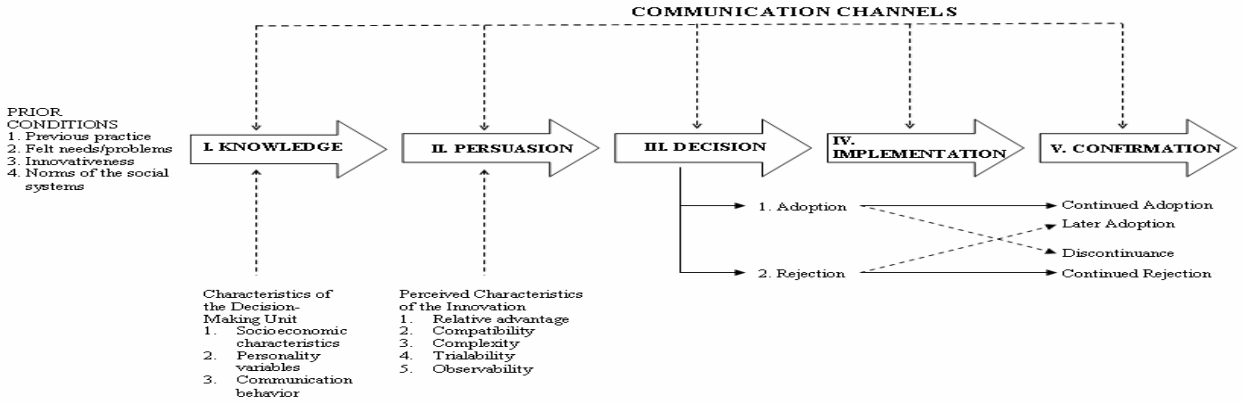

Figure 1: A model of five stages in the innovation-decision process (Source: Rogers, 2003).

Diffusion of innovations is a relevant theory for this study because ORM technologies can be communicated to the farmers through various communication channels and approaches. Taking into consideration the argument in this theory, the study assessed the effectiveness of information and communication on the adoption of ORM techniques (to build soil fertility) by farmers in the Central Kenyan Highlands.

2.2.2 Transtheoretical Model of Change

The transtheoretical model of change (TTM) is a model that addresses how people change their behaviours, with a person's readiness for change as the focus (Velicer et al., 1998 and Scholl, 2002). The model posits that people change behaviours based on their decisions and that change occurs over time.

TTM is derived from a comparative analysis of leading theories of behavioural change and psychotherapy culminating in the conception of change as a process that takes place in stages over time (Prochaska and Velicer, 1997; Velicer et al., 1998; Scholl, 2002). The main constructs of this model are the stages of change, processes of change, self-efficacy, and decisional balance.

TTM proposes that in the process of behaviour modification, a person moves through six stages of change: pre-contemplation, contemplation, preparation, action, maintenance, and termination (Prochaska and DiClemente, 1983; Prochaska et al., 1992; Prochaska andVelicer, 1997).

In the pre-contemplation stage, people have no intentions of taking action in the future (Prochaska et al., 1992; Prochaska and Velicer, 1997; Scholl, 2002). Individuals in this stage may be unaware or uninformed of the consequences of their behaviour (Prochaska et al., 1992; Scholl, 2002) or may have had a number of failed attempts at change and are discouraged to try again (Prochaska and Velicer, 1997). Prochaska et al. (1992) point out that those in the pre-contemplation stage tend to show resistance to recognizing or modifying a problematic behaviour.

In the contemplation stage, people contemplate making a change (Prochaska et al., 1992; Prochaska and Velicer, 1997; Velicer et al., 1998). People in this stage are aware and informed about the advantages and disadvantages of changing and thus weigh them to decide whether to change. An individual in this stage decides whether they need to correct the problem and whether or not the pros and cons of making a change outweigh the pros and cons of maintaining the status quo (Scholl, 2002). An individual will move on to the next stage if he or she thinks the pros outweigh the cons and if the force of motivation is stronger for change than it is for remaining stable (Scholl, 2002).

Preparation is the stage in which people intend to take action in the next 30 days. According to Scholl (2002), individuals will move to the next stage when they select a plan of action that they feel will work and if they feel confident that they can follow through with the plan.

In the action stage, people are actively involved in taking steps to change their behaviour by using a variety of different techniques. Prochaska and DiClemente (1983) say that the main ways of recognising that someone is in the action stage is through their significant efforts made to

change and through modifying the problem behaviour to acceptable levels. Movement into the final stage occurs when an individual sees evidence of performance improvement, has a positive affective state, and receives positive social and performance feedback (Scholl, 2002).

Lastly, in the maintenance stage people work to prevent relapse and secure their gains made during action. Individuals in the maintenance stage are less tempted to relapse and more confident that they will be able to uphold change (Prochaska and Velicer, 1997; Velicer et al., 1998). According to Prochaska et al. (1992), individuals are said to be in the maintenance stage if they have the ability to remain free from the problem behaviour and participate in new incompatible behaviours for more than six months. According to different researchers (for example, Patten et al., 2000; Prochaska et al., 1992; Prochaska and Velicer, 1997; Velicer et al., 1998), maintenance is a continuation of change, not an absence of it.

Termination is the stage at which individuals have zero temptation and 100% self-efficacy. No matter what situation they face, they are confident they will continue with their changed behaviour and not relapse to initial problematic behaviour (Prochaska and Velicer, 1997). At this stage, the behaviour has become automatic.

The process of change is the second major aspect of the TTM. This process describes how shifts in attitudes, intentions, and behaviours occur (Patten et al., 2000; Prochaska et al., 1992; Rodgers, Courneya, and Bayduza, 2001). The process of change comprises several elements among them self-efficacy and decisional balance (Prochaska and DiClemente, 1983).

However, it is indicative from existing literature that TTM has rarely been employed in assessing behaviour change in farmers, particularly in the adoption of new farming technologies. The model can effectively be used by extension agents to influence change in farming. An understanding of how change occurs allows agricultural professions to match audiences (farmers) with appropriate methods of messaging and supporting activities to encourage movement through to the next stage.

2.3 Conceptual Framework

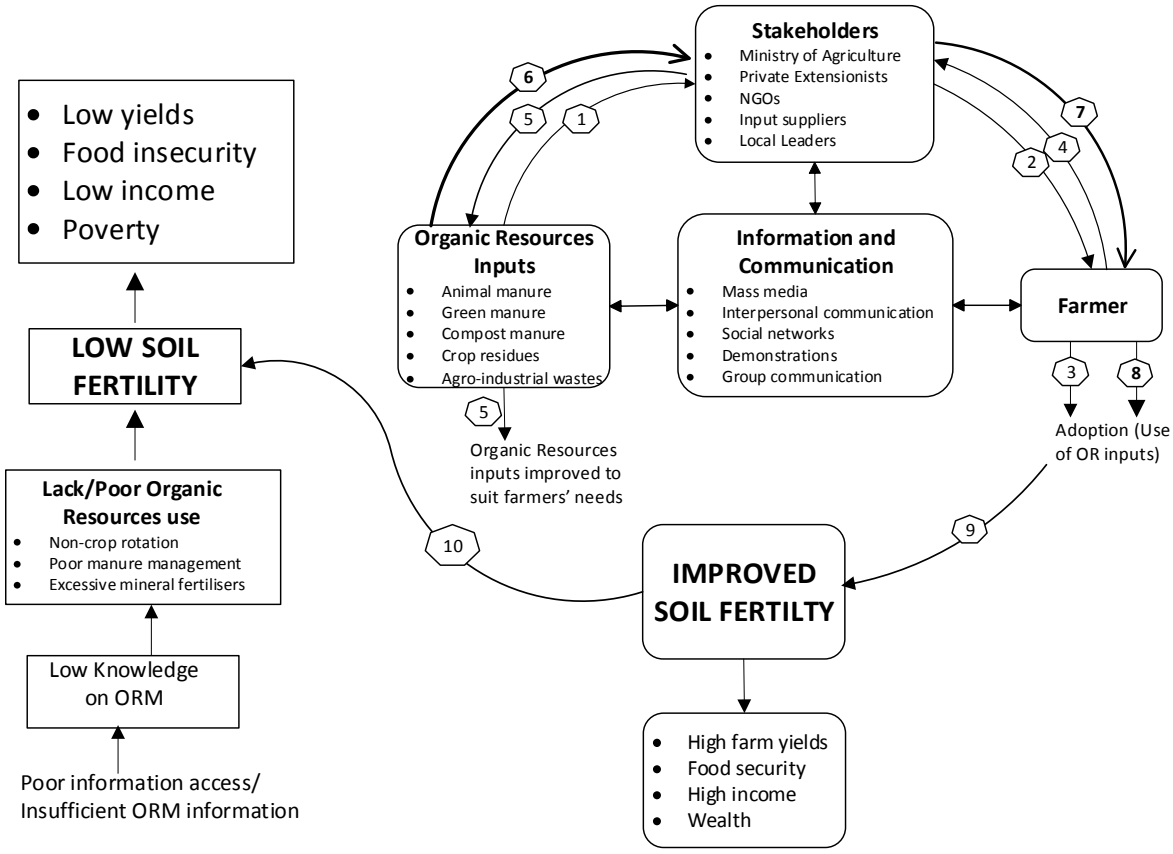

Figure 2: A conceptual framework illustrating the effect of information and communication on the use of organic resource inputs to build soil fertility (Source: Researcher)

Information plays a big role in influencing farmers adopt organic inputs to improve soil fertility. According to the framework, the available organic resource inputs get the attention of key agricultural stakeholders (Arrow 1). The stakeholders adopt the inputs and disseminate them to farmers (Arrow 2). Effective communication approaches such as mass media, group communication, etc. are used in disseminating these practices (inputs) to farmers. The dissemination of these inputs is marked by rigorous farmer trainings. Once farmers have received this information and understood it, their knowledge on ORM is improved. With improved knowledge, farmers adopt (use) the inputs on their farm (Arrow 3). In the process of adoption, some challenges associated with the inputs' use may arise and as a result farmers get back to the stakeholders through appropriate communication approaches in an effort to overcome these challenges (Arrow 4). The stakeholders look at ways of addressing farmers' feedback and

eventually modify the inputs (Arrow 5) to suit their (farmers') needs and address any difficulty during adoption. The improved (modified) organic resource inputs are taken up by the stakeholders (Arrow 6) and then by farmers via appropriate communication pathways (Arrow 7). With improved awareness and knowledge on ORM, farmers adopt and implement the improved inputs with ease (Arrow 8). With consistently using the inputs, the fertility of the soil on farmers' farms improves (Arrow 9). The improved soil fertility makes the farm more productive as farmers realize high yields, sufficient food (improves food security), and high farm income. This conceptual diagram shows the effectiveness of information and communication in influencing farmers to use the organic inputs to improve soil fertility.

2.4 Chapter Summary

This chapter examined existing literature related to the efficacy of information and communication in the adoption of ORM technologies in SSA. Important aspects that facilitate access to ORM information and eventual adoption of the technologies were discussed. As seen above, even though information and communication are key to improving the adoption rates of the techniques, there exist numerous challenges that hinder farmers in SSA from accessing such information and therefore the adoption rates are still low in the region. In that regard, the chapter critically discussed a theoretical framework that can be utilised to mitigate these challenges, improve access to ORM information and facilitate more adoption of the technologies. The next chapter discusses the methodology that was used in the research.

CHAPTER 3

METHODOLOGY

3.0 Introduction

This chapter discusses the methodology used in this study. This includes a description of the research design employed, population used, sampling methods and data collection tools used. Ethical issues governing the study are also discussed in this chapter. The chapter further discusses qualitative method analysis; a method used to analyse data in this study. The area where the study took place has also been described.

3.1 Research Design

This research adopted a multi-method approach mainly to overcome weaknesses inherent in single method studies. The approach involved the use of phenomenology qualitative research design strategy and participatory research to collect data from farmers and agriculture stakeholders.

Phenomenology research uses in-depth interviews to determine an individual's or group's perception of an event, relationship, program, emotion, etc. as they experience and understand them (Leedy, 1997, p.161). Participatory research enhances people's awareness and confidence and empowers their action (Chambers, 1993). The multi-method approach enhances the validity of the results (Campbell et al., 1999).

