ASSESSING FARMER LEARNING PATHWAY PREFERENCES AND AGRICULTURAL TECHNOLOGY UPTAKE BY SMALL SCALE FARMERS IN LURAMBI AND MACHAKOS SUB-COUNTIES OF KENYA

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A CONSULTANCY REPORT SUBMITTED TO BIOVISION AFRICA TRUST FOR THE ECOLOGICAL ORGANIC AGRICULTURE INITIATIVE IN AFRICA

UNDER SUPPORT FROM SWEDISH SOCIETY FOR NATURE CONSERVATION (SSNC)

DECEMBER, 2018

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EXECUTIVE SUMMARY

Kenya's agriculture sector is dominated by small scale farmers, and is characterized by; subsistence production, low yielding technologies, low resource base and relatively small volumes of produce on small plots of land. These result in low levels of agricultural production in most parts of the Country, and inability of the sector to contribute effectively to food security and poverty reduction. Adoption of improved agricultural technologies by small scale farmers is therefore critical to increasing agricultural production and productivity.

Studies have shown that adoption of agricultural technologies in many developing countries remains low and slow. Many of the studies done on factors affecting adoption of agricultural technologies have focused on extrinsic factors with little focus on intrinsic factors. Yet, intrinsic factors are key determinants of agricultural technology uptake. An important intrinsic factor is the farmer learning preferences. Understanding how farmers prefer to learn can inform the choice of strategies, channels and tools that would result to better technology uptake. It was on this basis that Biovision Africa Trust, in collaboration with PELUM Kenya and World Agroforestry Centre (formerly ICRAF), under the Ecological Organic Agriculture Initiative (EOA-I) commissioned this study to examine how farmers learn best and what this means to strategies for enhancing adoption of agricultural technology among small scale farmers.

This was a two-phased study that involved a desktop research consisting of published articles and meta-analysis of studies on intrinsic and extrinsic factors affecting uptake of technologies among small scale farmers; and a field survey to assess learning preferences of small scale farmers, and extension agents' perceptions of how farmers learn. It targeted small scale farmers and extension agents, with respondents drawn from Lurambi Sub-county in Kakamega County and Machakos Sub-county in Machakos County. Kakamega and Machakos counties were purposively selected based on three conditions: That the counties have sizeable populations of small scale farmers; the counties have both crop and livestock farming activities; and that BvAT had already been working in these counties.

Simple random sampling was used to select one rural and one peri-urban administrative ward from each sub-county. Shieywe (peri-urban) and Butsotso South (rural) wards were selected in Lurambi Sub-county and, Kola-Muumandu (peri-urban) and Mutituni-Ngelani (rural) wards

were selected in Machakos Sub-county. A sample of 142 small scale farmers was then selected from the two sub-counties, through convenience sampling procedure guided by the respective Ward Agricultural Extension Officers. In addition, all extension service providers in the selected sub-counties, from both the public and the private sector were also targeted as subjects in the study. The Statistical Package for Social Science (SPSS Version 22) was used to facilitate data analysis through frequencies, cross tabulations for comparison of categorical data, Principal Component Analysis and Varimax with Kaiser Normalization Rotation Method for extraction of components of farmer learning preferences, and Analysis of Variance (ANOVA) with Tukey HSD Post Hoc Test for comparison of farmer learning preferences in peri-urban and rural set-ups.

A meta-analysis of 70 studies on adoption of agricultural technologies in Kenya and other developing countries revealed that only 31.4 percent of the studies had findings on intrinsic factors affecting technology adoption (Appendix 1). The rest of the studies dealt with extrinsic factors only. This provides clear empirical evidence on the greatly skewed emphasis laid on extrinsic factors in understanding adoption behavior among small scale farmers.

Results from extension agents revealed that the five most preferred extension methods were; demonstrations (84.6%), farmer groups (82.1%), field days (79.5%), Agricultural Society of Kenya Shows (74.4%), and, farm and home visits (66.7%). However, there were variations in the ranking of these methods in the two study locations. The most common reasons given for preferring these methods were that they reach more farmers and therefore are cost effective. When asked which method they thought catalyzed most change in farmers, extension agents reported demonstrations, with almost 70 percent; field days (53.8%); farm and home visits (51.3%); and ASK shows (51.3%).

A comparison on the extension methods used to teach and what farmers prefer revealed great discrepancies between farmer preferences and methods used to teach them. The greatest discrepancy was noted in the use of demonstrations to teach crop production technologies (over 80%) with farmer preference being about half of extension agents' use of the method (47.6%). Extension methods utilized by extension agents to teach livestock production technologies did not differ much from farmer preferences as for crop production.

Eight components of farmer learning preferences were extracted using Principal Component Analysis. These were: Repetitiveness of extension messages; concrete learning experiences; verification of information received through mass media either by consulting extension officers or fellow farmers and, timeliness of learning session with farmers preferring afternoon sessions to mornings. Other components were: Solitary learning; learning through others rather than actively looking for information themselves; abstract learning especially for peri-urban farmers, and, peer learning rather than learning from extension officers.

This study recommends that extension service providers should align the extension methods they use to disseminate agricultural information with farmers' preferred methods. They should also provide farmers with conducive learning environments in tandem with their learning styles. Extension agents need to tailor-make learning contexts in line with farmer preferences, for improved learning experiences and increased adoption of new and improved agricultural technologies.

LIST OF ABBREVIATIONS AND ACRONYMS

ANOVA	Analysis of Variance
ASK	Agricultural Society of Kenya
BvAT	Biovision Africa Trust
EOA	Ecological Organic Agriculture
EOA-I	Ecological Organic Agriculture Initiative
FAO	Food and Agricultural Organization of the United Nations
GDP	Gross Domestic Product
ICRAF	International Centre for Research in Agro-forestry (World Agro-forestry Centre)
KES	Kenya Shillings
MOALF	Ministry of Agriculture, Livestock and Fisheries
NALEP	National Agriculture and Livestock Extension Programme
NGOs	Non-Governmental Organizations
PELUM	Participatory Ecological Land Use Management Association
SPSS	Statistical Package for Social Science

DEFINITION OF KEY TERMS

Agricultural Technology Uptake: This is the acceptance of an agricultural technology and implementing it or incorporating it in the agricultural activities one is involved in.

Communication channels: These are means through which information flows forward, backwards and sideways among stakeholders. In the context of this study, these are the means through which agricultural technology information flows to and from the farmer, extension agents and other stakeholders in the agriculture sector.

Extrinsic factors: These are factors emanating from sources other than within the person. With regard to adoption of agricultural technologies, these are factors influencing the farmer's adoption of technology but are not inherent within the individual.

Farmer learning pathways: These are learning activities that enable farmers to build knowledge in agriculture, deepening their understanding of agricultural technologies and best practices, leading to better performance.

Farmer learning preferences: These are learning activities and contexts that through experience, farmers have found to lead to better understanding of agricultural technologies and practices and therefore would choose them above others.

Intrinsic factors: These are factors emanating from within the person. In this study, intrinsic factors related to adoption of agricultural technologies are those factors that are inherently from within the farmer.

Small scale farmers: Farmers involved in growing crops and/or rearing of animals, at least in part, to be used by an individual family, with farming being a significant source of their livelihood.

1.0 INTRODUCTION

1.1 Background to the Study

The economies of most countries in Africa rely heavily on the Agriculture sector, which holds the key to growing inclusive economies in the region (AGRA, 2017). In Kenya, the Agriculture sector contributes about 24 per cent to the GDP and another 27 per cent indirectly through sector economic linkages; and it accounts for 65 per cent of the country's export earnings. More than 70 per cent of informal employment is in the rural areas (Government of Kenya, 2012).

The bulk of agricultural production in many developing countries is carried out by small scale farmers, who account for 80 percent of food production in Africa and Asia (FAO, 2017; Fan, Brzeska, Keyzer, & Halsema, 2013). Small scale agriculture is however, riddled with challenges, being characterized by; subsistence production, low yielding technologies, low resource base and relatively small volumes of produce on small plots of land (Ethical Trading Initiative [ETI], 2005; Fan, Brzeska, Keyzer, & Halsema, 2013). This has resulted in generally low levels of agricultural production in most areas of the country, and inability of the sector to contribute effectively to food security and poverty reduction. This, even as the country strives to work towards attainment of the first and second Sustainable Development Goals (SDGs) which are; to end poverty in all its forms, and end hunger, achieve food security, improved nutrition and promote sustainable agriculture by 2030 (United Nations, 2015).

The adoption of improved agricultural technologies by farmers is critical to increasing agricultural production and productivity, and, meeting the food insecurity and poverty challenges. Agricultural extension service providers would play a crucial role in bridging the gap between these technologies and the farmers and encouraging adoption of the technologies (Swanson, Bentz & Sofranko, 1997; Oakley & Garforth, 1985). It is generally recognized that agricultural extension contributes significantly to enhanced agricultural productivity and improved food security and rural livelihoods.

Extension agents use a variety of methods for disseminating content and facilitating processes that enhance farmer learning and adoption of new practices. They provide farmers with relevant and useful information and skills on agricultural innovations, and also help them to adopt these innovations for improved agricultural productivity (Muyanga & Jayne, 2006). If extension

services are well designed and implemented they are able to lead to improved agricultural productivity (Romani, 2003; Mwabu, 1998), although this will depend on other factors of production being favourable.

In Kenya, the agricultural extension service is divided into two broad categories; the public sector extension service and the private sector extension service. The Government recognizes the role of these two extension sub-sectors as critical to increased agricultural productivity and transforming the largely subsistence agriculture sector into a modern, vibrant and commercially oriented sector (Government of Kenya, 2012). The public sector is dominated by the Government extension service that is provided under the Ministry of Agriculture, Livestock and Fisheries. All counties in the country are served or expected to be served by the government extension services. The private sector has a variety of players including NGOs, private companies, community organizations and private practitioners. The Ministry of Agriculture is the lead extension service provider in the country, and has staff all over the country, up to the administrative Ward level.

Despite demonstrated potential of modern agricultural technologies through research, uptake by stakeholders especially farmers seem to be low and slow (Meijer, Catacutan, Ajayi, Sileshi & Nieuwenhuis, 2014). This realization has been supported by various studies that indicate uptake of agricultural technology by small holder farmers in Sub-Saharan Africa seems to be slow. A study by Kavoi, Mwangi and Kamau (2014) reported continued low adoption of improved agricultural technologies in the semi-arid areas of lower eastern Kenya.

Many studies have been carried out in developing countries, including Kenya, to understand the factors that influence farmers' adoption of agricultural technologies. It has been shown that extrinsic factors such as age, education attainment, income, family size, tenure status, and credit use; and intrinsic factors like value system and beliefs, are linked to adoption processes. In Kenya, a study by Andiema (2014) on factors influencing adoption of energy saving stoves among small scale households in Kapenguria, found that age, technology characteristics and contact with extension services were the main factors that increased the probability of adoption. Another study by Gitu, Onyango and Obara (2015) on factors affecting adoption of improved finger millet varieties by small scale farmers in Mogotio District of Kenya found that gender of

household head, household land control system, household's age and education level significantly affected adoption. Similar findings were obtained by Mshenga, Saidi, Nkurumwa, Magogo and Oradu (2016) in their study on adoption of African indigenous vegetables into agro-pastoral livelihoods in Narok and Kajiado counties. Other factors that have been found to influence adoption include governmental and political forces, farmer perception of new projects/technologies (Khatete, Matuli & Bor, 2016); capital, market availability and credit (Kinyangi, 2014) and, group involvement and social support (Nata, Shauri & Kadere, 2016). Another study carried out in Bungoma County on factors affecting adoption and intensity of use of organic management practices in maize production found that farm distance from homestead, off farm income and occupational options had significant effect on adoption (Gido, 2012).