3.2 Target Population

The target population comprised small scale farmers and agriculture stakeholders from the two sub-counties. The stakeholders were the key informants for the study.

3.3 Sampling

3.3.1 Sampling Procedure

Firstly, two counties – Tharaka Nithi and Murang'a – were selected for the study. A sub-county from each of the two counties were then selected (Meru South sub-county in Tharaka Nithi and Gatanga sub-county in Murang'a). From each sub-county, two villages were selected (Kinjoni and Kabutini villages in Meru South; and Rwaitira and Muriko-ini villages in Murang'a). The selected villages from each sub-county formed a focus area for the study.

3.3.2 Sample Size

A total sample size of 70 farmers (35 from each focus area) and 12 stakeholders was drawn from both study areas (sub-counties). Forty farmers were selected for participatory research while 30 were sampled for interviews. Seven selected stakeholders were from Meru South and five from Gatanga Sub-county.

Farmer Number	Farmer Code	Gender	Area of Study
Farmer 1	F01	Female	Meru South
Farmer 2	F02	Female	Meru South
Farmer 3	F03	Male	Meru South
Farmer 4	F04	Male	Meru South
Farmer 5	F05	Female	Meru South
Farmer 6	F06	Female	Meru South
Farmer 7	F07	Female	Meru South
Farmer 8	F08	Female	Meru South
Farmer 9	F09	Male	Meru South
Farmer 10	F10	Male	Meru South
Farmer 11	F11	Female	Meru South
Farmer 12	F12	Male	Meru South
Farmer 13	F13	Male	Meru South
Farmer 14	F14	Male	Meru South
Farmer 15	F15	Female	Meru South
Farmer 16	F16	Female	Gatanga
Farmer 17	F17	Female	Gatanga
Farmer 18	F18	Female	Gatanga
Farmer 19	F19	Female	Gatanga
Farmer 20	F20	Female	Gatanga
Farmer 21	F21	Female	Gatanga
Farmer 22	F22	Male	Gatanga
Farmer 23	F23	Male	Gatanga
Farmer 24	F24	Male	Gatanga
Farmer 25	F25	Female	Gatanga
Farmer 26	F26	Male	Gatanga
Farmer 27	F27	Male	Gatanga
Farmer 28	F28	Male	Gatanga
Farmer 29	F29	Male	Gatanga
Farmer 30	F30	Female	Gatanga

Table 1.1: Profile of respondents used in the household interviews

3.3.3 Sampling Methods

Purposive sampling technique was used to select the two counties and a sub-county from each county. This technique ensured that the researcher selected areas with respondents who possessed all the attributes required for the study (Berg, 2001, p. 32). Therefore, purposive sampling was appropriate in selecting the areas that met the purpose of the study.

All villages from each sub-county were stratified according to zones (tea or coffee zone) and one village from each stratum randomly selected. In Meru South, Kinjoni village is located in the coffee zone while Kavutini village lies in the tea zone. Rwaitira and Muriko-ini villages in Gatanga are located in the coffee and tea zones respectively. Stratified random sampling was appropriate since it ensured all the segments of the population under study were represented (Berg, 2001, p.31).

Simple random sampling was used to select farmers as respondents for the study. Twenty farmers from each focus area (selected villages in a sub-county) were selected to be respondents in participatory research and another 15 from each focus group were selected for interviews. Therefore, a total of 70 farmers (35 from each sub-county) were randomly selected. According to Bailey (1994), simple random sampling is devoid of researcher biases as it ensures every member of a population stands equal chances of selection. Seven stakeholders from Meru South and five from Gatanga were purposively selected.

3.4 Data Collection

Primary data were obtained from Participatory Rural Appraisal (PRA) tools, in-depth interviews and observation.

3.4.1 Participatory Rural Appraisal

One PRA meeting was held in each village. Chambers (1993) explains that PRA is a useful approach in clearly understanding a phenomenon since it comprises methods for learning about rural life and conditions from, with and by rural people

Four tools – timeline, problem tree, resource maps and Venn diagram – were used in the PRA exercises. A resource map was drawn by the farmers with the help of the researcher. It was used

to show the general distribution of resources (forests, roads, social amenities and rivers) within the village. Information from the PRA exercises was used to complement data obtained from individual interviews. The problem tree was used to highlight in detail the causes of soil fertility depletion, effects and possible solutions to the problem (the trunk represented the core problem – low soil fertility; roots represented the problem causes; and branches being the effects of low soil fertility). The Venn diagram was used to seek and indicate the external stakeholders involved in agricultural development in the area whilst the timeline was used in understanding the climatic and agronomic history of the area for the past five years. Information from the PRAs was used to complement data obtained from individual interviews.

3.4.2 Interview Schedules

Semi-structured interviews were conducted to collect information from respondents (farmers and stakeholders). Two interview schedules were used: one was used to collect data from selected farmers (see Appendix 2) and the other used for stakeholder data (see Appendix 3). Interviews provided an opportunity for the researcher to gain deeper insights of a situation and subjects' experiences and interpretations of it (Mack et al., 2005, p. 30). Data from the interview was recorded using a digital voice recorder with the consent of the respondent. The interview data were corroborated using observation and PRA data. Data collection took place in July and August 2015.

3.5 Pretesting the research instruments

A pilot study was carried out to test the suitability of interview schedules for farmers and stakeholders and PRA tools for farmers. Ten farmers were randomly selected – seven participated in PRA exercise, and three were interviewed individually. An extension agent was purposively selected and interviewed. The pilot study took place in Kivangua village of Manyatta sub-county in June 2015. The respondents who participated in the pilot exercise did not take part in the actual PRA exercise, household interviews or stakeholders' interviews. According to Mack et al. (2005, p. 80), pretesting of research instruments facilitates the identification of poorly worded questions, questions with offensive or emotion-laden wording, or questions revealing researchers' own biases, personal values, or blind spots and assesses whether the type of information being sought will actually be obtained.

3.6 Ethical Considerations

High level of professional ethical standards was adhered to during the study. Before obtaining data from a respondent, the researcher first explained the purpose of the study to respondents. Participants were then told about the objectives and the anticipated benefits of the study. Respondents were also asked for their consent before interviews and assured and assured of privacy and confidentiality. Participants' consent was also sought before any recording was done. Assuring the participants that whatever they say will be kept in confidence is important for earning their trust and thus eliciting accurate data (Mack et al, 2005, p. 53).

3.7 Data Analysis and Presentation

All the questions were checked to ensure they had been answered. Respondents' answers were then transcribed (their audio-recorded answers were put in written form). The audio data were in local language and Swahili. The transcription was done in English for easy analysis. Dialect and colloquial language was approximated to standard language for easy readability. During transcription, special codes were used to represent respondents (see Table 1.1). All responses from a respondent were put in one transcript and therefore 30 transcripts (each having responses from one respondent) were produced. All the answers for each question were then group together. Respondents' responses were then analysed and different themes emerged. The responses were categorised according to the themes. The themes were sub-categorised for purposes of description.

Qualitative data analysis methods were employed to extract various explanations, understandings and interpretations of the data/information collected. More specifically, the study used narrative analysis. Tables were used to present the data collected.

3.8 Area of the Study

The research was carried out in two counties – Tharaka Nithi and Murang'a – in the Central Highlands of Kenya. Two village, namely Kinjoni and Kabutini villages in Tharaka Nithi and Rwaitira and Muriko-ini villages in Murang'a County were selected for the study. The two study areas were chosen based on the fact that there is availability of different communication sources

in the areas. The areas were also chosen based on the difference in rainfall amount and distribution, cropping patterns, and socio-economic conditions.

Kinjoni and Kabutini villages are located in Mugwe CAW, Meru South Sub-county. Meru South sub-County is 172 km north east of Kenya's capital Nairobi and covers an area of 624.4 km^2 (GoK, 2014). The sub-county is located in the Upper Midland Zone Two (UM2) and Upper Midland Zone Three (UM3) agro-ecological zones, on the eastern slopes of Mt. Kenya (Jaetzold et al., 2007*).* UM2 is a coffee zone with a medium and a short-to-medium cropping season while the UM3 is a marginal coffee zone. The sub-county lies at an altitude of 1,500m above sea level and hasan annual mean temperature of 20°C and receives a total annual rainfall of 1,200 to 1,400mm (Jaetzold et al., 2007*).* The long rains run from March to June, and short rains from October to December. It is a predominantly maize (*Zea Mays L*) growing zone as an annual crop with smallholdings.

The predominant soil type is humic Nitisols, a typical deep and weathered soil with moderate to high inherent fertility (Jaetzold et al., 2007). According to the KNBS (2009), Meru South sub-county had a total population of 128,107 people (62,177 males and 65,930 females), 33,240 households with an average family size of seven persons and a population density of 205 persons per km^2 by 2009. Of the total number of households, 78.6% had radio, 59.6% had phones and 24.7% owned television sets by 2009 (KNBS, 2009). However, based on the earlier projections, the sub-county currently has a population of 142,717 people and this will grow to 147,949 by 2017 (KNBS, 2009). According to GoK (2014), a majority of the sub-county residents are small scale farmers with an average land of 2.9 hectares which is mostly used for food and cash crop farming. Tea, coffee and bananas are the main cash crops. The main food crops are maize, beans, and cowpeas. Livestock keeping is also a major source of livelihood in the sub-county. The main livestock include: dairy cattle, indigenous zebu cattle, sheep, goats and chicken (KNBS, 2009).

Rwaitira and Muriko-ini villages are located in Mugumo-ini and Kariara locations in Gatura CAW, Gatanga sub-county located 62 km north east of Nairobi. According to GoK (2014), the sub-county covers an area of 599 km^2. 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).

Gatanga sub-county receives total annual rainfall of 900 to 1,400 mm with a mean annual temperature of 26.3^{o}C (Jaetzold et al., 2007). It lies at an altitude of 1,520 – 2,280m 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 (*Zea Mays L*) and beans (*Phaselous Vulgaris*). Farming in the area often practise mixed farming. The main livestock bred in the county are cattle, pigs, goat, sheep and chicken.

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, moderately to highly fertile.

Based on the 2009 National Population and Housing Census, Gatanga had a total population of 163,597 people (80,987 males and 82,610 females), 30,211 households and a population density of 293 persons per a km^2 (KNBS, 2009). With a population growth rate of 0.4%, KNBS (2009) projected the total population to reach 167, 571 people by 2015 and 168,917 by 2017.

The average farm size per household is 1.4 acres with 62.1% of the farmers having title deeds (GoK, 2014). By 2009, most households in the sub-county had radio (87%) and phones (72%) while a few households (30.7%) had television sets.

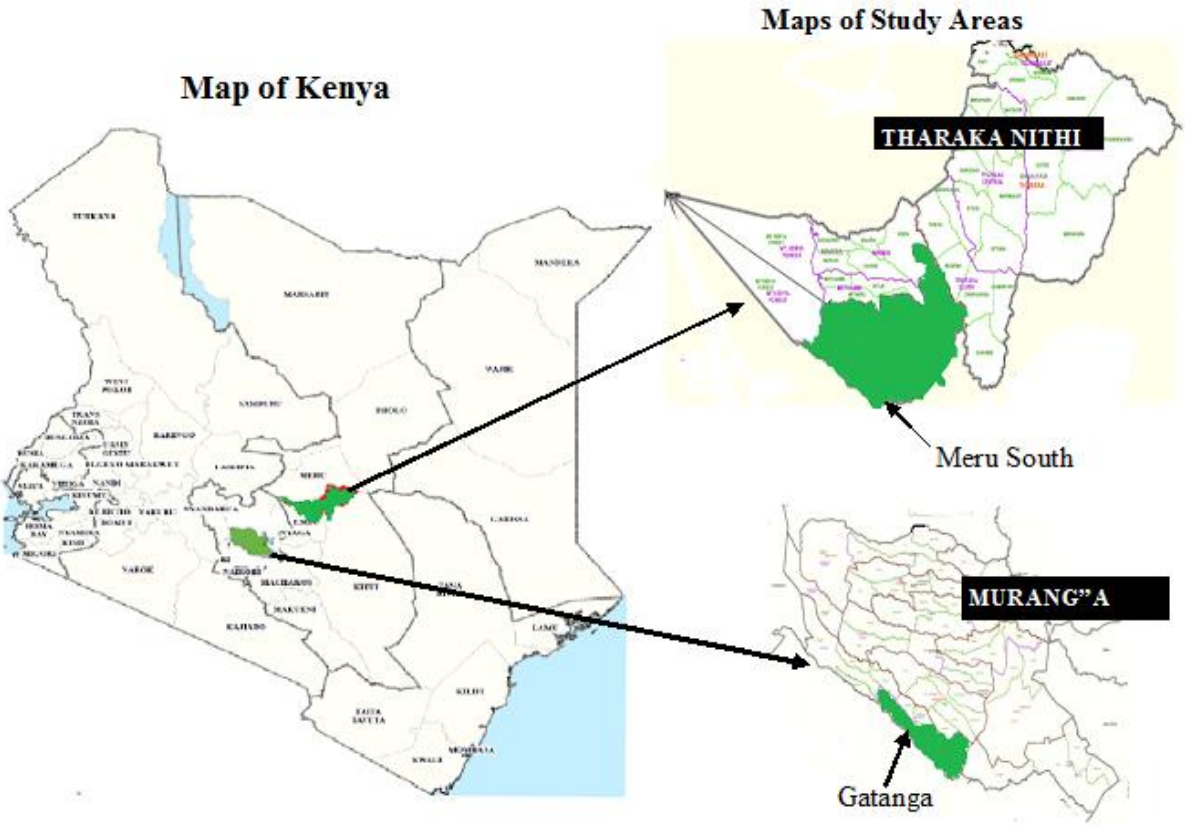

Figure 3: Map of the study area showing the location of study sites in Tharaka Nithi and Murang'a Counties

3.9 Chapter Summary

Chapter three discussed the methodology used in the study. It critically looked at the multi-method research design – a design that was used in the study – and detailed its advantages to this study. Sampling procedure and methods used to select the study respondents were also explained. The suitability of PRA and interview schedules as data collection tools in this research was discussed. Since issues of respondent's privacy and confidentiality are important, this chapter also emphasized ethical issues that were considered by the researcher during the study. Chapter three also justified the use of qualitative method to analyse data collected. In that connection, the next chapter analyses and presents data collected, and discusses the findings.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.0 Introduction

This chapter presents and discusses the findings on the effects of information and communication on the use of ORM inputs in Meru South and Gatanga sub-counties. The findings are grouped into five main themes: Awareness of ORM inputs; knowledge on use of the inputs; influence of information on their adoption; limitations of information and communication in influencing the use of ORM inputs, and socio-economic factors affecting access to ORM information. The themes are further sub categorised to gain a deeper insight into the findings. In order to contextualise these themes, the chapter begins by presenting respondent's socio-economic characteristics. It also describes communication sources used by farmers to access organic resource inputs.

4.1 Socio-Economic Characteristics

4.1.1 Gender

Sixteen of the respondents who took part in the household were female and 14 were male. In each sub-county, 8 female and 7 male were interviewed.

Study Area	Male	Female	Total
Meru South	7	8	15
Gatanga	7	8	15
	14	**16**	**30**

Table 1.2: Gender of respondents interviewed

4.1.2 Age

Most of the farmers interviewed in both sub-counties aged between 50 – 80 years. A few ranged from 36 – 49 years and only one was below 36 years. Nine respondents in Meru South and 12 in Gatanga were in age brackets of 50 – 80 years. Six and two respondents in Meru South and Gatanga respectively ranged between 36 – 49 years.

	Age Brackets		
Study Area	**26 – 35**	**36 – 49**	**50 – 80**
Meru South	0	6	9
Gatanga	1	2	12
	1	**8**	**21**

Table 1.3: Age of the respondents

4.1.3 Education

Majority of the farmers interviewed in both study areas attained formal education. More than half of the respondents in Meru South have primary school education with slightly less than a third having reached secondary school level. Only two respondents from that area have tertiary level education. In Gatanga, a fifth of the farmers interviewed have no formal education, a third have primary school education, and slightly over a third having secondary school education. Generally, most of the respondents in both areas have primary and secondary school education.

Level of education of respondents			Sub-County		
			Meru South	Gatanga	**Total**
	No schooling	Count	1	3	4
	Primary	Count	8	5	13
	Secondary	Count	4	6	10
	Tertiary	Count	2	1	3
Total		**Count**	**15**	**15**	**30**

Table 1.4: Levels of respondents' education

4.1.4 Farmer Respondents' profile

For the purpose of this study, the 30 respondents that took part have been assigned specific codes (as shown in table 1.4) for easy identification. The coding follows the order of interviews carried out. Data was firstly collected in Meru South followed by Gatanga. Therefore, F01 to F015 represent respondents from Meru South and F16 to F30 represent those from Gatanga.

4.1.5 Land Size and Tenure System

All the farmers interviewed in Meru South and Gatanga said that they possess their land under freehold tenure system. Three farmers in Meru South and two in Gatanga reported that in addition to the land they own, they have also leased other pieces to intensify their farming.

The mean farm size of the interviewed farmers in Meru South is 2.07 acres with individual farm size ranging from 0.75 to 8 acres. In Gatanga, the mean farm size of those interviewed is 2.43 acres and the individual farms size being between 0.2 and 6 acres.

4.1.6 Livestock

Different types of livestock are reared by farmers in both sub-counties. Dairy cows and chickens are the common types as majority of the respondents kept them. A farmer kept between one to four cows and two to 40 chickens. Other livestock mainly kept are goats and sheep. Farmers said that they feed their cows, goats and sheep using crop residues, fodder, and napier grass. A few farmers also buy dairy meals to feed their dairy cows. Most of the farmers keep chickens under free-range system.

4.1.7 Main Crops

From the PRA exercise, farmers' and stakeholders' interviews, the main cash crops cultivated in both sub-counties are bananas, coffee and tea. In Gatanga specifically, coffee and bananas are grown in the lower regions and tea cultivated in the upper parts towards the Aberdares. The main food crops in the sub-counties are maize, beans and bananas.

Study areas	Main Cash Crops	Main Food Crops
Meru South Gatanga	Bananas Coffee Tea	Maize Beans Bananas

Table 1.5: Main cash crops cultivated in Meru South and Gatanga

4.1.8 Stakeholders' Information

Twelve stakeholders were interviewed in order to gain the insights and confirm farmers' responses on the effects of information and communication on the use of ORM inputs. Of the 11, seven were drawn from Meru South and five from Gatanga. Stakeholders are persons and organizations that should benefit from, or at least engage with, a research either directly or indirectly through the communication and scaling-up of research products (Kimaru-Muchina et al., 2011; Sanginga and Woomer, 2009)).

Area of Study	Stakeholder Type	Institution/Location
Meru South	1. Head of Agriculture Extension	Sub-county Ministry of Agriculture
	2. Assistant Chief	Kiereni Location
	3. Village Elder	Kinjoni Village
	4. Agriculture Teacher	Kiereni Secondary School
	5. ICIPE Staff	Project at Kiereni Sec. School
	6. Juhudi Kilimo Manager	Chuka Branch
	7. Agro-input Dealer	Chuka Town
Gatanga	1. Chief	Gariera Location (Muriko-ini)
	2. Field Extension Agent	Ministry of Agriculture
	3. Agro-input Dealer	Rwaitira Village
	4. ICIPE Staff	Gatanga Sub-county
	5. KTDA Extension Officer	Ngere Tea Factory - Gatanga

Table 1.6: List of stakeholders who participated in this study

Participation of stakeholders in decision-making is recommended as a new approach in knowledge transfer adoption of agricultural technologies (Holderness and Global Forum on Agricultural Research, 2013).

4.2 Awareness of ORM Inputs

This theme presents and discusses the availability of information about ORM inputs to farmers. It describes sources of ORM information and specifically identifies those disseminating information about different input. The overarching aim of this theme is whether farmers have heard of these inputs through these information sources.

4.2.1 Sources of ORM Information

Notably, all farmers said that they have heard about different ORM techniques. All the farmers interviewed said that they know about animal manure with majority saying they know about combined organic and inorganic fertilisers and crop rotation. However, not all farmers have heard of green manure, compost manure, cover crops, conservation agriculture, biomass transfer, agroforestry and mulching. They said that different information sources enabled that to aware of the techniques.

Respondents indicated that they use more than one source to access information about ORM inputs. The government extension staff and vernacular radio are the most used sources of information on ORM in both study areas. However, the government extension staff are the highly preferred information source for different ORM option (Table 1.5). It is followed by vernacular radio, agricultural organisations and television respectively.

	Agricultural extension	**Media**		**Agricultural Organisations**		**Farmer Groups**
		Radio	Television	ICIPE	KALRO	
Meru South	8	5	0	0	1	2
Gatanga	7	3	1	1	1	2
Note: The figures show the number of respondents preferring the source for ORM information						

Table 1.7: Sources of ORM information

Farmers said that they mostly access information from extension officers because they are readily available, discuss different ORM methods in great details and use participatory approaches in their training. It was also found that another reason why the government extension staff are the main source is that they offer their services free of charge to the farmers. More importantly, farmers said that they prefer the government extensionists because they use local language – a language they clearly understand – in dissemination these inputs. For instance, one farmer (F24) said:

> *I receive a lot of information about soil fertility through extension officers from the ministry. They visit the farm any time you invite them. They are ready to address your farming challenges. They teach about preparation and application of manure, conservation agriculture and many others [...]*

This finding that government extension staff are the main source of information about organic resource inputs is corroborated by various stakeholders among them Kinjoni village elder and Kireni Secondary school agriculture teacher in Meru South and Gariera chief and agro-input dealer in Gatanga. The village elder explained that:

> *My people are learning new agricultural methods through the extension officer. I thank her lot (extension officer) because she works for the people tirelessly. I hear people saying she knows how to teach and she's humble and good-hearted […]*

These findings agree with Kimaru-Muchina et al. (2011) findings that the government extension agents are the main sources of information about soil fertility management in the central highlands of Kenya. The fact that farmers prefer them because they use local language is supported by Oladoja et al. (2008) who recommended the use of local language to communicate agricultural information to local farmers.

Source of ORM Information	Main Reasons for Preference
Government Extension Staff	• Readily available • Discuss different ORM methods in great details • Use participatory approaches in their training • Use local language to train farmers
Vernacular Radio	Use local language to disseminate information

Table 1.8: Reasons why government extension and vernacular radio are the main sources of ORM information

Vernacular radio is the second most preferred source of ORM information. In Meru South, those who cited radio as their other source of ORM information mentioned Muuga FM, Kameme and Wimwaro FM as radio stations that made them aware of some of the ORM techniques. On the other hand, some farmers from Gatanga said that they receive ORM information from Inooro FM, Kameme or Coro FM. These respondents argued that they also prefer vernacular radio because it disseminates information in their local language. One of them (F30) said the following about radio as they source of ORM information:

> *I can say that Mugambo Wa Murimi (Farmer's Voice) agricultural programme on Inooro is useful to me though it usually concentrates on dairy farming. Once in a while, it gives me useful information about soil fertility management and inputs. Kayo Ka Mwingi (Kameme FM) also an agricultural programme once a week and I listen to it sometimes for information about new ways of improving soil fertility […]*

This finding is supported by the results of Adolwa et al. (2012) that radio is the most suitable for the dissemination of information among rural populations since many farmers own radio.

Area of Study	Vernacular Radio listened to
Meru South	Muuga FM Kameme FM Wimwaro FM
Gatanga	Inooro FM Kameme FM Coro FM

Table 1.9: Vernacular radio stations respondents listen to in Meru South and Gatanga

From the findings, television, print media, agricultural organisations and private extension staff are rarely used as sources of ORM information by farmers in the two study areas. Farmers lamented that they do not prefer television because it is expensive and requires electricity to operate (not available in the villages). Print media are not used as a source of ORM information because farmers said that they rarely carry agricultural information. In addition, farmers said that newspapers and brochures do not use a language they easily understand.