Although many studies have been done on factors that affect adoption of agricultural technologies, most of them have tended to focus on extrinsic factors rather than intrinsic factors such as knowledge, farmers' perceptions to new agricultural technologies and learning preferences. In view of the continued low adoption of agricultural technologies and the complexity of technology adoption, there is need to focus on intrinsic factors such as farmers' perceptions on technologies, in addition to the extrinsic factors (Meijer, Catacutan, Ajayi, Sileshi & Nieuwenhuis, 2014). This may provide a better understanding of technology adoption since the farmers deal with the technologies and probably perceive technologies differently from researchers and extension agents. More importantly, understanding the farmers' learning preferences may inform what strategies and tools to use in working with them for greater technology uptake. This was the motivation for this study.

The study was commissioned by Biovision Africa Trust, in collaboration with PELUM Kenya and World Agroforestry Centre (formerly ICRAF), under the Ecological Organic Agriculture Initiative (EOA-I). EOA-I is a continental initiative whose mission is to promote ecologically sound strategies and practices among diverse stakeholders in production, processing, marketing and policy making to safeguard the environment, improve livelihoods, alleviate poverty and guarantee food security. The overall goal of the initiative is to mainstream ecological organic agriculture into national agricultural production systems by 2025 in order to improve agricultural productivity, food security, access to markets and sustainable development in Africa (Biovision Africa Trust, 2015).

The EOA-I aims at achieving specific results which include: Increased scaling up of best practices in EOA through adoption and adaptation of innovations of the technologies, systems and practices by small scale farmers, especially the women and youth; increased exposure and courage to the public to embrace and consume ecologically grown food; increased productivity, incomes, and improved food security as a result of innovations and adhering to standards; increased local and external demand for safe food; and inclusion of EOA in national agricultural research policies and programmes as well as educational programmes at different levels.

EOA is a holistic production management system that considers the agro-ecosystem in all its diversity. It focuses on attaining a balanced food system designed to enhance biological diversity, promotes healthy use of soils, air and water; relying on renewable resources in locally organized agricultural systems. EOA systems increase soil biological activity and maintain long-term fertility. They rely on biodiversity, ecological processes and cycles to sustain the health of soils, ecosystems and people while minimizing the addition of external inputs like agrochemicals and inorganic fertilizers that may have adverse effects on these systems. EOA combines modern science, innovative practices and tradition to promote good relationships of the various environmental elements. There are a number of farming practices that are carried out under EOA. They include; organic farming, sustainable agriculture, bio-intensive agriculture, permaculture, and ecological farming (PELUM, 2011).

1.2 Purpose and Objectives of the Study

In regards to technology uptake by farmers, studies have focused more on extrinsic factors while less research and studies have been done on intrinsic factors. The purpose of this study was therefore, to examine how farmers learn best and what this means to strategies for enhancing the adoption of agricultural technology among small scale farmers in Kenya. The specific areas of focus were:

i. A meta-analysis of intrinsic and extrinsic factors from studies undertaken on factors affecting uptake of technology by farmers.
ii. Review of learning frameworks and channels of information used in informing dissemination of agricultural technology to small scale farmers.
iii. Assessment of how farmers in some selected counties in Kenya prefer to learn and compare with literature in the task above.

iv. Assessment of extension agents' perceptions of how farmers in the selected counties in Kenya learn and how these perceptions are similar to or different from the farmers' indicated learning preferences.
v. Recommendations of how extension agents should change or reinforce outreach approaches and educational experiences to align with farmers' learning preferences for more successful educational programming and technology uptake.

The study was therefore guided by the following specific objectives:

i. To carry out a meta-analysis of intrinsic and extrinsic factors affecting uptake of agricultural technologies among small scale farmers in Kenya.
ii. To review and document the learning frameworks and information channels used in informing current agricultural technology dissemination practices in Kenya.
iii. To assess the learning preferences of small-holder farmers in Lurambi and Machakos Sub-counties and compare with what is documented.
iv. To assess extension agents' perceptions of how farmers in Lurambi and Machakos sub-counties learn, and compare with the farmers' reported learning preferences.
v. To formulate recommendations on alignment of agricultural technology dissemination strategies with famers' learning preferences for improved agricultural technology uptake.

2.0 THEORETICAL UNDERPINNING OF AGRICULTURAL TECHNOLOGY DISSEMINATION METHODOLOGIES

Agricultural extension aims at changing farmers' knowledge, skills and attitudes towards agricultural innovations by providing appropriate and relevant information on modern agricultural technologies (Oakley & Garforth, 1985). A major role of extension is to expose farmers to relevant information and then help them use the knowledge to make decisions through which they can optimize the use of their resources and be able to realize their goals in the best way possible (van den Ban & Hawkins, 1996; Muyanga & Jayne, 2006). Agricultural extension is greatly informed by several theories that include the adult education theories, andragogy theories, Social Cognitive Theory, Experiential Learning Theory, Communication Theory, Extension theory, Empowerment theory, Diffusion of Innovations Theory among others (Braun,

McCoy & Finkbeiner, 2014; Clarke, 1999; Knowles, 1984; Kolb & Kolb, 2012; Sewell *et.al*., 2017; Rogers, 1983, 1995; Botha & Atkins, 2015).

Extension education is a lifelong voluntary informal learning process involving adults of different ages and abilities with no definite syllabus, examination, degree or other certificate. It is given to the participants to change their behavior, attitude and to help them solve their own problems, meet their own needs and interests using their own resources to improve their livelihoods and wellbeing. This broad definition is informed by a combination of several learning theories, frameworks, styles, or learning pathway streams that lead and complement each other in a variety of ways to knowledge translation, technology uptake and informing the adoption process.

Adult Education theories are relevant in actively helping adults focus on solving and managing their problems. Adults learn well through dialogue and other learning styles. Educators need to know how adults define their problems, what adults want to know and why they want to know to design effective education (Boyle, 1981; Braun, McCoy & Finkbeiner, 2014; Franz, 2007). Adult education theories are very relevant in emphasizing how adult learning programmes can harness the experience of participants; considering the age limitations of the participants, promoting personal development while providing adults with as much choice as possible in the availability and organization of learning programmes (Merriam, Caffarella, & Baumgartner, 2007).

Andragogy applies to any form of adult learning and has been used extensively in the design of farmers' training programmes (Knowles, 1984). According to **Knowles' Theory of Andragogy**, adults are self-directed and expect to take responsibility for decisions, need to be involved in the planning and evaluation of their instruction, are most interested in learning subjects that have immediate relevance to their job or personal life where learning is problem-centred rather than content-oriented. Strategies such as case studies, role playing, simulations, and self-evaluations are most useful and instructors adopt a role of facilitator or resource rather than lecturer or grader (Knowles, 1984). This theory has direct implications in the choice of extension methods that an extension agent makes, since they have to appeal to the farmers as adult learners.

Farmers' learning through agricultural extension is also informed by the **Social Cognitive Theory** (SCT), specifically on how people acquire and maintain knowledge, skills and beliefs

through their interactions with, and observations of, others. This theory provides a framework for designing, implementing and evaluating learning programmes that seek to change patterns of behavior. It does so by recognizing the dynamic interaction between the people, their behavior and the social and physical environment in which they are embedded (Sewell *et.al*., 2017). There is need therefore, for extension agents to take into account the farmers' environment and context in the design and implementation of extension programmes.

Another theory that is useful in guiding farmer learning is David Kolb's **Experiential Learning Theory** (Kolb & Kolb, 2012), although it is mostly applied in pedagogy. Kolb argues that effective learning is seen when a person progresses through a cycle of four stages: The cycle starts by having a concrete experience followed by observation of and reflection on that experience which leads to the formation of abstract concepts (analysis) and generalizations (conclusions) which are then used to test hypothesis in future situations, resulting in new experiences. This awareness can help the extension agent to be more deliberate in designing learning programmes that allow the farmer to go through the four cycles in order for effective learning to occur. Kolb's experiential learning theory also argues that people naturally have specific preferred learning styles, although these are influenced by factors such as social environment, educational experiences, or the basic cognitive structure of the individual. In dealing with farmers therefore, extension agents should keep in mind that they each have their own preferred learning styles. By focusing on active hands-on learning through experience and reflection, experiential learning models bring learners outside of the traditional classroom lecture setting *(*Ahmed et al., 2017; Andreasen, 2004; Kolb, 2014; Kolb & Kolb, 2012).

Another relevant theory is the **Communication Theory**, which is key in terms of who says what in which channels, to whom and with what effect and is relevant in examining the interaction of audience and media for influence on knowledge, opinions, attitudes and behaviors of audiences (Braun, McCoy & Finkbeiner, 2014; Rogers, 1983). The communication processes are central to encouraging or discouraging behavior and in the diffusion of information and adoption of innovation. This theory is relevant or used to design targeted audience campaigns and messages (Braun, McCoy & Finkbeiner, 1983).

Extension theory is very helpful to better inform the contextual factors and brings perspective to the communication channels and mechanisms used to influence the individual (Botha & Atkins, 2015). **Empowerment theory** which is a process by which individuals gain perceived autonomy and confidence to achieve control over problems and issues of concern to them through appropriate solutions is also relevant in programmes that leave individuals, groups, communities and/or organizations with sufficient ability and confidence that they can address issues and/or solve problems themselves (Zimmerman, 2000; Zimmerman & Warschausky, 1998). According to Zimmerman (2000), empowerment is both a value orientation for working in the community and a theoretical model for understanding the process and consequences of efforts to exert control and influence over decisions that affect one's life, organizational functioning, and the quality of community life.

Diffusion of Innovations Theory by Everett Rogers sheds much light to the adoption process and the diffusion of innovations. The theory describes diffusion as the process by which an innovation is communicated through certain channels over time among the members of a social system (Rogers, 1995). The Theory explains how a new idea, product or positive behavior (innovation) spreads through a community or social structure depending on characteristics of the innovation, communication channels, time and the social system. Perceived innovation or technology related characteristics such as relative advantage, complexity, compatibility, trialability and observability may affect the extent to which farmers adopt the innovation. This is supported by various studies (Baiyegunhil, 2015; Khatete, Matuli & Bor, 2016; Mbugua, 2009; Mignouna, 2011). Apart from the innovation itself, the Diffusion of Innovations Theory is also concerned with the manner in which a new technological idea, artefact or technique, moves from creation to use and communicated through particular channels, over time, among the members of a social system (Clarke, 1999). Communication channels are an important element in the diffusion of innovations (Rogers, 1995).

Extension education is essentially a process of communication of ideas and skills between and among people (Braun, McCoy, Finkbeiner, 2014). An effective extension communicator needs to have an understanding of the various teaching methods and be able to apply one or a combination of them to effectively deliver the extension message and to be an effective in his work. The ability to communicate determines to a very large degree the success or failure of an

extension worker. The extension worker establishes effective communication with the people he serves so they use this information to continually improve their agriculture and rural life. An effective communication depends on the communication skill, knowledge level, and attitude of the communicator and how he desires to affect his receiver. It is the responsibility of the extension agent to choose the appropriate communication channel and decide the teaching methods and channels of communication that he can use to ensure maximum learning (Braun, McCoy, Finkbeiner, 2014).

Extension teaching methods or techniques are used to set up learning situations and to maximize learning. They are grouped into individual, group and mass methods, based on the number of people they are designed to reach (Oakley & Garforth, 1985). **I**ndividual methods include farm and home visits, office calls, telephones calls, personal letters and informal contacts. There are many advantages associated with individual methods of teaching, although the advantages vary depending on the specific method in question. One advantage that cuts across all individual methods is the personal contact involved, which enables the extension agent to exert personal influence on the farmers and hence encourage adoption of innovations. Individual methods however, are more expensive in terms of staff time and travel, and are therefore not widely used in developing countries where the public extension services are characterized by financial and human resource constraints.