The findings show that organisations such as International Centre of Insect Physiology and Ecology (ICIPE) and Kenya Agricultural and Livestock Research Organisation (KALRO) are least preferred since they are seasonal, do not visit farmers on their farms and widely unavailable. Private extension staff dealing with soil fertility management are not also available in these areas. F05 had this to say:

> *At one point, KALRO trained us about ways of improving soil fertility. I regret that they came only once. Two months ago, a friend told me that they were undertaking a project in a village far away from here but we cannot travel to look for them because we are always busy on the farms […]*

Another farmer (F04) said:

> *The government extension officer sometimes teaches how to improve soil quality, Some people from KALRO used to visit this are about three years ago to test our soil but there've ceased from visiting us [...]*

The discovery of the rare use of television and print media agrees with Adolwa et al. (2012) findings that television and newspapers are not highly regarded because they are expensive thus unaffordable to the poor farmers in addition to the fact that newspapers pose the danger of language barrier to farmers, who most of them are illiterate.

4.2.2 Sources of Information for Different ORM Inputs

The government extensionists are mainly used by farmers to access information on different ORM inputs. Most of those who rely on them mainly access information about combined use of organic and inorganic fertilisers, animal manure, crop rotation and biomass transfer. This finding is best captured by F17 sentiment:

> *I often interact with the man in charge offering agriculture extension services in this village. We meet in church, in our shopping centre or even on the street. Even if he is not working or we are in an informal chat, he usually tells me one or two things about animal manure, crop rotation or mixing fertilisers with manure […]*

The above sentiment emphasizes earlier responses from farmers interviewed in Meru South. For instance, F11 remarked that:

> *I get information on animal manure and proper crop rotation from the local extension officer from the Ministry of Agriculture […]*

Those who said they mainly use vernacular radio revealed that the medium gives them information on animal manure, compost, green manure and crop rotation. According to farmers, KALRO and ICIPE train farmers on cover crops and combined use of organic and inorganic fertilisers. In both areas of the study, a few farmers said they mostly rely on farmer groups for information about animal manure and combined use of organic and inorganic fertilisers.

Source of ORM Information	ORM Inputs
Extension Staff	Combined organic and inorganic fertiliser Animal manure Crop rotation Compost manure Biomass transfer
Vernacular Radio	Animal manure Compost manure Green manure Crop rotation
Agricultural Organisations (KALRO and ICIPE	Combined organic and inorganic fertiliser Cover crops
Farmer Groups/Organisations	Animal manure Combined organic and inorganic fertiliser

Table 2.0: Sources of information for different ORM inputs

4.2.3 Farmer/Community Organisations Ineffective in ORM Information Access

One of the objectives of this study was to investigate the influence of community groups or organisations on the communication and adoption of ORM techniques. In this study, community organisations refer to groups in which locals join to pursue common interests. This study found out that that the respondents belonged to the following groups as shown in table 2.0:

Study Area	Groups/Organisations	Members (n)	Frequency of meeting (f)
Meru South	Religious organisations	11	Weekly
	Farmer groups	4	Every 4 months
	Cooperatives (SACCOs)	3	Fortnightly
	Village associations	1	Weekly
	Women group	1	Yearly
	Self-Help groups	1	Monthly
	Water groups	1	Every 3 months
	Farmer Field Schools	0	N/A
Gatanga	Religious Organisations	9	Weekly
	Cooperatives (SACCOs)	9	Fortnightly
	Village Associations	8	Monthly
	Farmer Groups	6	Monthly
	Farmer Field Schools	2	Monthly
Note: Some respondents are members of more than one group			

Table 2.1: Organisations/groups in Meru South that respondents are members

Interesting, the study discovered that these groups rarely disseminate information about ORM. Only four respondents – two from Meru South and two from Gatanga (see table 1.7) – said that they access ORM information from farmers groups. Although, religious organisations (churches) have the largest membership of the respondents from both study sites, it does not discuss agricultural issues. The respondents said that cooperatives focus only on two issues: Loan access by farmers, and good market for cash crops. Those in farmer groups said they talk about better cultivation of crops such as tea, coffee and maize. They revealed that though they talk about manure preparation and availability, they do not do it explicitly. These respondents lamented that they do not invite any agricultural expert to train them. One farmer (F07) in Meru South said:

> *In this area of ours there are no serious agricultural groups. In fact, people are individualistic and want to live in isolation. Like me, I only meet my fellow farmers only on Sunday when I attend church. A few women and I are in a coffee SACCO and that is*

where we also meet though we do not discuss about soil fertility… And who will talk about agriculture in church? Do you go to church to talk about agriculture or worship God? […] (Light moment of laughter).

Three out of four PRA exercises held also revealed that farmers in different organisations and groups do not talk about ORM and soil fertility management. This finding validates Sanginga and Woomer (2009) argument that lack of participation of local people in groups to build traditional knowledge is one of the principal weaknesses in the development and dissemination of improved farming methods.

4.3 Knowledge of ORM Inputs

This theme describes the farmers' ability to describe the ORM inputs in simple terms as a way of improving quality of their soil and give advantages and disadvantages of the techniques. It also presents the findings on whether different information sources are sufficient in imparting knowledge about the inputs. More specifically, this theme carries two sub-themes namely understanding of ORM inputs, and effectiveness of ORM information sources.

4.3.1 Understanding of ORM Options

The respondents clearly demonstrated their understanding on animal manure, organic and inorganic fertilisers, and biomass transfer. A few clearly explained the benefits of crop rotation and cover crops. Farmers expressed that they have learned about the advantages, management and costs of these methods.

It is noteworthy to point out that majority of the respondents said that they learned that the methods improve soil fertility by incorporating nutrients to the soil, improve crop productivity, prevent soil erosion and reduce cost of farm management such as cost of maintaining soil fertility.

Most respondents in both Meru South and Gatanga have some knowledge on animal manure. The respondents explained that the information they get emphasizes that animal manure incorporates nutrients to the soil, improves soil structure and water holding capacity of the soil,

improves crop productivity, and favours the survival of organisms that are important to the soil. This is what F09 (from Meru South) had to say about animal manure:

> *I have learned from the extension officer that animal manure improves crop productivity and improves the quality of soil in terms of fertility so that we can boast and say we've good soil […]*

They also noted that they have knowledge on manure preparation. The respondents said that they are given information on how to collect and arrange cow dung in the process of preparing manure. They also said that information is available about signs of good or poor manure.

Majority of respondents were also able to describe some advantages of combined organic and inorganic fertilisers they have learnt. Notable among the advantages they gave is that adding inorganic fertiliser to cow dung or crop residues when preparing manure speeds its maturity. Others said that it makes the manure richer in nutrients.

Some farmers from both study areas also know about biomass transfer. They explained that biomass transfer is the transportation of organic residues from one point to another where it is incorporated in the soil for the purpose of adding it nutrients. These farmers have learned about the use of tithonia as a biomass transfer plant. F28 (from Gatanga) explains what he knows about biomass transfer:

> *Let me tell you that farmers in this area know the benefits of tithonia. This is a shrub that is highly rich in nutrients and we have been taught that if we cut and take it to our farms soil fertility will increase […]*

Majority of the respondents also said that they have been trained on the application of these inputs. For instance, some respondents reported that they have been taught on the application rates of manure on their farms.

ORM Method	Perceived Benefits by Respondents
Animal manure	- Incorporates nutrients to the soil, - Improves soil structure and water holding capacity of the soil - Favours the survival of organisms that are important to the soil - Improves crop productivity
Organic and inorganic fertilisers	- Fertiliser speeds manure maturity during preparation - Fertiliser enriches nutrients to the manure
Biomass Transfer	- Highly rich in nutrients that improve soil fertility

Table 2.2: A reflection of respondents' knowledge about ORM methods

However, the study established that there was little knowledge on the benefits of green manure, compost manure, cover crops, agroforestry and crop rotation. Most respondents revealed that they do not know about them as techniques of improving soil fertility.

Data from most stakeholders agree with farmers' responses that information sources have imparted knowledge on animal manure, organic and inorganic fertilisers and biomass transfer. Here is what the head of agricultural extension in Gatanga sub-county said:

> *My officers are reporting from the field that farmers have understood the methods we are teaching them. Even when I personally visit farmers they usually appreciate the work our officers are doing saying that they have knowledge on soil fertility measures that include use of manure and so on […]*

These findings agree with Shanthy and Thiagarajan (2011) and Agbamu (1995) findings that information sources promote knowledge of different agricultural methods especially to farmers in developing countries. Furthermore, Kimaru-Muchai et al. (2011) argue that Farmer's access to different information sources helps them to get information about improved technologies and enhance the adoption of new innovations.

4.3.2 Effectiveness of Information Sources in ORM Knowledge

Majority of the respondents reported that the government extension staff are the most effective source of knowledge on ORM inputs and techniques. This was followed by vernacular radio.

4.3.2.1 Extension Staff and Vernacular Radio as Most Effective

From the findings, farmers mostly appreciate information about animal manure, combined organic and inorganic fertilisers, biomass transfer and crop rotation from the extension staff. For those who said that they learn about ORM inputs from vernacular radio importantly mentioned animal manure and crop rotation as well learnt techniques. Though farmers said KALRO is not their main source of ORM information, those who used it were emphatic that they learnt much about use of organic and inorganic fertilisers. A respondent in Gatanga (F20) explained that:

> *I think I can say that the extension people are really training us well. If you go and ask all the people around this place, they will tell you that they have learned many things about manure and crop rotation […]*

These findings concur with the findings of PRA exercises done prior to the household interviews in the two areas. Farmers who participated in the exercises agreed that the extensionists are their main source of ORM information and knowledge.

This finding is cemented by majority of stakeholders from both areas who believed that government extension agents play a big role in training farmers about ORM. According to some stakeholders, the extensionists reach out to a large number of farmers compared to other sources. An agro-input dealer in Gatanga said:

> *For me I would say that the ministry of agriculture is doing marvelous work here. Villages are accessed by their agents who teach farmers on new farming technologies including soil fertility practices. I really congratulate the government for educating our farmers […]*

Sources of ORM Information	Reasons for Effectiveness
Agricultural extension staff	i. Discuss different ORM techniques in great details; ii. Better trained and highly informed about SFM techniques; iii. Employ participatory approaches in their training. iv. Employ numerous approaches
Vernacular radio	i. Most respondents own a radio set ii. It uses a local language; language understood by the respondents iii. Radio is portable thus can be carried along to the farm

Table 2.3: Reasons why the extension staff and vernacular radio are effective knowledge sources

4.3.2.2 Approaches used by Extension Staff

It was found out that the extension staff are emerging as the effective source of ORM knowledge because they use different approaches to disseminate information. The staff use farmer field days, demonstration plots, group communication (through farmer groups), contact meetings with farmers and public *barazas*. These avenues, farmers said, are convenient for them. The assistant chief of Kiereni location noted that:

> *Information about soil fertility is mostly obtained through chief barazas (forums) where the extensionists get opportunities to talk about SFM. I hold two barazas per month […]*

Information Dissemination Approaches by Extension Staff
• Farmer field days • Demonstration plots • Group communication • Individual contact meetings • Public *barazas*

Table 2.4: Approaches extension staff use to train farmers about ORM methods

The aforementioned finding support Darr and Pretzsch (2008) findings that extension agents considerably enhance the diffusion of innovations and allow the knowledge to spread more equally by often employing personal interactions, field visits, demonstrations, outreach, workshops, etc. as mechanisms to transfer new knowledge and innovation.

4.4 Influence of Information and Communication on Adoption of ORM inputs

It was established that the widely adopted ORM techniques in both Meru South and Gatanga are animal manure, combined organic and inorganic fertilisers and crop rotation. Most farmers said that they use more than one of these techniques.

All the farmers interviewed in Meru South and 14 in Gatanga keep livestock from where they obtain animal manure. They explained that manure comes mainly from cattle, goats, chicken, pigs, and rabbits. All those who have received information about the benefits of the input reported that they use it. However, a few respondents in Gatanga argued that the manure is insufficient and thus have to source some from Narok. F10 (Meru South) said:

> *Besides crop rotation, I also quite often apply (animal) manure on the crops so that I can have good harvests […]*

Most farmers also said that they also employ a combined use of organic and inorganic fertilisers. Most of them attributed the use to knowledge they got from extension staff. Di-ammonium phosphate (DAP) and nitrogen-phosphorous-potassium (NPK 23:23:0) fertiliser are mixed with manure during planting. A mixture of manure and calcium ammonium nitrate (CAN) fertiliser is used for top dressing by majority of the respondents. They said the combination is the best for their farms. A farmer (F22) in Gatanga explained that:

> *I use mineral fertilisers. I use NPK - 23:23:0 and 17:17:0. I apply a handful of the fertiliser to four or five holes when planting maize. I also use manure alongside mineral fertilisers to boost yield production […]*

Most respondents also mentioned that they plant cover crop on their farms. The dominant cover crop cultivated is bean. According to the respondents, they use cover crops because they have learnt that they reduce soil erosion. However, they hardly mentioned that beans fix nutrients to

the soil. It also emerged that most respondents practise crop rotation on their farms with one aim being to improve soil fertility on their farms since they have information that the technique is important in soil fertility improvement. Respondents in both study areas also noted that they use crop rotation because they have small pieces of land arguing that crop rotation is suitable with small land.

Majority of the stakeholders interviewed reiterated that animal manure is the commonest input at the disposal of farmers in both Meru South and Gatanga saying that the input is broadly used. For instance, the KTDA extension officer at Ngere factory asserted that:

> *Animal manure and crop rotation are options that farmers in Gatanga mainly use. Others mix D.A.P. fertiliser and manure as we have taught them that this significantly improves soil fertility. Farmers apply manure to crops like maize, beans, tea and coffee. Maize and beans are usually used in crop rotation programme […]*

It was found that the adoption of these techniques was mainly influenced by availability of information about their benefits, preparation and implantation. These findings are similar to Khan et al. (2008) findings that exposure to a variety of agricultural information sources significantly influences the likelihood of agricultural technology adoption. Information on recommended soil fertility management is an important factor influencing its adoption in which interpersonal communication, extension services including NGOs, scientific institutions, and mass media are involved (Fischler, 2010).

ORM Technique	Reasons for Adoption
Organic plus inorganic fertiliser	• Improves soil productivity • Increases farm yields • Easy to apply
Animal manure	• Improves soil productivity • Increases farm yields • Enhances soil moisture retention capacity
Cover crops	• Reduces soil erosion • Improves soil fertility
Crop rotation	• Economical on small land • Improves soil fertility • Enables shifts in types of crops cultivated

Table 2.5: A summary of ORM techniques adopted and reasons for adoption

4.5 Limitations of Information and Communication in influencing Use of ORM Inputs

This theme identifies the gaps in accessing information and obtaining knowledge about the best ORM techniques (inputs) in Meru South and Gatanga. This theme is categorised into three sub-themes: (i) Insufficiency of information about ORM by extensionists; (ii) insufficient ORM information on vernacular radio; (iii) insufficient ORM knowledge; (iii) socio-economic factors affecting ORM information access.

4.5.1 Insufficiency of Information about ORM by Extensionists

From interviewed farmers' responses, it emerged that though they receive information about ORM, this information is insufficient to address their needs. Even though the government extension staff is one of the main sources, respondents from both areas felt that this source is inadequate in addressing their ORM information needs.

Some of the respondents complained that the extension officers do not have enough time to train them on various options. They explained that lack of enough time to interact with the extensionists is due to the insufficiency of the staff to serve all farmers. F01 (from Chuka) explained:

> *There is only one extension officer here and she covers a big area; so there is insufficiency of agricultural information especially on SFM options […]*

The insufficiency of extensionists was echoed by participants who took part in the PRA exercises held in all the four villages in the two study areas. This finding emphasizes the findings of Sanginga and Woomer (2009) that it is not unusual for 200 agricultural field agents within a district or province to be assigned to 200,000 or more small-scale farming households in SSA. The insufficiency of extension staff is a pointer that sources of ORM information are insufficient in the two areas of the study. Adolwa et al. (2012) and Kimaru-Muchina et al., (2011) had earlier found out that communication pathways used in dissemination of soil fertility management practices, especially in Central Kenya, are insufficient.

Other respondents said that the staff do not avail them information on new methods or approaches regarding ORM saying that the same 'old' information about crop rotation, planting and top dressing is repeated. A farmer (F30) in Gatanga observed that:

> *I cannot say I'm 100 per cent satisfied about information on new methods of improving soil fertility. Yes, we appreciate the efforts by our extension officer but he repeats the same information about planting and top-dressing so we don't learn new ways of soil fertility improvement […]*

Respondents also explained that the agricultural staff do not explore all the ORM options and only concentrate on combined organic and inorganic fertiliser, animal manure, crop rotation and compost manure. For instance, F07 (from Chuka) pointed out that:

> *The extension officer does not talk about all the methods you've told me. She only talks about manure, crop rotation and mixing manure with fertilisers […]*

This revelation is supported by Kiereni Secondary School Agriculture teacher who noted that only animal manure is emphasized at the expense of other methods. He said:

> *I think the extension agents prioritise availing information about animal manure because it is what is readily available as farmers here keep livestock […]*

The study also discovered that there is insufficient dissemination of information about challenges of accessing or using some of the ORM inputs. Dominant among the challenges not talked about is the expensive cost of obtaining additional manure from other places. This is what one farmer (F28) in Gatanga said:

> *I hear from people that it is extremely expensive to buy manure in places very far from here. I was contemplating to purchase it but when I heard that it is expensive, I decided that I do with what I have. No one gives us concrete information on the cost of buying manure from other places […]*

Respondents said that it is expensive to transport manure since it is bulky. In Kiereni and Kanjoni villages in Meru South, respondents said that sometimes the manure is not sufficient for application on the farms but they are not informed on where to get more manure. The responses from the interviewed farmers are reiterated by ICIPE field officer in Kiereni (in Meru South) and the chief of Gariera Location (in Gatanga). The chief revealed that:

> *…A few import the poultry manure from Kajiado at Ksh 40,000 per a 7-tonne lorry. The cow manure is imported at Ksh 28,000 per a 7-tonne lorry. But how many can afford that? […]*

Limitations of Extension Staff in Dissemination of ORM Information
• Insufficient extension staff
• Lack of enough time to train farmers
• Insufficient information on new ORM methods
• Information about four ORM inputs only; other inputs not talked about
• Lack of information on how to access or use some ORM inputs

Table 2.6: A summary of limitations of extension staff in dissemination of ORM information

4.5.2 Insufficiency of ORM Information on Vernacular Radio

Most respondents appreciated the role vernacular radio is playing in availing ORM information to them. However, respondents felt that this medium does not provide sufficient information about the inputs. They explained that the time designated for agricultural programmes (and SFM programmes) on radio and television is too short and insufficient. Most of them also said that agricultural programmes on radio and television are broadcast at odd hours and that these programmes mainly focus on livestock keeping and agri-business, and little focus on ORM. Interestingly, respondents said that sponsors of agricultural programmes on radio or television give only that information that favours the sale of certain inputs and serves their interests. It was also found that radio and television do not offer opportunities for questions and thus there is no participatory involvement of the farmer in ORM training on radio and television. One farmer's experience with radio (F24) summed up this finding when he remarked that:

> *Information on soil fertility on radio is hard to come by. Soil fertility information on radio is scanty and only talks about how to use manure and fertilisers but doesn't explore other options. Different fertiliser companies give this information on radio and they are only interested in selling their inputs not necessarily concerned about improving soil fertility. There is also lack of participatory involvement of farmers on radio […]*

Insufficiency of ORM Information on Vernacular Radio
• The time designated for agricultural programmes (and SFM programmmes) on radio and television is too short and insufficient
• Agricultural programmes on radio and television are broadcast at odd hours;
• Most agricultural programmes in the media focus on livestock keeping and agri-business
• Sponsors of agricultural programmes in the media give only information that favours the sale of certain inputs and serves their interests
• Radio does not offer opportunities for questions; no participatory involvement on radio

Table 2.7: A summary of insufficiency of ORM information on vernacular radio

This finding is similar to the discovery by Obidike (2011) that agricultural information on radio and television is always aired at odd hours when farmers who desire such information have gone to their farms. Kimaru-Muchina et al. (2010) argued that inadequacy of information on media

channels is a big challenge in dissemination of soil fertility management practices in Central Kenya.

4.5.3 Inadequate Knowledge about ORM

Respondents said that they have insufficient knowledge on how to use the inputs and implements some of the techniques. The study established that the respondents do not know the exact rate of manure application on their farm. They said that they have not been adequately trained on what amounts of manure to apply in a given area of land. Most said that the application rate is informed by the amount of manure available. F06 (from Meru South) said:

> *... I use manure when available and use less when not in plenty. However, yield still remains the same […]*

Some farmers interviewed also revealed that they do not have enough knowledge on the preparation of manure saying that much cow dung is wasted due to poor methods in its collection. Farmers' explanation on how animal wastes are collected, how manure is prepared, and the preparation period varied significantly, a clear indicator that they do not receive information about those aspects.

Although most respondents receive information about combined use of organic and inorganic fertilisers, some of them admitted that they do not know the mixing ratio of these fertilisers. They said that they use little mineral fertilisers together with manure when planting. Only one farmer in Meru South demonstrated how he has modified his method of manure preparation with the use of DAP fertiliser. Respondents' inadequate knowledge on organic and inorganic fertilisers is well captured in this statement by F18 (from Gatanga).

> *I know mixing manure with fertilisers is a good method in the improvement of soil fertility but sincerely speaking I do not know the mixing ratio neither do I know the rate of application […]*

The study also found out that respondents face a number of difficulties while using some of the inputs. Some respondents said that they sometimes unexpectedly encounter problems while preparing manure and they said this affects the quality because they have not learned about how

to overcome the problem. Others lamented the fact the heavy rains sometimes wash away manure or destroy cover crops yet they have not learned on how to mitigate effects of such rains on their manure.

It was found that respondents in both areas also have limited knowledge on signs of poor soil fertility. Whereas all of them can tell poor soil fertility from the colour of the soil and its productivity, they do not know which weeds are indicators of soil fertility. From their responses, most know that tithonia weed grows on fertile soils but do not know weeds that grow on soils with poor fertility. They said that they have not been told about this. One farmer (F25) explained that:

> *The lower side of the farm has poor fertility. Tea has started drooping, an indication that it's feeling the pinch of the poor soil. Soil in that part has gravels and even bananas don't grow there. I think the upper part is moderately fertile though some weeds have started growing and I don't understand whether they indicate good or poor fertility […]*

The PRA exercises and the stakeholder interviews in both areas confirmed that there is inadequate knowledge about ORM. One farmer who participated in a PRA exercise in Rwaitira observed that:

> *One major challenge to food insecurity in our families is insufficient knowledge about new farming methods and best methods of manure preparation. For sure, if we had enough farming knowledge we would be wealthy from agriculture […]*

Insufficiency of ORM knowledge by the respondents is supported by Sanginga and Woomer (2009) findings that among the constraints to improved soil fertility in SSA include insufficient knowledge on various SFM options available. Adolwa et al. (2012) note that lack of knowledge and awareness about the technologies is attributed to lack of access to reliable and current information, wide communication gaps between researchers and farmers, and partial utilization of ISFM knowledge to addressing soil fertility management problem.

Inadequate Knowledge about ORM
• Inadequate knowledge on the rate of manure application
• Insufficient knowledge on manure preparation
• Insufficient knowledge on the use of organic and inorganic fertilisers
• Insufficient knowledge on the signs of poor soil fertility

Table 2.8: A summary of inadequate knowledge on ORM

4.6 Socio-Economic Factors affecting Access to ORM Information

This study find out that five socio-economic factors affect access of ORM information in both Meru South and Gatanga Sub-Counties. These are age, income, education, gender and the size of the land.

4.6.1 Age versus ORM Information Access

From the data collected, it was established that the age of a farmer significantly affects access of ORM information and adoption of the techniques. More than two-thirds of the respondents who took part in the household interviews were at least 50 years of age. Only one (out of 30) was less than 35 years of age. This is because most of those who practise farming in the areas of the study are people in their 50s. According to most respondents, youth ignore farming since they perceive it as non-economical and a peasant's occupation. They also explained that most of the young people in their villages are studying and cannot get time to practise farming. The respondents revealed that most youth in the area are educated and thus live in towns as they search for jobs as others do business.