Group methods are more economical to use, as they involve extension agents meeting a group of farmers at a go. They provide higher farmer coverage, better environment for shared learning, including farmer to farmer learning, and enable farmers to undertake group action (Oakley & Garforth, 1985). They are especially affective in moving people from the interest stages to the trial stages of adoption process. Examples of group methods include field days, meetings, method and result demonstrations, tours and field trips, and group discussions. In more recent years, the Farmer Field School (FFS) approach has been used as an innovative extension method (FAO, 2006). It is a participatory and interactive learning approach that emphasizes problem solving and discovery based learning. It is an experiential training methodology that allows farmers to learn by doing.

Farmer field schools are widely used especially by non-governmental organizations, and have been found to have a positive effect in improving agricultural productivity. A study by Davis

et.al. (2012) found that FFS had a positive impact on crop production among women, low literacy and medium land size farms. Participation in FFS also had significant effect on income and crop productivity overall.

The mass methods which are also commonly referred to as mass media are those that reach large masses of people. Examples of mass media include radio, television, newspapers, magazines, posters, exhibits, displays, educational campaigns, audio visual aids/media, films and printed materials, internet, and mobile phones used by extensionists to carry messages to large numbers of people quickly. They are popular for making people aware of innovations, changing people's knowledge and stimulating their interest (Oakley & Garforth, 1985). The most common mass media methods used in extension are the radio and television. The radio is found in almost every household, and has the advantage in that there are numerous radio stations that broadcast in vernacular and therefore can reach even the most illiterate farmer.

In recent years, mobile phones have emerged strongly among the ICTs as an extension method. Mobile phone-based applications and services are being used widely in the agricultural sector, to provide information on market prices, weather, transport and agricultural techniques via voice, short message service (SMS), radio and even the internet (Aker, 2011). A study carried out by Fu and Akter (2016) on the impact of mobile phone technology on agricultural extension services delivery in India highlights the impact mobile phones have had. According to the study findings, the amount, quality and speed of extension service delivery had improved significantly due to mobile phone usage. There was also greater knowledge and awareness of new agricultural practices, farmers' aspiration to try new technology in the future and access to credit.

The increased penetration of ICTs in developing countries provides a unique opportunity to transfer agricultural knowledge for both public and private extension service providers. Mobile phones have been found to significantly reduce communication and information costs for the rural poor, who are usually disadvantaged by other forms of ICTs like the internet. This has significantly improved access to agricultural technologies among many farmers (Aker, 2011).

In summary, agricultural technology dissemination and learning is underpinned by a variety of theoretical and learning frameworks**.** They include the adult education theories, andragogy

theories, Social Cognitive Theory, Experiential Learning Theory, Communication Theory, Extension theory, Empowerment theory, Diffusion of Innovations Theory among others (Braun, McCoy & Finkbeiner, 2014; Clarke, 1999; Knowles, 1984; Kolb & Kolb, 2012; Sewell *et.al*., 2017; Rogers, 1983, 1995; Botha & Atkins, 2015). Extensionists use one or a combination of extension teaching methods and techniques such as farm and home visits, office calls, telephones calls, personal letters, informal contacts, field days, meetings, method and result demonstrations, tours and field trips, group discussions, Farmer Field Schools, radio, television, newspapers, magazines, posters, exhibits, displays, educational campaigns, audio visual aids/media, films and printed materials, internet, and mobile phones.

3.0 METHODOLOGY

The study adopted an ex-post-facto cross-sectional survey research design and was carried out in two phases. The first phase consisted of a desktop study consisting of a review of journal articles, reports, books, proceedings of workshops and conferences and meta-analysis of studies on intrinsic and extrinsic factors affecting uptake of technologies among small scale farmers. The second phase of the study consisted of field surveys to assess learning preferences of small scale farmers, and to assess extension agents' perceptions of how farmers learn.

The target population consisted of all small scale farmers and extension service providers in Kakamega County in the western part of Kenya, and Machakos County in eastern Kenya (see APPENDIX 5). The two counties are dominated by the Luhya and Kamba ethnic groups respectively whose livelihoods are primarily dependent on agriculture. Kakamega County covers an area of 3,343 square kilometers and has a population of 1,660,651 (Kenya National Bureau of Statistics, 2013). The County is divided into 12 sub-counties, one of which is Lurambi Sub-county. Machakos County on the other hand covers an area of 6,208.2 square kilometers' with a population of 1,098,584. It consists of eight sub-counties, including, Machakos Sub-county which contains the county headquarters.

The two counties were purposively selected for the study based on three conditions. First, the counties have sizeable populations of small scale farmers. Secondly, the counties had both crop and livestock farming activities, and thirdly, BvAT had already been working in these counties. From each county, one sub-county was purposively selected on the basis of diversity of agricultural activities under both rural and peri-urban set-ups. The two sub-counties selected were Lurambi Sub-county in Kakamega County, and Machakos Sub-county in Machakos County. Simple random sampling was then used to select one rural and one peri-urban administrative ward from each sub-county, giving a total of four wards namely. Shieywe (peri-urban) and Butsotso South (rural) wards in Lurambi Sub-county were selected. In Machakos Sub-county, Kola-Muumandu (peri-urban) and Mutituni-Ngelani (rural) wards were selected. A sample of 142 small scale farmers was then selected from the two sub-counties, through purposive sampling in some cases, and convenience sampling in others. Respective Ward Agricultural Extension Officers played a key role in directing researchers to small scale farmers, most of whom belonged to farmer groups. In some cases, specific appointments were made with

the farmer groups, while in other cases, the researchers met them while they were having previously planned group meetings. Apart from small scale farmers, the study also targeted extension service providers in Lurambi and Machakos sub-counties, from the public sector as well as the private sector. All the extension service providers were purposively selected.

Three different instruments were used for data collection. The first instrument was a matrix to guide the desktop study for meta-analysis (APPENDIX 1). Details of publications, major findings on technology uptake, and explanatory variables for technology uptake categorized into extrinsic and intrinsic factors were recorded. The second instrument was an interview guide for small scale farmers (APPENDIX 3) which was used to collect data on small scale farmers' demographic characteristics, farming practices, sources of information on agricultural technology, methods of extension contact and their learning preferences. Most of the items in this instrument were structured, although the last two were open ended.

The third instrument was a semi-structured questionnaire for extension staff (APPENDIX 4) which facilitated data collection on extension agents' preferences and perceptions of how farmers learn. The instruments were validated by experts in the field of Agricultural extension from Egerton University. Reliability of the interview schedule was ensured through a pilot test involving five (5) small scale farmers in sub-counties neighbouring each sub-county selected for the study. Two sets of pilot tests were done, one in each study location, to ensure that the instruments were piloted as close as possible to the actual areas of study. The results of the pilot tests were used to adjust the items in the interview guide and questionnaire and ensure that they yielded consistent results.

The Statistical Package for Social Science (SPSS Version 22) was used to facilitate data analysis through frequencies, cross tabulations to compare data from Lurambi and Machakos Sub-counties, Principal Component Analysis and Varimax with Kaiser Normalization rotation method to extract components of farmer learning preferences and Analysis of Variance (ANOVA) with Tukey HSD Post Hoc Test to compare farmer learning preferences in peri-urban and rural set-ups.

4.0 RESULTS AND DISCUSSIONS

4.1 Intrinsic and Extrinsic Factors Affecting Uptake of Technologies among Small Scale Farmers

A meta-analysis was conducted, to identify intrinsic and extrinsic factors affecting uptake of technologies among small scale farmers in Kenya, and developing countries in general. The extrinsic factors affecting uptake of technologies among small scale farmers in Kenya identified by different authors were more than intrinsic factors as shown in Table 1. A total of 70 sources were reviewed, and out of these, only 22 (31.4%) had findings on intrinsic factors affecting technology adoption.

Table 1: Intrinsic and extrinsic factors affecting uptake of technologies among small scale farmers

Extrinsic factors	Intrinsic factors
i. Farmer characteristics such as age, education level and gender (e.g. Gitu, Onyango & Obara, 2015; Adesina & Chianu, 2002; Baffoe-Asare *et al.*, 2013). ii. Household and farm related economic factors such as household income, availability of productive resources, area under cultivation, commodity/ enterprise choice, farm labour availability, lack of collateral to access credit, problem and opportunity identification, risk management, land tenure system, farming as a business, wealth, competition for resources with household needs, access to credit, lack of resources (e.g. Baffoe-Asare *et al.*, 2013; Onyango & Obara, 2015; Adesina & Chianu, 2002; Armand, Afrakhteh & Bozayeh, 2015; Akudugu, Guo & Dadzie, 2012). iii. Extension related factors e.g. contact with extension service providers; extension delivery systems, farmer relationship with service providers, farmer trainings, farmer/client targeting, trustworthiness of the information source, adequacy of information,	i. Farmers' perceptions on uptake of new agricultural technologies (e.g. Adesina & Baidu-Forson, 1995; Adesina & Zinnah, 1993; Khatete, Matuli & Bor, 2016; Kyambo, 2014). ii. Farmer perceptions and attitudes about the technology characteristics, such as relative advantage, complexity and compatibility (e.g. Wyche & Steinfield, 2015; Baiyegunhill, 2015). iii. Inadequate knowledge/ information leading to inability to apply technology and level of knowledge/awareness about the technology (e.g. Okoedo-Okojie & Onemolease, 2009; Mukasa, 2016; Deshmukh, Kadam & Shinde, 2007; Inambao, 2012; Matata, Ajay, Oduol & Agumya, 2010). iv. Lack of interest (e.g. Kabwe, Bigsby & Cullen, 2016). v. Risk taking (e.g. Mignouna, 2011). vi. Farmer preferences (e.g. Odame, Kimenye, Kabutha, Alemu & Oduori, 2013). vii. Farmer's goals and values (e.g. Aragao,

communication ability and credibility of the extension worker, number of media used, dissemination pathway (e.g. Andiema, 2014; Adesina & Chianu, 2002; Armand, Afrakhteh & Bozayeh, 2015; Akudugu, Guo & Dadzie, 2012; Khatete, Matuli & Bor, 2016). iv. Social factors e.g. mobilization and group dynamics, membership to a group, social support, social capital, farmer participation, local leadership and decision makers (e.g. Obayelu, Ajayi, Oluwalana & Ogunmola, 2017; Nato, Shauri & Kadere, 2016; Mignouna, 2011) v. Market related factors: distance to market and input source, low profitability (e.g. Adesina & Chianu, 2002; Adesina *et al*., 2000; Baffoe-Asare *et al.,* 2013). vi. Technology related factors e.g. technology characteristics, availability, cost, time taken to benefit from the technology, Exposure to agricultural innovations (e.g. Andiema, 2014; Bwambale, 2015; Niusiima, 2015). vii. Political factors e.g. policy support, institutional support, availability and accessibility of other support services, poorly functioning institutions, lack of support infrastructure (e.g. Khatete, Matuli & Bor, 2016; Chilonda & Huylenbroe, 2001). viii. Climate and Agro-ecological issues (e.g. Chilonda & Huylenbroe, 2001).	2011)

The meta-analysis revealed a number of intrinsic factors that affect uptake of agricultural technologies among small scale farmers in Kenya and other developing countries. They included; the farmers' perceptions about new agricultural technologies, and technology characteristics such as relative advantage, complexity and compatibility. Another intrinsic factor was level of knowledge on new technologies, which would affect a farmer's ability to effectively apply the technologies. Level of awareness about the technology is also another intrinsic factor, and is closely linked to the level of knowledge. Level of interest in the innovation, another intrinsic factor, is linked to an important stage in the adoption process, the interest stage which

follows the awareness step in the five-step adoption process (Beal & Bohen, n.d.; Rogers 1995). Other intrinsic factors are; ability to take risks, which is linked to the fourth stage in the adoption process, that of trialability. Trying out new ideas can be full of uncertainties and requires the farmer to be able to take some degree of risk. Other studies found attitude towards the new technologies, farmer preferences and, farmers' goals and values as significant intrinsic factors affecting adoption of agricultural innovations.