The respondents, participants of the PRA exercises and some stakeholders said that this group of farmers (over 50 years) actively seeks for agricultural information more than any other group. They said that these farmers dominantly attend farmer field days, chief barazas and more often interact with extension agents and attend to different media for information about ORM. F14 (from Meru South) said:

I would really want my children to follow my footsteps and become farmers but they seem to have different priorities. Then I said if that is the case let them pursue what they want and I will help them achieve it […]

Another farmer (F19) from Gatanga remarked:

I have two grown sons in their mid twenties who really hate farming. They usually tell me that I'm killing myself with farming yet it does not pay […]

The chief of Gariera location (in Gatanga) argued that the youth do not want to be taught about agriculture despite his efforts to convince them into farming. The chief said most youth are alcoholic. This is his sentiment:

The main challenge to economic development are the youth who have refused to take farming as an enterprise but instead decided to consume alcohol and disturb order […]

This finding disagrees with the finding by Murage et al. (2012) that middle-aged farmers in Western Kenya were the most active group in seeking information about push-pull technology. Furthermore, contrary to this finding, Soniia and Asamoah (2011) note that a farmer's age has a profound negative effect on agricultural knowledge gain.

4.6.2 Income versus ORM Information Access

All the respondents said that farming is their main source of income. It noteworthy to report that all of them said that the income they get is insufficient to take care of all their primary needs.

Of importance was the question of whether the amount of income a farmer gets affects their access to ORM information. Respondents said that the amount of income greatly affects information access. Some said that they cannot attend farmer trainings and agricultural shows held far away from the village saying travelling is expensive. Other respondents reported that the income they get is insufficient and are unable to invite agricultural experts or private extensionists to train them on ORM. Most respondents also explained that they cannot seek advisory services on soil analysis because they are unable to fund for them. They said that because of this, they use their soil oblivious of its fertility status. Some farmers also observed

that their farm income is not enough to purchase information and communication appliances like television and have their houses connected with electricity. F04 said:

> *Every time I'm faced with a problem of money (insufficiency). This has made me miss several agricultural trainings through barazas since I am always on the farm trying to look for money that is not forthcoming […]*

Income versus ORM Information Access
• Insufficient income prevents farmers from attending trainings • Insufficient income incapacitates farmers' ability to invite ORM experts • Inability to seek soil analysis advisory and private extension services due to low income • Low income affects a farmer's media choice on ORM (cannot purchase television and have their houses connected with electricity)

Table 2.9: How income affects information access about ORM

This revelation agrees with Rees et al. (2000) results that income-poor farmers have low access to government, non-governmental extension workers and agri-business sources as well as print media.

4.6.3 Education versus ORM Information Access

More than half of the respondents in both sub-counties did not reach secondary school level. Most of these respondents said that they do not understand English and only speak in Swahili and their mother tongues (Gikuyu and Ameru). Some of them revealed that they do not know how to read and write.

The respondents (those with no secondary education) admitted their choice of ORM information source is mainly based on their literacy levels. The respondents said that they attend to vernacular radio and local extensionists since they use local language; a language they understand. This limits their access to information about ORM since most information is in English. A few respondents with secondary education sometimes obtained ORM information on television.

This fact that the less educated have limited options to information sources is reinforced by all the PRA exercises held where most participants revealed that most farmers are less educated and thus seek for sources that communicate in their language.

This finding supports Taley and Khadase (2006) observation that low level of formal education is a barrier in disseminating useful information and Sanginga and Woomer (2009) discovery that low levels of literacy among the smallholder farmers in SSA are a main constraint to effective communication and dissemination of soil fertility information.

4.6.4 Land Size versus ORM Information Access

The study established that the size of land a respondent owns affects their information-seeking behaviour. The respondents in both sub-counties are smallholder farmers (owning small pieces of land). Most of them said that they seek information about animal manure, organic and inorganic manure, cover crops and crop rotation since these methods, according to them, are suitable for small pieces of land. They explained that they access information that can help them use the techniques in the best possible way to reap maximally from their farms. F20 (from Gatanga) said:

> *The biggest challenge we face here is that our farms are too small. But I have heard of people with tiny pieces of land harvesting big from their farms. So I want to know what he did so that I can replicate it […]*

4.6.5 Gender versus ORM Information Access

In Meru South, the gender of the farmer has a bearing on information access about ORM. Some male and female respondents revealed that more women than men access ORM information in the area. They said that the reason for this is because majority of women work on the farm as men look after livestock. The respondents explained that women working on farms actively seek information on how to use manure or practise crop rotation. One respondent (F07) said:

> *You see, I am the main decision maker when it comes to what to plant and at what time. My husband does not know even what is growing on the farm now. So I am the one who is more serious in seeking information that serves soil fertility needs of our farm […]*

Another respondent (F12) had this to say:

> *I usually ask my wife to attend agricultural meetings since it would be pointless for me to be in attendance yet my wife does farming more than I do […]*

This finding disagrees with Gladwin et al. (2002) argument that African women are disadvantaged in terms of access to information. However, according to Sanginga & Woomer (2009), women's access to ORM information may be hindered by unequal opportunities within their families and communities and male-oriented development programmes that fail to recognise the role of women.

4.7 Chapter Summary

This chapter presented and discussed the findings of the study. Five key findings have emerged from the study. Firstly, the study found out that farmers in the study areas are aware of ORM inputs with government extension staff and vernacular radio being the main facilitators of this awareness. Secondly, it was discovered that farmers in the areas have knowledge on animal manure, organic and inorganic fertilisers, crop rotation and biomass transfer. Thirdly, it emerged that information and communication about ORM has significantly influenced the use of animal manure, organic and inorganic manure, and crop rotation. The fourth key finding is that there exists insufficiency of information on the use of organic resource inputs resulting into inadequate knowledge of ORM. Another important finding is that farmer's age, income, education level and land size affect access to information about ORM. Therefore, this chapter showed that although information and communication have had substantial positive effects on the use of organic resource inputs, several factors limit their access for effective adoption of the options. The chapter that follows gives summary of the findings, conclusion and recommendations of this study.

CHAPTER 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This chapter presents summary of the findings, conclusions and recommendations of the study, and suggests areas of further research in relation to the purpose of this study. The objective of this study was to assess the effects of information and communication on the use of organic resource inputs by farmers in the Central Highlands of Kenya.

5.1 Summary of the Findings

This section summarises the findings of the study based on the four objectives of this study. The study sought to: (i) Identify the available sources of information and innovations on organic resource inputs directed to farmers; (ii) determine whether farmers' socio-economic status influence communication processes and information access regarding the adoption of organic resource inputs.; (iii) investigate the effects of community groups and associations on the communication and adoption of organic resource inputs by farmers; (iv) assess the effects of communication on the uptake of ORM techniques by farmers.

5.1.1 Sources of Information and Innovations on Organic resource Inputs

The first objective of the study was to identify the available sources of information and innovations on organic resource inputs directed to farmers. The study found out that the available sources of ORM information in both Meru South and Gatanga sub-counties are government extension staff, vernacular radio, farmer groups, television and agricultural organisations (KALRO and ICIPE). The most preferred ORM information sources are the government extension staff and vernacular radio with farmer groups, television and agricultural organisations being the least preferred. In Meru South Muuga FM, Wimwaro FM and Kameme FM vernacular radio stations are readily available as Inooro FM, Kameme FM and Coro FM are available in Gatanga. Some farmers use more than one source to access ORM information.

The study established that extension staff are the main source information about animal manure, organic and inorganic fertilisers, crop rotation and biomass transfer. Vernacular radio disseminates information about animal manure, compost manure, green manure and crop rotation. It was found out that communication approaches used by extension staff to disseminate ORM information to farmers are group communication, chief barazas, individual contact methods and demonstration plots.

5.1.2 Influence of Farmers' Socio-Economic Characteristics on Communication Processes and Information Access regarding the Adoption of ORM Inputs

The second objective was to determine whether farmers' socio-economic chaSracteristics influence communication processes and information access regarding the adoption of organic resource inputs. The study revealed that farmer's age, income, level of education, land size and gender significantly affect access of information about organic resource inputs by farmers.

The findings show that older residents more actively seek ORM information more than the young. Interestingly, the older generations in both areas are farmers while the younger ignore farming; a fact that explains why the older actively seeks ORM information. The study also found out that farmers get insufficient income and this hinders them from accessing information from a variety of extension approaches. A farmer's level of education also influences their choice of ORM information source. As more than half of the farmers have basic or no education, they do not understand English and thus prefer extension staff and vernacular radio since these sources use local language to disseminate ORM information. Farmers also said that they only seek information about ORM methods that are economical and suitable for their small pieces of land. The study also established that female farmers access ORM information more than the male because most of them work on the farms.

5.1.3 Effects of Community Groups and Associations on Communication and Adoption of Organic resource Inputs

The third objective of this study was to investigate the effects of community groups and associations on the communication and adoption of organic resource inputs by farmers. The study shows that religious groups are the main community organisation in both areas of this

study. Other organisations are cooperative associations, village associations, self-help groups, farmer groups, a water association and a women group. The findings indicate that these organisations and associations do not influence information access on ORM as they hardly focus on ORM.

5.1.4 Effects of Communication on the Uptake of ORM Techniques by Farmers

The last objective was to assess the effects of communication on the uptake of ORM techniques by farmers. The study found out that information and communication of organic resource inputs created awareness about the inputs, marking the first stage in the process of their adoption. Access to ORM information improved farmers' knowledge especially on animal manure, organic and inorganic fertilisers and crop rotation. Information access and knowledge are important elements that facilitate adoption of agricultural technologies (Kimaru-Muchai et al., 2011; Sanginga and Woomer, 2009; Shanthy and Thiagarajan, 2011; Agbamu, 1995).

Animal manure, organic and inorganic fertilisers, and crop rotation are the most adopted techniques by farmers as a result of information access and knowledge gain about ORM. The use local language, numerous approaches and participatory methods in communicating ORM information are among the elements that favour input adoption in the two areas. Farmers adopted the techniques since they perceive that they improve soil fertility and increase farm yields.

5.2 Conclusion

The following conclusions are made based on the findings of the study:

i. Information and communication have had remarkable effect on the use of animal manure, organic and inorganic fertilisers, and crop rotation. Through government extension and vernacular radio, farmers have gained improved knowledge on the benefits and implementation of these techniques. However, other information sources such as television, print media, NGOs, agricultural organisations, and farmer groups play little role in influencing the use of these inputs. Agriculture development stakeholders should work towards making these sources effective for increased adoption of the techniques.

ii. On the other hand, information and communication have played little role on the adoption of green manure, compost manure, cover crops and mulching. There is a great potential of using these inputs in Meru South and Gatanga.

iii. Socio-economic characteristics namely farmer's age, income, level of education, land size and gender greatly impacts access to information about ORM inputs and subsequently affect adoption of these inputs. If a farmer's income and land size increase, they have better access to ORN information. Improved level of a farmer's education also means better ORM information access.

iv. Community organisations can be made useful to ORM information dissemination and subsequent adoption of the techniques. It is substantive to note that a fairly large numbers of farmers are members of religious groups. If such organisations provide platforms for ORM information access then the rate of ORM information will be scale up.

5.3 Recommendations

Based on the findings of the study, the following recommendations are put forward for consideration:

i. Researchers should consider how extension agents can be made more useful in dissemination of ORM information since they are the main source of this kind of information.

ii. Agricultural stakeholders and religious leaders should work out on ways of incorporating religious organisations in the dissemination of information and organic resource inputs. These organisations are a great avenue for ORM information access and adoption due to their popularity, big membership and strong adherence.

iii. For effective ORM inputs adoption, extension agents should make follow-up visits to farmers after training them.

iv. A campaign to create awareness on the advantage of farmer group formation and encourage them to form groups should be carried out in Meru South and Gatanga. Farmer groups are important an important pathway in dissemination ORM technology information and facilitation its adoption.

v. Sources of information and communication about organic resource inputs are advised to consider farmers' socio-economic characteristics in the process of disseminating ORM information. A communication strategy, informed by farmers' socio-economic characteristics is effective minimising hindrances in ORM information access brought about by these characteristics.