The meta-analysis also revealed a great range of extrinsic factors that affect uptake of technologies among small scale farmers. These can be grouped into: Farmer-related factors, Household and farm related economic factors, Extension related factors, Social factors, Technology related factors, Market-related factors, Political factors, and Climatic and agro-ecological issues. Given the number of studies that have focused on these factors, it is clear that these factors have been widely studied and continue to be the focus of many studies on technology adoption among small scale farmers.

Findings of the meta-analysis provide clear empirical evidence on the greatly skewed emphasis laid on extrinsic factors in understanding adoption behavior among small scale farmers. One of the explanations for the over-emphasis on extrinsic factors affecting technology adoption is that these factors by their very nature are external to the farmer and their effect is more obvious or more easily measurable. Intrinsic factors on the other hand tend to be less obvious, and are difficult to collect data on and analyse desired relationships.

4.2 Information Channels used to Disseminate Agricultural Information and Extension Agents' Perceptions of How Farmers Learn

4.2.1 Background Information of the Extension Agents

A total of 39 extension officers were involved in the study, with 22 (56.4%) being from Lurambi Sub-county while 17 (43.6) percent were from Machakos Sub-county. The summary of their socio-economic attributes is shown in Table 2.

Table 2 Socio-economic attributes of extension agents in Lurambi and Machakos Sub-counties

Socio-economic Attribute	Frequency	Lurambi Sub-County	Machakos Sub-County	Overall Percentage
Percentage of female extension workers	18	59.1	31.2	47.4
Percentage of male extension workers	20	40.9	68.8	52.6
Extension workers Aged ≤25 yrs	1	4.5	0.0	2.6
Extension workers Aged 25-35 yrs	13	40.9	23.5	33.3
Extension workers Aged 36-45 yrs	9	13.6	35.3	23.1
Extension workers Aged 46-55 yrs	10	31.8	17.6	25.6
Extension workers aged over 56 yrs	6	9.1	23.5	15.4
Extension workers with certificate	5	13.6	12.5	13.2
Extension workers with diploma	12	36.4	25.0	31.6
Extension workers with degree	16	45.5	37.5	42.1
Extension workers with postgraduate	5	4.5	25.0	13.2
Extension workers from public sector	22	68.2	41.2	56.4
Extension workers from private sector	17	31.8	58.8	43.6
Specialized in crops	17	50.0	35.3	43.6
Specialized in livestock	8	18.2	23.5	20.5
Specialized in both crops and livestock	7	22.7	11.8	17.9
Specialized in other areas (Food science, Engineering, marketing and agri-business, entrepreneurship, finance and accounts, statistics)	7	9.0		17.9

Overall, both genders were well represented among the extension agents who participated in the study, with 52.6 percent being male and 47.6 percent being female. However, there was noticeable variation in gender balance between the two sub-counties. Machakos Sub-county had substantially lower representation of female extension agents at 31.2 percent as compared to Lurambi which had a significantly higher percentage of females (59.1%). The extension agents were generally young, with the highest percentage (33.3%) being in the category of 26 to 35 years, while 2.6 percent were below 25 years.

However, the age distribution in the two subcounties did not follow the same pattern. The extension agents in Lurambi were significantly younger, with 45.4 percent being less than 36 years old, compared to 23.5 percent in Machakos. Only 15.4 percent were in the category of 56 years and above with Machakos posting a higher proportion than Lurambi (23.5% and 9.1%

respectively). These extension officers are close to the mandatory retirement age, which is set at 60 years by the Kenya Government.

The extension agents were generally well educated, with only 13.2 percent having been trained to certificate level. The highest percentage was in the category of bachelor's degree holders (42.1%) while a significant proportion of 13.2 percent had masters' degrees. Lurambi Sub-county had a higher percentage of extension agents with diploma and degree training (81.9%) as compared to Machakos at 62.5 percent. However, Machakos had a higher percentage of extension staff with postgraduate education (25%) compared to Lurambi (4.5%). Education provides a base for developing the competencies needed for effective extension work. A study by Ng and Fieldman (2009) found that education level not only positively influenced core task performance but was also positively related to creativity and citizenship behaviours. Therefore, high education levels are also likely to contribute to enhanced performance by the extension agents. It can therefore be deduced that both Lurambi and Machakos sub-counties had competent extension staff, based on their education levels.

The extension agents were drawn from both the public and the private sectors. Lurambi Sub-county had majority of extension agents from the public sector (68.2%) as opposed to Machakos Sub-county that had majority of the extension agents (58.8%) coming from the private sector. The public sector was represented by the Ministry of Agriculture, Livestock and Fisheries (MOALF) in both study locations. In Lurambi Sub-county, the private sector was mainly represented by non-governmental organizations (NGOs), examples being One Acre Fund and Welt Hunger Hilfe. In Machakos Sub-county, in addition to NGOs, there was representation from agro-vet dealers and private companies dealing with agro and veterinary products and services. The significant representation of the private sector in the provision of extension services in both locations is a result of the National Agriculture Sector Extension Policy, which advocates for pluralism in the provision of agricultural extension services in Kenya (Government of Kenya, 2012).

The extension agents represented different areas of specialization, although the majority specialized in crops (50% in Lurambi and 35.3% in Machakos). A significantly higher percentage of extension agents were specialized in crops in Lurambi Sub-county. This could be

due to the fact that more extension agents in the Sub-county were from the public sector, which tends to be dominated by staff specialized in crops. Only 18.2 percent and 23.5 percent were specialized in livestock in Lurambi and Machakos sub-counties respectively. Lurambi had more staff trained in both crops and livestock (22.7%) as compared to Machakos (11.8%). Other areas of specialization reported by the respondents included food science, engineering, marketing, agri-business, and entrepreneurship.

4.2.2 Common Extension Methods used by Extension Agents

The respondents were asked to select from a list of extension methods, those that they commonly used. The findings were as indicated in Figure 1.

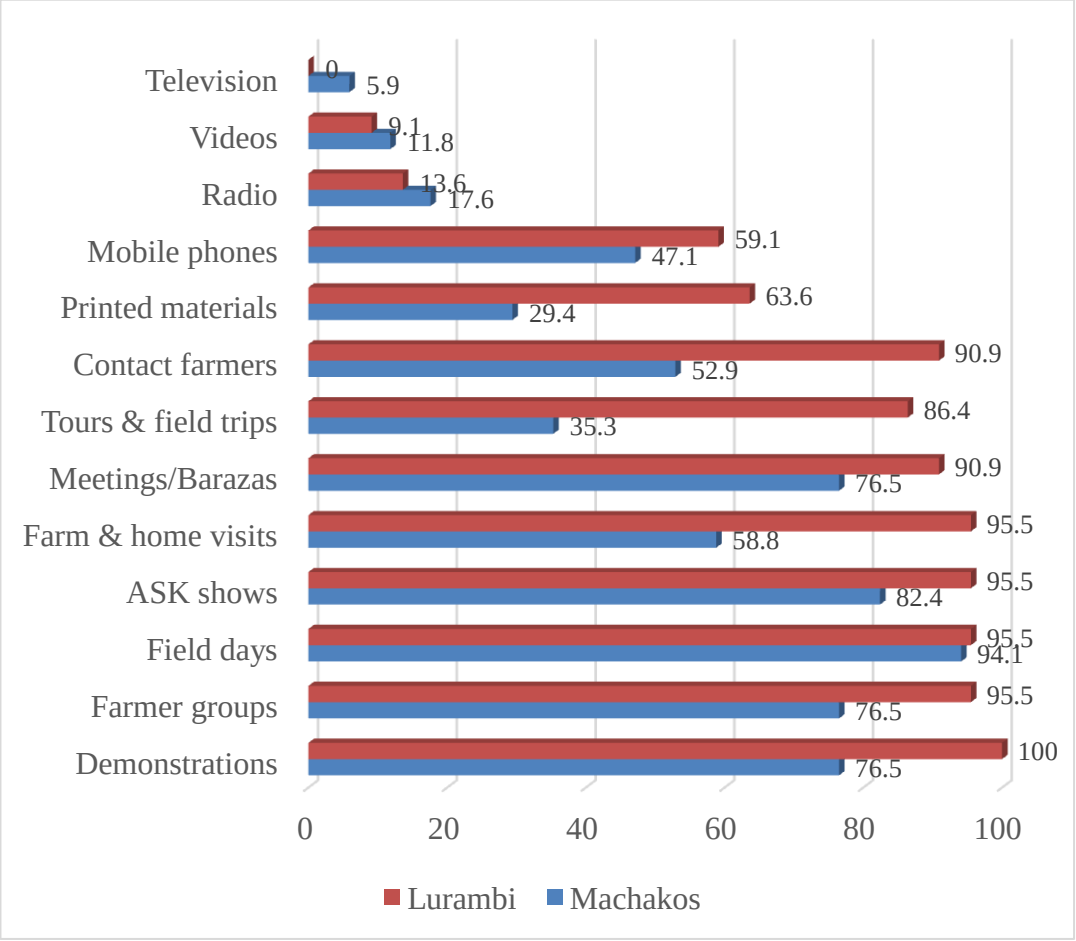

Figure 1 Methods Commonly used by Extension Agents

The findings indicate that the extension agents used a variety of teaching methods in reaching the farmers. This is in line with the general practice in Kenya where due to the pluralistic nature of extension services, many service providers are involved, and they use a variety of extension methods depending on their circumstances and target group (Government of Kenya, 2012).

In Lurambi Sub-county, the leading extension method was the use of demonstrations, where 100 percent of the respondents reported that they commonly used this method. These were followed by; farmer groups, field days, Agriculture Society of Kenya (ASK) shows and farm and home visits, all reported by 95.5 percent of the respondents. The use of contact farmers and meetings/barazas was also reported by a large majority (90.9%) of the respondents in the Sub-county. Other methods reported to be widely used were tours and field trips (86.4%), printed materials (63.6%) and mobile phones (59.1%). The six most commonly used methods in Lurambi Sub-county were therefore; demonstrations, farmer groups, field days, ASK shows, farm and home visits, meetings, and, use of contact farmers.

In Machakos Sub-county, the extension agents also reported using a variety of teaching methods. The leading was field days (94.1%), followed by ASK shows (82.4%), demonstrations, farmer groups and meetings (76.5% each), and, farm and home visits (58.8%). There are notable differences between Lurambi and Machakos in the ranking of the commonly used methods as well as in the percentages of respondents reporting using the teaching methods. While demonstrations were the leading method used by all the respondents (100%) in Lurambi, they came third in Machakos, with 76.5 percent reporting using them. In collecting data, the study did not distinguish between method demonstrations and result demonstrations, and therefore it is not possible to distinguish which specific demonstrations were being used by the extension agents.

Field days were the leading method in Machakos and the second in Lurambi, although the percentages of respondents reporting this were very close (94.5% and 95.5% respectively). Another notable difference between Lurambi and Machakos sub-counties is that farm and home visits were reported to be used more in Lurambi (95.5%) than in Machakos (58.8%). Lower percentages of respondents in Machakos reported using the various methods as compared to those in Lurambi, which implies that the extension agents in Lurambi used a wider variety of methods as compared to those in Machakos. This could be linked to the greater representation of

public sector extension agents in Lurambi as opposed to Machakos where private sector extension agents were the majority.

The top six methods used in both sub-counties fall under the category of group extension teaching methods. This could be due to advantages associated with group extension methods which include; greater coverage and hence cost effectiveness, more conducive learning environment, and, encouragement of group action by farmers (JICA, 2008; Oakley & Garforth, 1985).

Almost all extension agents reported using field days (94.9%). This could be due to the advantages associated with this method of extension. According to Oakley and Garforth (1985), field days provide opportunities for extension agents to hold method or result demonstrations on a slightly higher scale than usual. Through field days, extension agents can bring together more farmers than they would under normal demonstration methods. In addition, the field days provide an opportunity for other extension service providers to participate, hence farmers get information from a variety of sources. Field days can vary in size from a few farmers to many, and their purpose is mainly to introduce a new idea and stimulate interest of many farmers (JICA, 2008).

An interesting finding was on the high percentage of respondents who reported using Agricultural Society of Kenya (ASK) shows (95.5% in Lurambi and 82.4% in Machakos). These shows are usually organized at regional level, and are usually annual events. They represent a highlight in the calendar of the Ministry of Agriculture, Livestock and Fisheries and its exhibition stand is usually a big attraction for the general public. Many other extension service providers including parastatals, NGOs and private companies also participate in the agricultural shows. Many farmers, young and old attend the agricultural shows in their regions and even in other regions.

Apart from the top six methods, other methods reported by a significant percentage of respondents included; use of printed materials in Lurambi (63.6%) and use of mobile phones (59.1% in Lurambi and 47.1% in Machakos). With regard to printed materials, their use as an extension teaching method tends to be restricted due to low literacy levels among rural people in many developing countries. However, the fairly high percentage of extension agents reporting

use of this method in Lurambi could imply that the farmers in the area are fairly literate. Mobile phones are an emerging information communication technology (ICT) based extension method that is gaining popularity in many developing countries. The significant percentages of extension agents reporting using them Lurambi and Machakos is an indication that mobile phones are an important channel for communicating extension messages to farmers in the two locations. Mobile phones have been found to be important for communicating information on markets and weather (Chharchhar & Hassan, 2013). A significant percentage (48.7%) of extension agents in Lurambi Sub-county reported commonly using printed materials, which is an indication that a sizeable proportion of their target group was literate.

The differences in the extension methods commonly used in the two study locations could be attributed to the difference in the representation of government and private sector extension agents, whereby Lurambi had more government agents while Machakos had more private sector agents. This assumption is supported by the findings of a study by Chimoita (2014) which found variations in the extension methods used by public sector and private sector extension service providers. Findings revealed that farmer field schools, demonstrations, contact farmers method and community leaders were most utilized methods to promote extension services by private firms. On the other hand, methods mostly utilized by government extension officers included; field days, agricultural shows, church based groups, and organised field visits.

4.2.3 Findings about extension methods preferred by the agents

From the list of commonly used extension methods, the extension agents were asked to indicate which ones they preferred to use. This is because of the realization that it is possible for an extension agent to use one particular method while preferring another. The findings were as indicated in Figure 2.

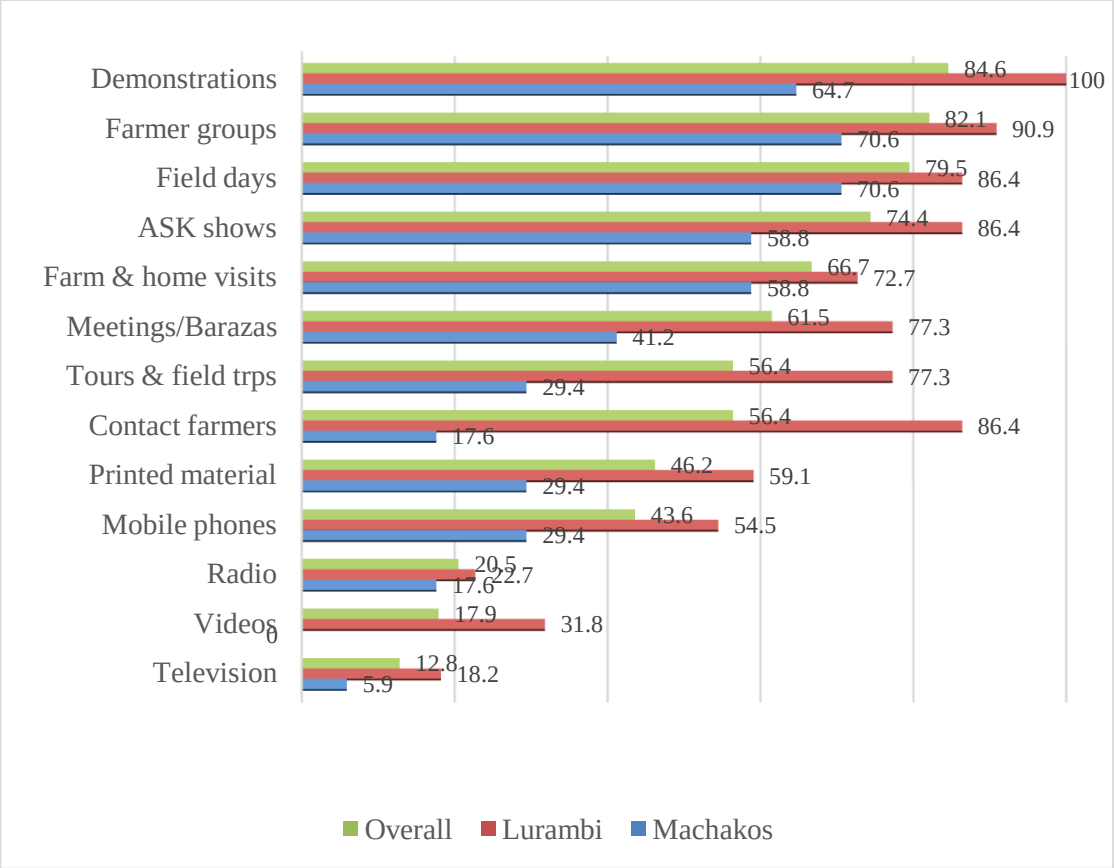

Figure 2: Extension methods preferred by extension agents

The six most preferred extension methods in Lurambi Sub-county in order of preference were: Demonstrations (100%), Farmer groups (90.9%), Field days and ASK shows (86.4%), Meetings/Barazas (77.8%) and Farm and home visits (72.7%). The high percentages of respondents indicating that they preferred the methods (over 70%) show that all the six methods were popular among extension agents in the region.

On the other hand, in Machakos Sub-county, the most preferred methods were farmer groups and field days (70.6%), followed by demonstrations (64.7%). Farm and home visits, and ASK shows came third with 58.8 percent of the extension staff reporting that they prefer them. Meetings were reported to be preferred by less than half of the respondents (41.2%). From the results, the two extension methods that appear to be highly preferred in both study locations are farmer groups and field days, although the percentages are higher for Lurambi Sub-county. It is interesting to note that although analysis of combined data reveals that demonstrations were the

most preferred methods (84.6%), there was significant variation between the two study locations. Demonstrations were reported to be used and preferred by all extension agents (100%) in Lurambi Sub-county but they were not as popular in Machakos, and only 64.7 percent of the respondents reported that they preferred them.

The ranking of the extension methods commonly used and preferred in Lurambi Sub-county did not differ significantly as they roughly followed the same order. A point of departure was with the farm and home visits, which were among the top most commonly used methods (reported by 90.9% of respondents), they ranked fairly low in the list of preferred extension methods. It can therefore be inferred that although farm and home visits are commonly used, the extension agents would prefer to use them less as compared to other methods. The same case applies for use of contact farmers, which featured highly among commonly used methods (reported by 90.9% of respondents), yet this method did not feature in the list of six most preferred methods of teaching.

For Machakos Sub-county there were some notable differences in the ranking of the extension methods as well. Results showed that field days were leading in usage and preference, but farmer groups which were third in terms of usage came first, alongside field days, in terms of preference. This is an indication that although the extension agents are not using farmer groups as much as field days, they rank them the same in terms of preference. Farm and home visits came last in the list of six most preferred methods of extension, although the percentage of respondents was fairly high at 72.7 percent.

Majority of the most preferred methods of extension in both locations fall under the group methods of teaching, where the extension agent meets with farmers in groups rather than individually (JICA 2008; Oakley & Garforth 1985). This could be associated with the advantages of group methods of extension.

4.2.4 Reasons why Extension Agents Prefer the Extension Methods

When asked about the reasons for preferring the extension methods, the extension agents gave four main reasons, as summarized in Table 3. The most common reasons given for preferring demonstrations, field days, farmer groups and ASK shows were that they reach more farmers and are cost effective. This is in line with the generally agreed upon advantages of group methods of

extension (Oakley & Garforth, 1995). Another commonly given reason was that some of these methods were easier to use, especially for the demonstrations and field days.

Table 3. Reasons for Preferring Extension Methods

Extension methods	**Reasons for preferring**				
	Cost effective	Reaches more farmers	Easier to use	Less time consuming	Others
Farm and home visits	28.2	15.4	15.4	2.6	2.6
Field days	20.5	61.5	20.5	7.7	2.6
Demonstrations	20.5	33.3	33.3	5.1	2.6
Farmer groups	20.5	43.6	15.4	10.3	2.6
Contact farmers	10.3	20.5	17.9	17.9	0
Tours and field trips	5.1	17.9	5.1	5.1	2.6
ASK Shows	7.7	48.7	5.1	2.6	2.6
Meetings/Barazas	7.7	43.6	15.4	12.8	0

Other reasons given which were not captured among the options given were that the methods address specific needs and give the real picture on the ground (mainly with regard to farm and home visits) and, they are more practical (demonstrations). The reasons given by the extension agents for preferring the various extension methods are in line with the advantages that are associated with these methods.

4.2.5 Methods thought to catalyse the most change

The extension agents were also asked about which methods they thought brought about the most change in knowledge, skills and attitudes among farmers, leading to improved adoption of innovations. The responses were as indicated in Figure 3.

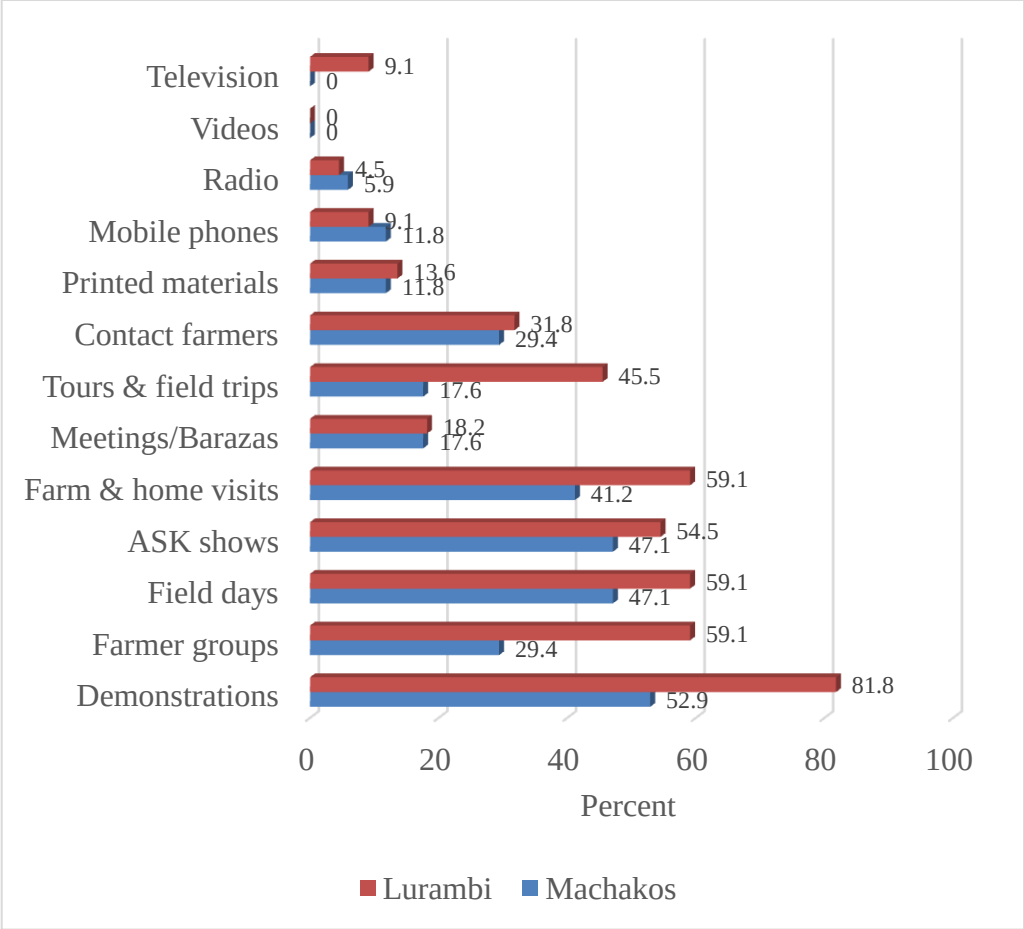

Figure 3 Methods thought to result into most farmer learning

The method that was reported to bring about the most change was use of demonstrations, with 81.8 percent of respondents in Lurambi Sub-county and 52.9 percent of the respondents in Machakos Sub-county choosing this method. With regard to Lurambi Sub-county, this is not a surprising finding since demonstrations were reported to be the most commonly used and also the most preferred method. However, it is an interesting finding with regard to Machakos since the demonstrations were neither the most commonly used nor the most preferred method of extension, being commonly used by 76.5 percent of the respondents as compared to field days standing at 94.1 percent and preferred by 64.7 percent compared to farmer groups and field days, both recording 70.6 percent (see Figures 1 and 2). It then implies that the extension agents' preferred methods are not those they believe bring about the most farmer learning, and they are aware of this.