5.4 Suggestions for Further Research

This study suggests further research in the following areas:

i. Assessment of the effects of information and communication on adoption ORM techniques by women farmers in Kenya. From this study, it was established that women have a more positive information-seeking behaviour on organic resource inputs and thus it is important to specifically investigate the effects of information and communication on their adoption of ORM techniques.
ii. Investigation whether socio-economic characteristics of an agricultural extension agent affects information access and adoption of ORM inputs by farmers.
iii. Investigation of farmers' perceptions on agricultural programmes on local vernacular radio stations.

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APPENDICES

APPENDIX 1

INTRODUCTION INTO FARMER INTERVIEW

Good morning/afternoon,

I am ……NAME OF INTERVIEWER…… a student at the University of Nairobi. I am conducting an agricultural communication research in this region. The research enquires about the effect of information and communication on the use of organic resource inputs to build soil fertility in this region. The study is part of a Government of Switzerland-sponsored research project that enquires on new methods of Soil Fertility Management in four African countries – Kenya, Zambia, Ghana and Mali – and investigates how the methods can be implemented.

I kindly request you to answer some questions to help me get information from your side about the effects of information and communication on improvement of soil fertility in this region. It is expected at the end of the project – in six years – better ways to improve soil fertility will have been found.

Is it possible that you avail yourself for an interview that might last for one hour? **(*Waiting for an answer from the farmer*).**

Thank you for being ready for this interview. I seek your consent to record this interview with this mobile recorder to be able to listen to you once again. Is that fine with you? ***(Waiting for an answer. If the answer is not positive, leave the recording).***

Be assured that I will assess the interview anonymously, i.e. your name will not appear in any publication or presentation.

So much to the introduction, now we get to the questions.

APPENDIX 2:

FARMER INTERVIEW SCHEDULE

Introduction done by interviewer (please use introductory sheet): *The Interviewer introduces himself/herself and explains the purpose of the visit. He/she also explains expected duration of interview (about one hour) and seeks consent to record interview.*

Name of interviewer…… Interview No: .....

Date of interview..... Village: …… Commune/County: …….

Name of interviewee: …….. **Gender**: ☐ Male ☐ Female

Phone Number: …….

Main area – what we would like to know	Questions	Follow-up questions OR instructions	Results
Farm data			
1	Who is the main decision-maker on this farm?		
2	Since when have you been farming here?	Year started? For x years?	
3	**Work force:** How many people usually work on this farm (fulltime, part-time)?	Is this family labour or hired labour?	
4	**Land size:** What is the size of your farm?	In acres; Do you have separate sections of arable land, pasture land, and idle land?	
5	What is the land tenure status of your farm?	Own land? Lease? Mixed tenure conditions?	

Main area – what we would like to know	Questions	Follow-up questions OR instructions	Results
	Would you mind drawing for me a sketch map of your farm on a piece of paper?		
6	What are your main crops?	Main cash and food crops	
7	Do you have a forest or trees on your farm?	What trees and shrubs do you appreciate most? Why?	
8	Do you keep livestock on your farm?	How many of each? (Cattle, goats, dairy cows, chicken, other).	
9	How do you manage/dispose cow dung or droppings from your livestock?	Do you prepare animal manure?	
Agronomy			
10	**Quality of soil:** How would you rate the quality of soils on your farm?	Can you rate the soils regarding quality? *Let the farmer explain how good the different parts are (e.g. where the best crops and other crops are planted*) How are you able to tellgood soils from bad soils?	
11	Have you noticed any problems with the soils on your farm?	If YES, what problems?	
Now let's talk about information and communication regarding soil fertility			
	Media Channels		
Main area – what we would like to know	**Questions**	**Follow-up questions OR instructions**	**Results**

12	**Media use:** What media do you use regularly?	For interviewer: Please remind the interviewee to answer for all types of media	
	Information about innovation		
13	What is your main source of information about agriculture and marketing of agricultural produce?		
14	Where do you usually hear about any kind of agricultural innovation or change? Please mention all occasions where you have heard about such issues.		
	Sources of organic resource inputs and Information about soil fertility		
15	From what sources do you receive information about the following organic resource inputs (methods): □ Green manure □ Animal manure □ Cover Crops □ Agroforestry □ Mulching □ Compost □ Crop rotation □ Agro-industrial wastes □ Organic plus inorganic fertiliser (ISFM)	If no source at all: why – in your opinion – is there no information about organic resource inputs?	
16	What exactly do these sources talk about in regard to the organic resource inputs/methods?	Do they say the options preserve/improve soil fertility? Do they talk about their implementation? Where to find inputs? Preparation and use? etc.	
17	Have your tried these inputs/methods at any one time?	*Let the interviewee talk about experiences.*	

Main area – what we would like to know	Questions	Follow-up questions OR instructions	Results
18	**Information Influence:** Do you think the information you receive about the use of organic resource inputs has motivated you to use the methods?	*Let the interviewee explain and give their experience.*	
19	Would you say you receive sufficient information about soil fertility (management) options through radio and other media?	If not, could you explain what exactly is unclear or is missing from the information you receive through the media?	
20	Would you say you receive sufficient information about soil fertility (management) options through extension staff?	If not, could you explain? Please ask whether information is given with lot or little explanation?	
21	Do you think you have sufficient opportunities to ask follow-up questions to extension officers?	If YES – which opportunities do you have? If NO – would you like to get these opportunities?	
22	Would you say that you receive adequate information about the advantages of SFM techniques?	Can you give an example?	
23	Would you say that you receive adequate information about difficulties in implementing SFM techniques?	What difficulties were in need to talk about?	
24	Are there challenges of SFM techniques that are not talked about on radio or field days?	Please explain the challenges you encounter. Who informs you about the difficulties in implementing SFM techniques?	

Main area – what we would like to know	Questions	Follow-up questions OR instructions	Results
25	Do you share the information you receive about ORM inputs with others?	If YES, with whom do you talk about agricultural innovations? Do you share this information with those who work on your farm?	
	Groups influencing information and communication on organic resource inputs		
26	Are you a member of any group or association?	If YES, which ones? (*Allow for time to recall).* *Interviewer should probe for the following:* o Religious organisations (church, mosque, temple) o Villages associations? o Cooperatives – Sacco; Dairy?) o Farmer group? o Farmer Field School?	
27	**Frequency of group meetings:** How often do you meet in these groups? Please indicate for each	*Find out which groups meet more frequently*	
28	Do you discuss the work you do on your farm in these groups?	If YES, please explain the issues you discuss in the groups.	
29	Do you talk about different ORM inputs with other group members?	If YES, what exactly do you talk about regarding ORM inputs? Let the interviewee explain.	
30	In your group(s), do you invite agricultural experts to teach you on implementation of ORM inputs?	If YES, what has the interviewee learnt about ORM methods from the experts?	
31	Do you find the information you get from the groups useful in implementing the techniques on your farm?		

Main area – what we would like to know	Questions	Follow-up questions OR instructions	Results
32	Approximately how many non-formal trainings have you attended since you started farming	Probe on ; • FFDs • FFS • Exchange visits • Demonstrations • Others...	
33	In the trainings you have attended, have you been taught at any one time about ORM?	Please explain what you were taught about ORM.	
34	Do you think the trainings have been useful in helping you adopt different ORM inputs?	*Let the interviewee talk about their experience.*	
	Socio-economic factors influencing communication of organic resource inputs		
35	Does the culture of your community or ethnic group support or hinder the acess of information about organic resource inputs in any specific way?	If YES, please let us know which ethnic group and in which way culture supports or hinders the access of information about organic resources. Which inputs are supported or hindered?	
36	Does the information you receive specify that certain organic resource inputs should be used only by men or women?	If YES, which organic resource inputs? And why?	
37	What are your sources of non-farming income?	Shop? Houses? Salary? Other...	
38	Does the income you receive (either farming or non-farming income) affect access to information about organic resources?	How does it affect? Is there information about organic resource inputs you cannot access due to insufficient income? Has income sufficiency/insufficiency affected use of organic resource inputs?	

Main area – what we would like to know	Questions	Follow-up questions OR instructions	Results
39	Do you think a farmer's level of education affects access and comprehension of information about organic resource inputs?	Let the interviewee explain. And does it affect adoption of organic resource inputs?	
Now we are almost done. Let me ask you a few questions about yourself as we conclude the interview.			
Personal data			
40	In what age bracket do you belong? o 18-25 o 26-35 o 36-50 o 51 and above	*Interviewer reads age brackets*	
41	Formal education: What was your highest level in formal schooling?	No schooling; primary school / sec. school, tertiary (be specific)	
42	How many people live in this household? (Household: equals "eating from one pot")		
Last comments			
43	Do you have any comment or questions for me?		

Thank you *very much for your time and interest in answering the questions. I will keep you informed about the results of this research for this area. I hope that some of our results will be useful to you over the next few years.*

APPENDIX 3:

STAKEHOLDER INTERVIEW SCHEDULE

Introduction: *Interviewers introduce purpose of research; expected length of interview (about one hour); require consent to recording; anonymity is not provided in data collection but is guaranteed for publication.*

Name of interviewer…….....

Date of interview..... Village: …… Commune/County: …….

QUESTIONS ON PERSONAL DATA

Name of interviewee: …….. **Gender**: □ Male □ Female

Occupation..... **Phone Number:** ……

Main area – what we would like to know	Questions	Follow-up questions OR instructions	Results
Farm data			
	What is your current task or responsibility in the village/ community or region?		
	Since when have you been living in this community?	No. of years? Since *x* year?	
	Farm size: What is the structure of land size in this region?	Distinction amongst big farms medium and small farms. Division into arable land, pasture land, and idle land?	
	Land tenure system : What is the typical setting regarding land tenure here? What are the problems associated with land tenure systems in this region?	Own land? Lease? Mix? tenure conditions	
	What are the main crops grown in this area?	Main cash and main food crops	
	Are there forests and trees in this area?	What trees and shrubs are appreciated most by people in this area? Why?	

Main area – what we would like to know	Questions	Follow-up questions OR instructions	Results
6	What are the main livestock types kept by farmers in this community/area?		
7	Do farmers use livestock cow dung/droppings to prepare manure?		
Agronomy			
8	**Quality of soil:** How would you rate the quality of soils in your community?		
9	What measures are put in place to preserve or improve the quality of soils in this area?	Interviewer should follow up to get a description of the methods	
10	Do the farmers in this area use organic inputs?	If YES, which ones and for which crops? Why do you think farmers in this area use organic inputs? What improvement, if any, have you noticed in your community as a result of the use of organic inputs? What do farmers say about their experiences with organic inputs? Advantages, disadvantages?	
	Have the following methods been tried in your community? ☐ Animal manure ☐ Green manure ☐ Cover Crops ☐ Agroforestry ☐ Mulching ☐ Compost ☐ Crop rotation ☐ Agro-industrial wastes ☐ Organic plus inorganic fertiliser (ISFM)		

Main area – what we would like to know	Questions	Follow-up questions OR instructions	Results
	What is the role of your organisation regarding soil fertility?		
INFORMATION AND COMMUNICATION			
11	What are the main sources of agricultural information and marketing information in your community?		
	Sources of information about organic resource inputs		
12	From what source do farmers get information about different organic resource inputs if any?	Please mention all media and other sources. If no source at all: Explain why – in your opinion – is there no information about soil fertility?	
	What exactly do these sources talk about in regard to the organic resource inputs/methods?		
16	Do you think farmers are receiving sufficient information about soil fertility options through radio and other media?	If not – could you explain what exactly is unclear or what is missing?	
17	Do you think farmers are receiving sufficient information about soil fertility options through extension staff?	If not – could you explain? Please ask whether this information is adequately explained?	
	Have you attended or heard about a public discussion on soil fertility as an issue to be addressed?	If YES – where are/were those opportunities? If NO – would you like to get these opportunities?	
	Information Influence: Do you think the information farmers receive about the use of organic resource inputs has motivated them to use the methods?		