Field days, farm and home visits and ASK shows were reported by an almost similar percentage of respondents (53.8%; 51.3% and 51.3% respectively). It is worth noting that field days and ASK shows are also used as platforms for conducting method and result demonstrations. Farmer groups came fifth with 46.2 percent of extension agents citing them. This finding agrees with that of a study on extension workers' perceptions of how farmers prefer to learn, whereby 95 percent reported demonstrations and 90 percent field days (Franz, Piercy, Donaldson, Westbrook & Richard, 2010).

The extension agents all reported more than one method they thought brought about the most change among farmers, meaning that they recognized that no single method on its own can work effectively. The findings also revealed that mass media was the least effective in causing change, with radio, television and video being the least effective in that order. This agrees with what is commonly reported in literature, that the lack of personal contact and personal influence of the extension agent makes mass media less effective in convincing farmers to change their attitudes and practice (Oakley & Garforth, 1995).

4.2.6 Extension Methods that would be used if the agents were well supported

When asked which methods they would use if they were well supported, they reported as summarized in Figure 4.

For both study locations, television was reported by the highest percentage of respondents as an extension method that they would use if well supported (68.2% in Lurambi and 47.1% in Machakos). It was followed by radio, with 50 percent and 47.1 percent respectively for Lurambi and Machakos sub-counties. Video was in third place for both study locations.

Television falls under mass media along with radios, video, newspapers and internet among others. Mass media has advantage in that it reaches many people at once with the same message and is quite cost effective compared to individual and group methods. Television is particularly appealing because it is an audio-visual, appealing to both sight and hearing. A study by Abubakar, Ango and Buhari (2009) found that television and radio were commonly accessible mass media that people used to obtain agricultural extension messages, although the respondents reported challenges in the cost of acquiring and maintaining them. The study recommended the need to embrace ICTs in extension.

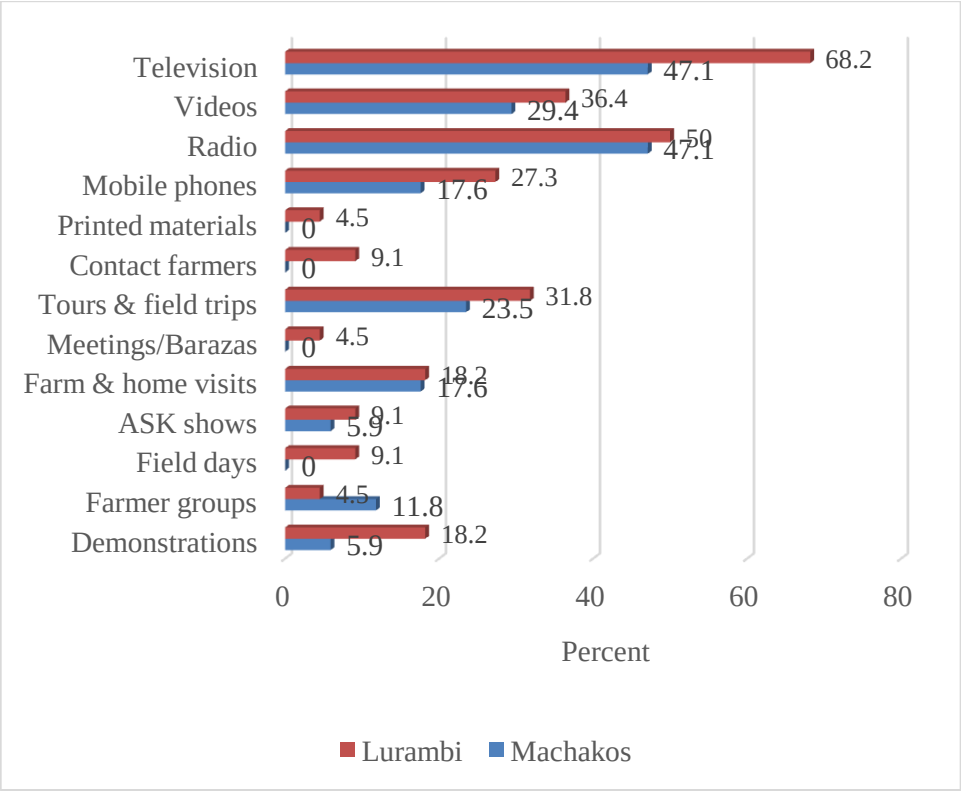

Figure 4 Methods extension agents would use if supported

It is interesting however that the three methods were ranked to be the least effective in causing change among farmers. This implies that the extension agents recognized the advantages associated with the three methods, despite their weakness in directly influencing change among farmers. Only 27.3 percent of respondents in Lurambi and 17.6 percent in Machakos reported that they would use mobile phones if well supported.

4.3 Findings on Small-Scale Farmers' Learning Preferences

4.3.1 Farmer Demographic Information

The study was conducted in two counties, Machakos and Kakamega Counties. From each county, one sub-county was selected, Machakos Sub-county (45.8%) and Lurambi Sub-county (54.2%). A total of 142 farmers were interviewed from two wards in each selected sub-county as shown in Table 4Table 4.

Table 4. Proportions of respondents per Ward

Sub-County	Ward	Frequency	Percent
Machakos	Kola-Muumandu	36	25.4
	Mutituni-Ngelani	29	20.4
Lurambi	Shieywe	35	24.6
	Butsotso South	42	29.6
Total		**142**	**100**

Majority of the small scale farmers interviewed were female, representing almost three quarters (72.5%) of all those interviewed (*Figure 5*). However, Lurambi had a slightly higher proportion of female farmers (76.6%) than Machakos (67.7%).

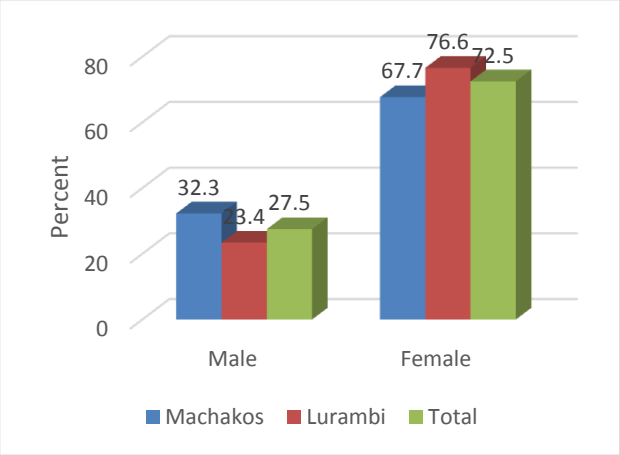

Figure 5: Gender of respondents

Concerning their marital status, over 80 percent were married with the two counties posting almost similar proportions at 86.2 percent in Machakos and 80.5 percent in Lurambi Sub-counties (*Figure 6).*

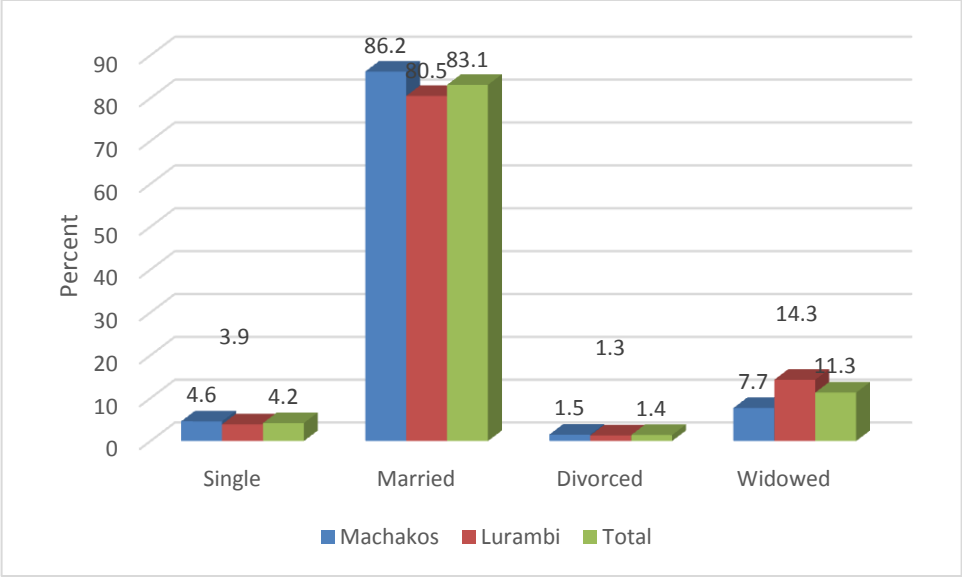

Figure 6 Marital status of respondents

A good proportion (40.1%) of all those interviewed were aged over 55 years with Machakos Sub-county recording a much older farmer population than Lurambi Sub-county at 47.7 percent and 33.8 percent respectively. The youthful population accounted for less than a quarter of the respondents with Machakos recording a much smaller proportion of the youthful population than Lurambi at 15.4 percent compared to 27.3 percent as illustrated in *Figure 7*.

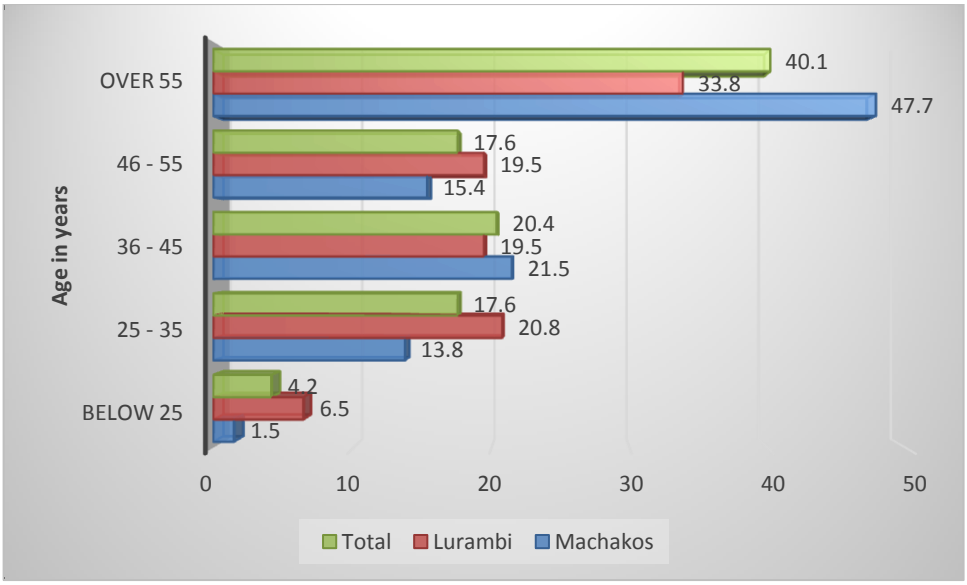

Figure 7 Age of respondents

Generally, education levels were lower than the national rates of education with 12 percent reporting no formal education compared to 7 percent nationally and 30.3 percent having secondary or tertiary education compared to 43 percent nationally (Kenya National Bureau of Statistics, 2014). A closer scrutiny revealed slightly lower education levels in Lurambi than in Machakos Sub-county as depicted in *Figure 8*.

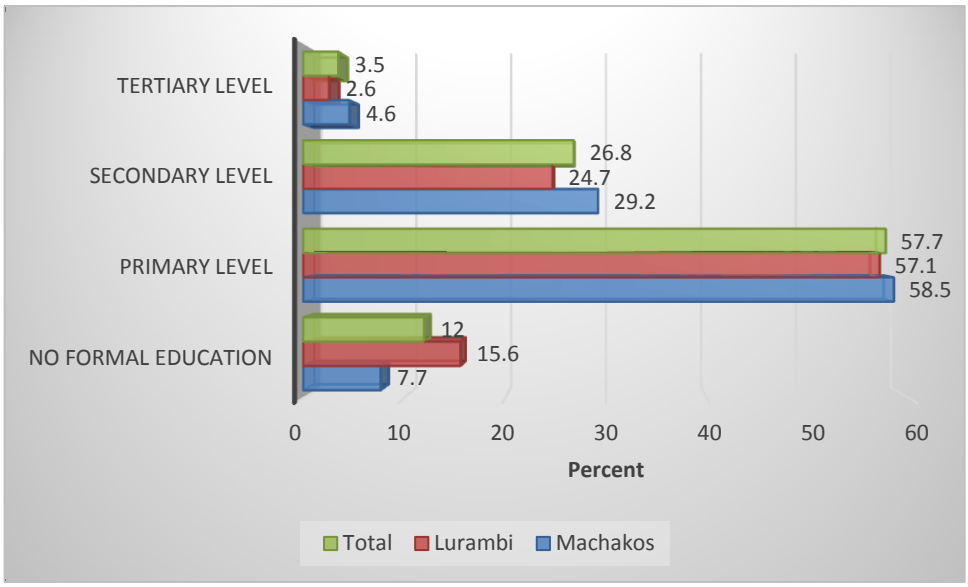

Figure 8 Education levels

The respondents had an average farming experience of 19.9 years, ranging from one year to 66 years. Additionally, they had varied sources of income though almost all cited farm income as the main source of household income as shown in *Figure 9*Figure 9. However, 9.9 percent of all the respondents did not get any farm income; all that was grown and the animals kept were for consumption purposes only. Lurambi had a larger proportion of such farmers than Machakos at 13 percent and 6.2 percent respectively (see *Figure 10*).

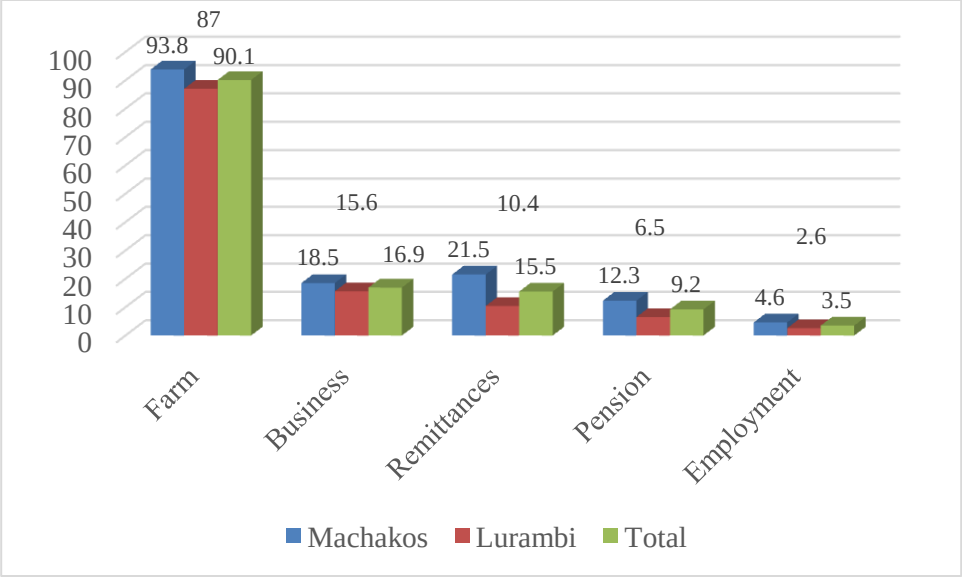

Figure 9 Main sources of income

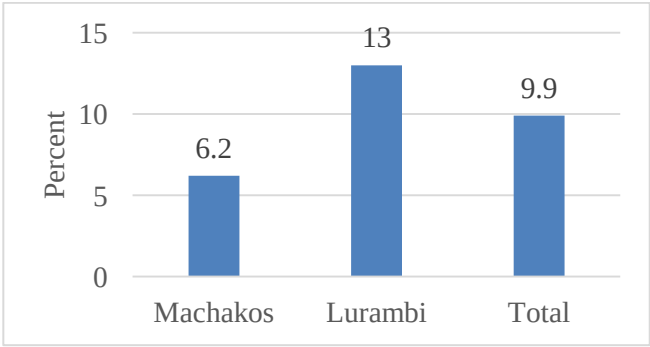

Figure 10 Proportions of farmers with no farm income

4.3.2 Land Size and Ownership

Land size per household in the study areas varied between 0.13 acres and 10 acres with an average size of 2.17 acres. Farmers in Machakos Sub-county had slightly bigger pieces of land than those in Lurambi as shown in *Table 5*.

Table 5 Household's land size

County	Minimum acreage	Maximum acreage	Mean acreage	Standard deviation
All	0.13	10	2.17	2.14
Machakos	0.25	10	2.68	2.58
Kakamega	0.13	9	1.69	1.49

More than half (55.6%) of the respondents owned the land they farmed with Lurambi Sub-county recording a higher proportion of 70.1 percent compared to Machakos 38.5 percent. Higher proportion of famers in Machakos Sub-county farmed on family land (61.5%) compared to Lurambi Sub-county with a proportion of 27.3 percent. A small proportion (1.4%) rented the land they used, all of whom were in Lurambi Sub-county. This has implications on the agricultural technologies that can be adopted by these farmers. For instance, technologies requiring or leading to permanent or near-permanent installations may not be appropriate for rented land, and sometimes, family land.

Further investigations on land ownership in relation to whether respondents realized a farm income or not revealed that all who rented land got some income from it as shown in *Table 6.*

Table 6. Farm Income versus Land Ownership

Sub-county	Own land		Family land		Rented land	
	%	Farm Income	%	Farm Income	%	Farm Income
Machakos	38.5	88.0	61.5	97.5	0.0	-
Lurambi	70.1	85.2	27.3	90.5	2.6	100
All	55.6	86.1	43	95.1	1.4	100

4.3.3 Crops grown and income per season

Various crops were grown in the study area as shown in *Table 7* with only 1.4 percent growing only one type of crop and another 16.2 percent growing only two types of crops. The rest of the farmers grew at least three types of crops. Earnings from these crops realized a maximum of KES 180,000 per season. Farmers in Lurambi had a wider range of crops than those in Machakos and their income was higher too. The importance farmers attach to crops may not necessarily be on the basis of the income it brings to the household, as illustrated by a farmer earning an

average of KES 126,000 per season from sugarcane yet relegating it to 3rd position after maize (KES 64,000) and beans (KES 9,000).

Table 7. Crops Grown and Income Obtained in Lurambi and Machakos Sub-counties

Crop	% of farmers growing crop					
	Machakos			Lurambi		
	1st	2nd	3rd	1st	2nd	3rd
Maize	86.2	3.1	6.2	80.5	10.5	2.6
Vegetables	13.8	12.3	16.9	2.6	7.9	24.7
Bananas	-	-	-	5.2	14.5	7.8
Sugarcane	-	-	-	5.2	2.6	1.3
Tubers	-	-	4.6	3.9	2.6	13.0
Legumes	-	84.6	58.4	1.3	53.9	7.8
Millets	-	-	1.5	1.3	2.6	3.9
Groundnuts	-	-	-	-	2.6	14.3
Fruits			3.1	-		-
Min. income per season (Kes)	0.00	0.00	0.00	0.00	0.00	0.00
Max. income per season (Kes)	40,000.00	40,000.00	36,000.00	180,000.00	48,000.00	126,000.00
Av. income per season (Kes)	4,707.65	2,775.65	2,315.35	9,882.40	3,625.95	3,014.45

4.3.4 Types of Animals kept by the Respondents

The main animals kept in the study areas were cattle, chicken, goats and sheep (see *Table 8*Table 8). Others were donkeys kept by 6.2 percent of the respondents in Machakos but none in Lurambi and pigs kept by 6.5 percent of the respondents in Lurambi but none in Machakos. Some of the respondents in Machakos (12.3%) kept bees with between one and five beehives per household.

Table 8. Types of animals kept by the respondents in Lurambi and Machakos Sub-counties

Type of animal	Percent	Average number	Local breed	Exotic breed	Crossbreed
Cattle	66.2	2	75.5	3.2	21.3
Chicken	80.3	11	61.4	36.8	-
Goats	41.5	2	94.9	5.1	-
Sheep	16.2	7	100	0.0	-

4.3.5 Findings on Access to Extension Services on Crop and Livestock Production

The respondents were asked to state whether they accessed extension services on crop and livestock production within the last 12 months. Interestingly, 16.2 percent of them had not accessed any agricultural advisory services.

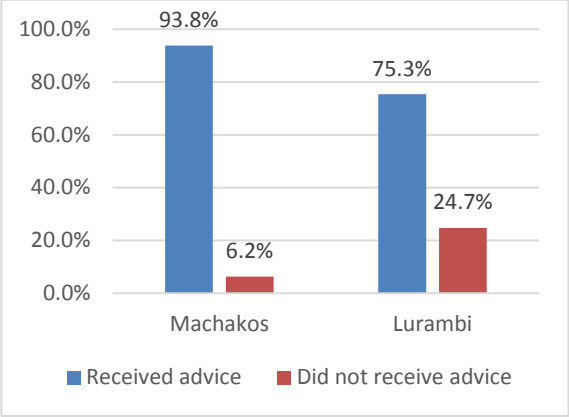

Figure 11. Access to advice on crop production

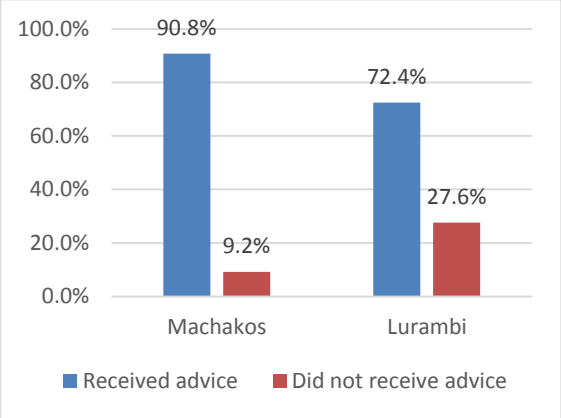

Figure 12. Access to advice on livestock production

An investigation of the sources of agricultural advisory services revealed that majority of the respondents accessed crop production advice from public extension officers and none reported accessing from agricultural input dealers (see *Figure 13* and *Figure 14)*. This is in agreement with findings by Muyanga and Jayne (2006) that reported a skewed private extension provision towards high-value crops. Non-Governmental Organizations (NGOs) provided advice to half of the respondents in Lurambi while in Machakos they reached less than a quarter of the farmers.

Research organisations did not provide agricultural advice to any of the farmers in Machakos unlike in Lurambi where these organisations reached 17.5 percent and 16.4 percent of farmers with crop production and livestock production advice respectively. Apparently, the radio is an important source of agricultural advice in both counties, reaching approximately a quarter of the respondents.