Main area – what we would like to know	Questions	Follow-up questions OR instructions	Results
	Groups influencing information and communication on organic resource inputs		
21	What role do other organisations or groups in your community play regarding soil fertility	If Yes, which ones? *Let them time to recall.* *Interviewer should probe for* o Farmer groups? o Cooperatives – Sacco; Dairy?) o Banks and Finance sector o NGOs o Middle men and traders? o Agrovets? o Common Interest groups o Religious organisations (church, mosque, temple)	
22	Have you ever worked with the other groups mentioned above?	If YES, probe whether he/she has helped the group members use organic resource inputs	
	In which forums do farmers talk about any kind of agricultural innovation or change? Please mention all occasions where such issues are discussed.	Are organic resources discussed in these forums? If YES, which ones? What is talked about them?	
	Socio-economic factors influencing communication of organic resource inputs		
23	Does the culture of this community or ethnic group support or hinder the access of information about organic resource inputs in any specific way?	If YES, please let us know which ethnic group and in which way culture supports or hinders the access of information about organic resources. Which inputs are supported or hindered?	
24	Does the information farmers receive specify that certain organic resource inputs should be used only by men or women?	If YES, which organic resource inputs? And why?	
	What are your sources of non-farming income for most farmers here?		

Main area – what we would like to know	Questions	Follow-up questions OR instructions	Results
25	Does the income farmers receive (either farming or non-farming income) affect their access to information about organic resources?		
26	Do you think a farmer's level of education affects access and comprehension of information about organic resource inputs?		
Now we are almost done, but allow me to ask you a few questions about yourself			
Personal Data			
27	In what age bracket are you? o 18-25 o 26-35 o 36-50 o 51 and above	*Interviewer reads age brackets*	
29	Formal education: What was your highest level in formal schooling?	No schooling; Primary school / Sec. school, tertiary (be specific)	
Last comments			
30	Do you have any comment or question for me?		

Thank you *very much for your time and interest in answering these questions. I will keep you informed about the results of the research and I hope that some of the results will be useful for you this area.*

APPENDIX 4

Meru South Sub-County

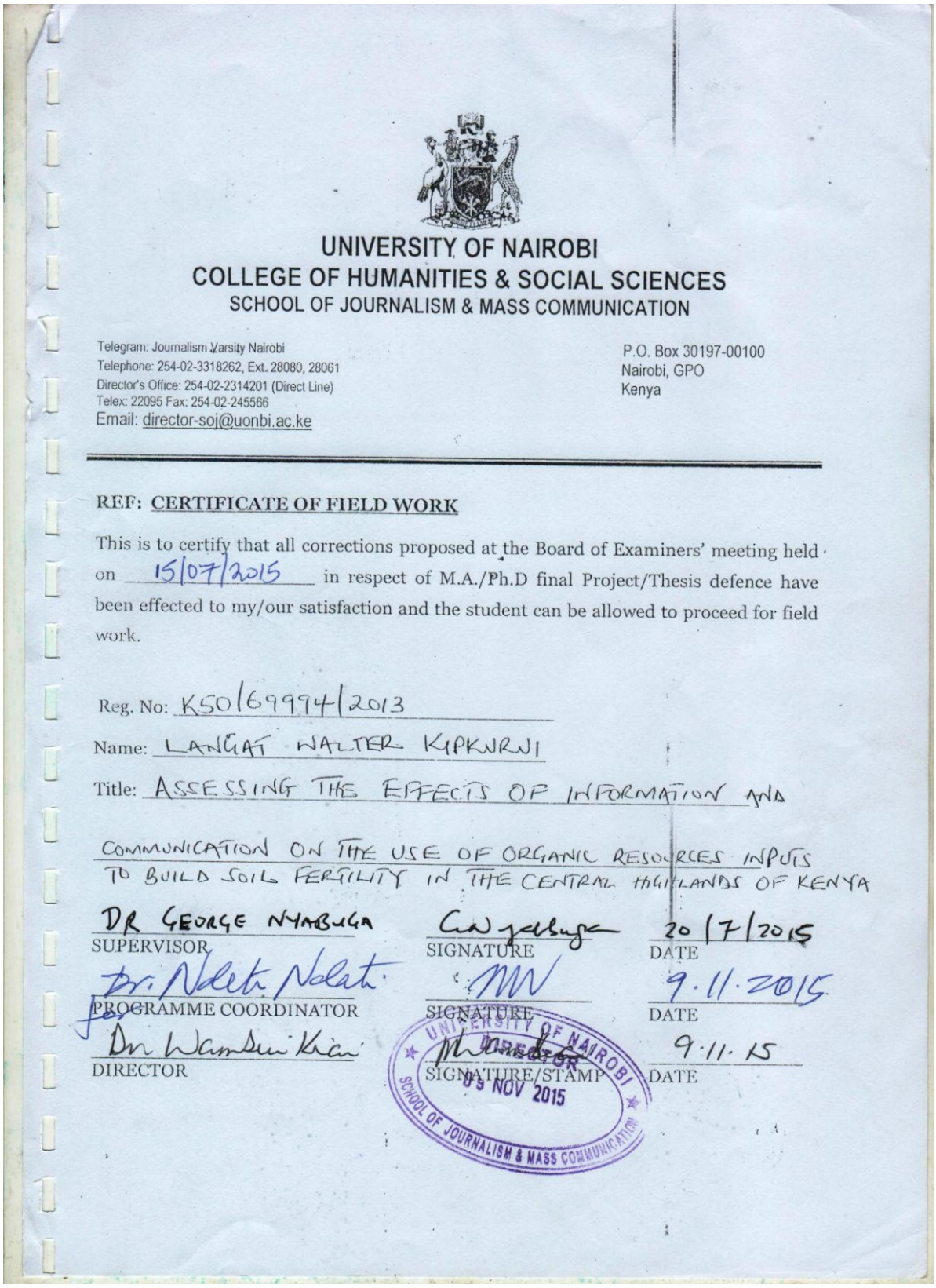
PHOTO 1: Selected farmers participate in the PRA exercise at Kiereni Primary School in Meru South Sub-County.

PHOTO 2: A respondent in Kinjoni village (Meru South) shares her experiences regarding effects of information and communication on the use of ORM inputs. ***PHOTO 3:*** The head of Meru Sub-County extension services participates in an interview held in her office in Chuka town

Gatanga Sub-County

PHOTO 4: A PRA participant in Rwaitira village (Gatanga) takes part in identifying important stakeholders in information and knowledge dissemination on use of ORM inputs.
PHOTO 5: Farmers selected for PRA exercise in Gatanga discuss the effects of information and communication sources on knowledge and adoption of ORM techniques in the area.

APPENDIX 5



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REF: CERTIFICATE OF FIELD WORK

This is to certify that all corrections proposed at the Board of Examiners' meeting held on 15/07/2015 in respect of M.A./Ph.D final Project/Thesis defence have been effected to my/our satisfaction and the student can be allowed to proceed for field work.

Reg. No: K50/69994/2013

Name: LANGAT WALTER KIPKURUI

Title: ASSESSING THE EFFECTS OF INFORMATION AND COMMUNICATION ON THE USE OF ORGANIC RESOURCES INPUTS TO BUILD SOIL FERTILITY IN THE CENTRAL HIGHLANDS OF KENYA

DR GEORGE NYABUGA SUPERVISOR	SIGNATURE	20/7/2015 DATE
Dr. Ndeta Nolato PROGRAMME COORDINATOR	SIGNATURE	9.11.2015 DATE
Dr. Wambui Kiai DIRECTOR	SIGNATURE/STAMP	9.11.15 DATE

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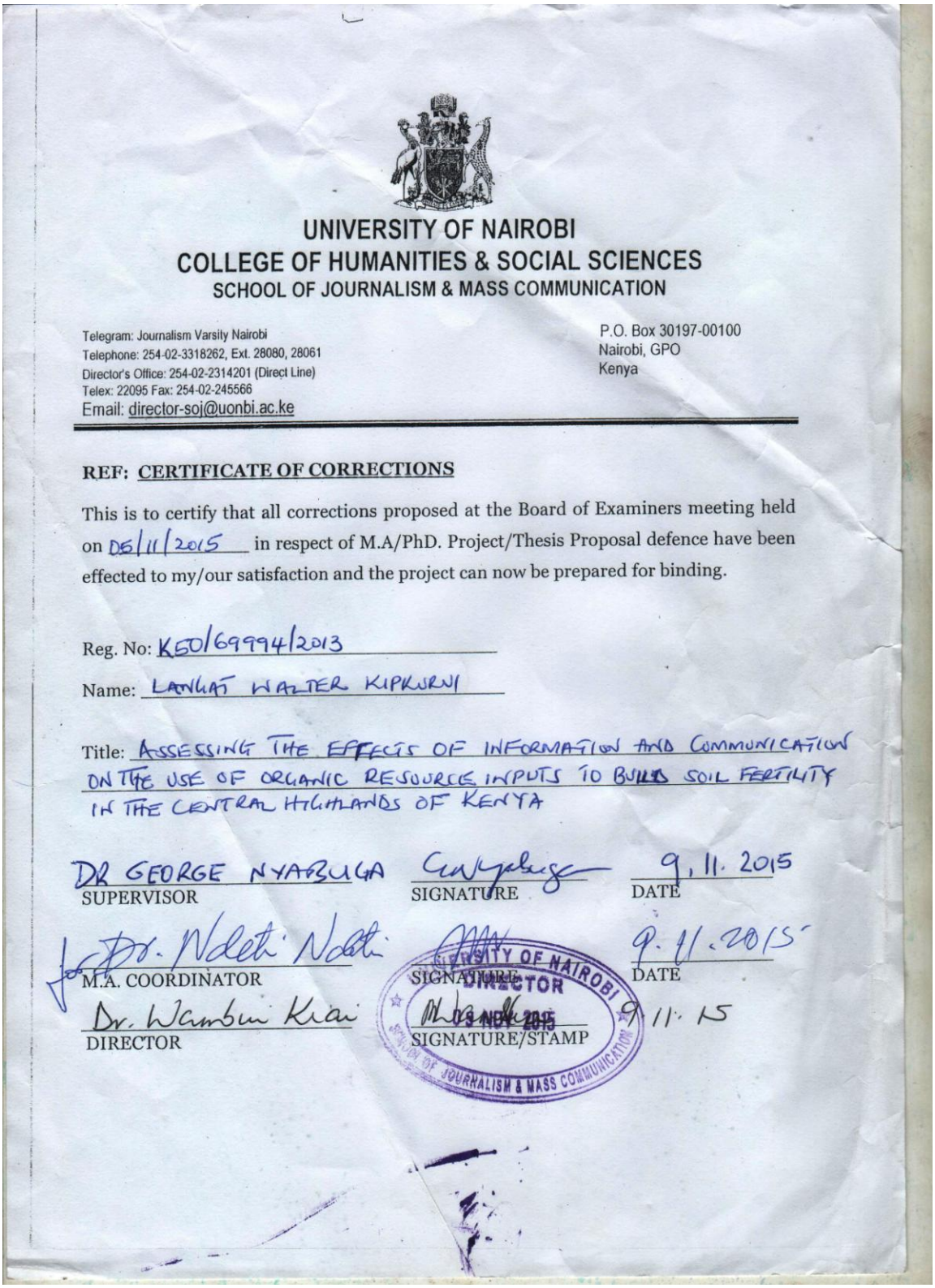
APPENDIX 6



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This is to certify that all corrections proposed at the Board of Examiners meeting held on 05/11/2015 in respect of M.A/PhD. Project/Thesis Proposal defence have been effected to my/our satisfaction and the project can now be prepared for binding.

Reg. No: K50/69994/2013

Name: LANGAT WALTER KIPKURUI

Title: ASSESSING THE EFFECTS OF INFORMATION AND COMMUNICATION ON THE USE OF ORGANIC RESOURCE INPUTS TO BUILD SOIL FERTILITY IN THE CENTRAL HIGHLANDS OF KENYA

DR GEORGE NYABUGA SUPERVISOR	SIGNATURE	9.11.2015 DATE
for Dr. Ndeti Ndeti M.A. COORDINATOR	SIGNATURE	9.11.2015 DATE
Dr. Wambui Kiai DIRECTOR	05 NOV 2015 SIGNATURE/STAMP	9.11.15

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