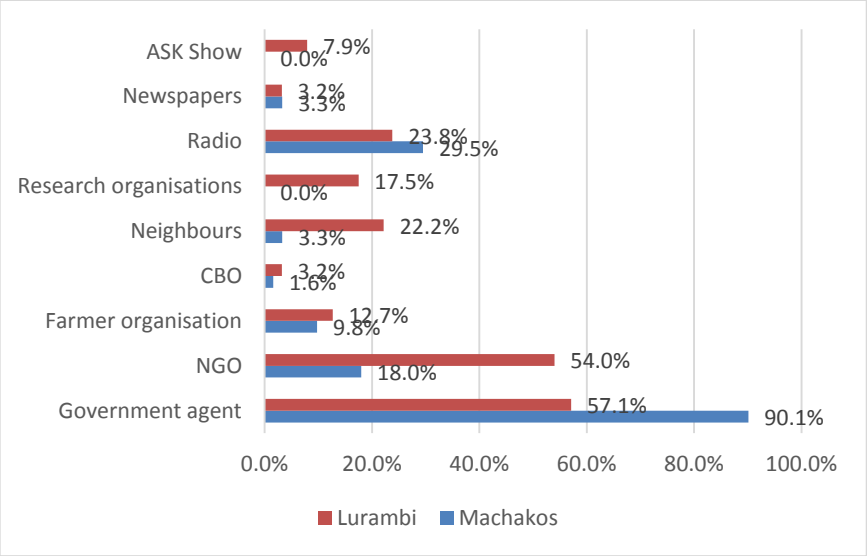

Figure 13. Sources of agricultural advice on crops

Almost a quarter of the respondents in Lurambi received agricultural advice on both crop and livestock production from neigbours unlike in Machakos where the proportion was quite low. This could be a reflection of the strength of the social ties in the two areas, whereby stronger social ties are likely to encourage more information sharing. None of the farmers in Machakos County and only 7.9 percent in Lurambi received agricultural advice from the ASK shows. This was in contrast to what was reported by the extension agents about extension methods that they commonly used, whereby 95.5 percent and 82 percent of the agents in Lurambi and Machakos respectively reported commonly using this method.

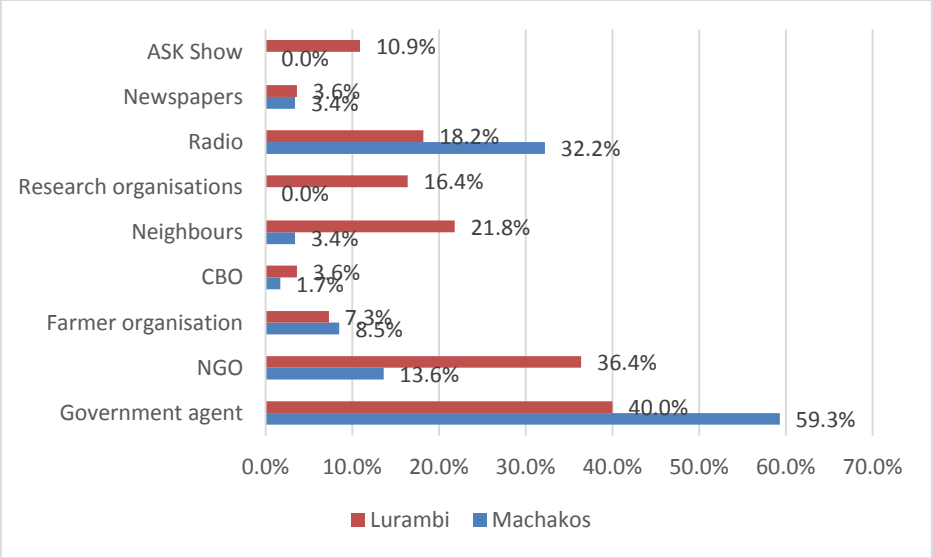

Figure 14. Sources of livestock production advice

Farmers reported that they chose to receive agricultural advice from various service providers for a number of reasons. These included; accessibility of service provider, reliability of the service provider, the fact that the same message could be given several times (repetitiveness), cost of the service, usefulness of the information, and professionalism of the service provider (see *Figure 15* and

Figure 16). Accessibility of service providers, usefulness of information provided and reliability of service providers were some of the important attributes that farmers considered in selecting service providers.

Almost half of the respondents that selected public extension officers and NGOs as sources for crop production advice did so due to their accessibility and usefulness of advice received. The radio was selected due to its accessibility. Cost of service provided was not very much of a concern to the farmers probably because all service providers in the two counties did not charge for the advice given.

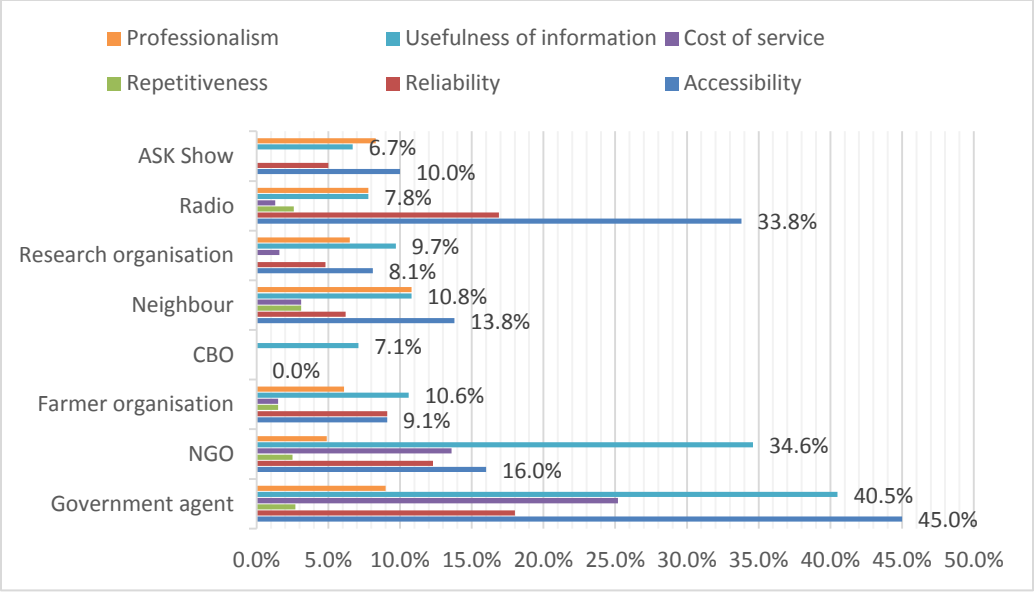

Figure 15. Preferred attributes of crop production service providers

The findings on the preferred attributes of extension service providers on livestock production are summarized in Figure 16.

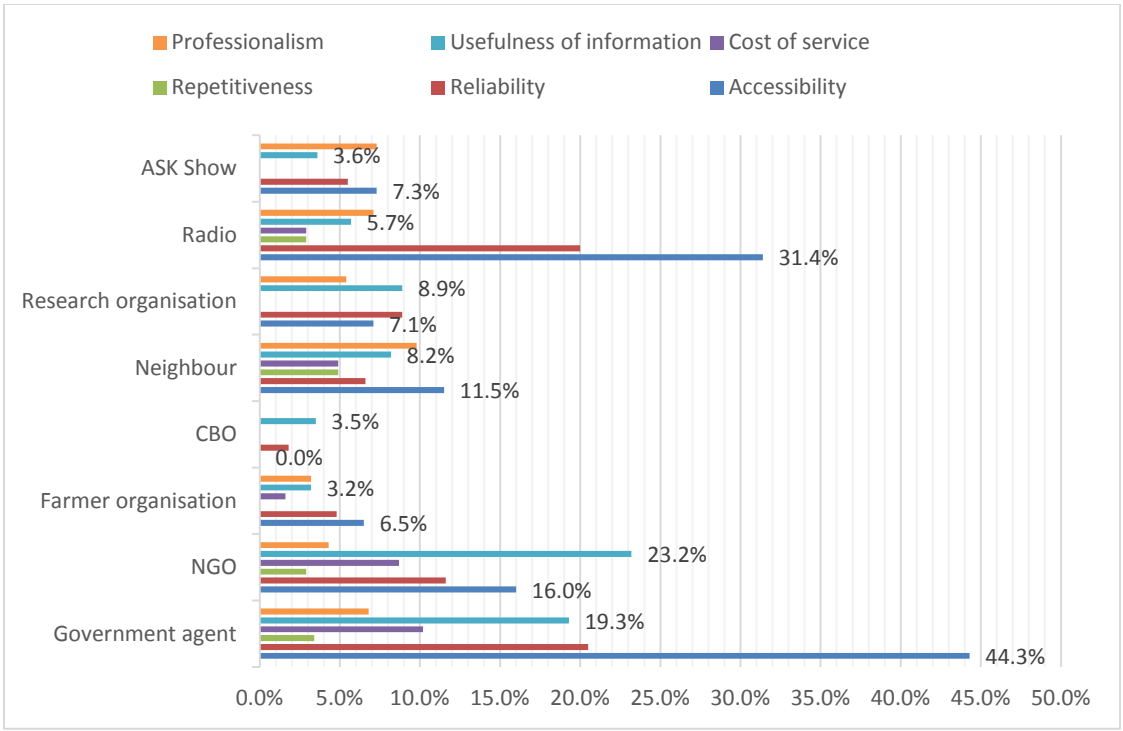

Figure 16. Preferred attributes of livestock production service providers

When asked which service providers they preferred for crop and livestock production advice, farmers indicated a preference for government extension agents. The findings are indicated in *Figure 17Figure 17*.

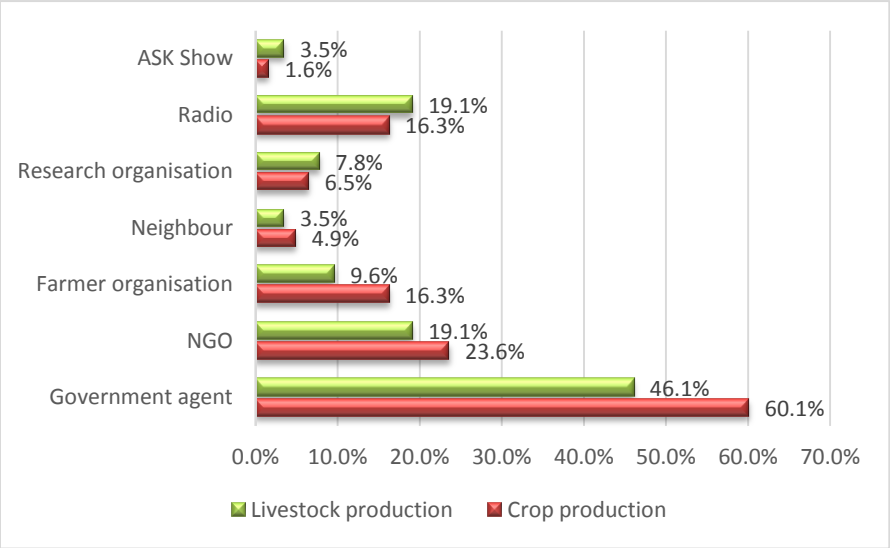

Figure 17. Preferred extension service providers

This is in line with the findings of a study by Nambiro, Omiti and Mugunieri (2006) which indicated that government extension agents are highly regarded by farmers and their advice is likely to be operationalized. Non-Governmental Organisations came second in preference and the least preferred were Community Based Organisations with near zero percentages. According to Nambiro, Omiti and Mugunieri (2006), extension delivery by community based organisations are perceived to be of low quality. Radio was rated at the same level as NGOs in providing livestock production advice.

4.3.6 Methods of learning agricultural technologies

A comparison was made on the extension methods used to teach farmers and the methods they prefer to learn both crop and livestock production technologies. Results presented in *Figure 18* and *Figure 19* reveal great discrepancies between farmer preferences and methods used to teach them.

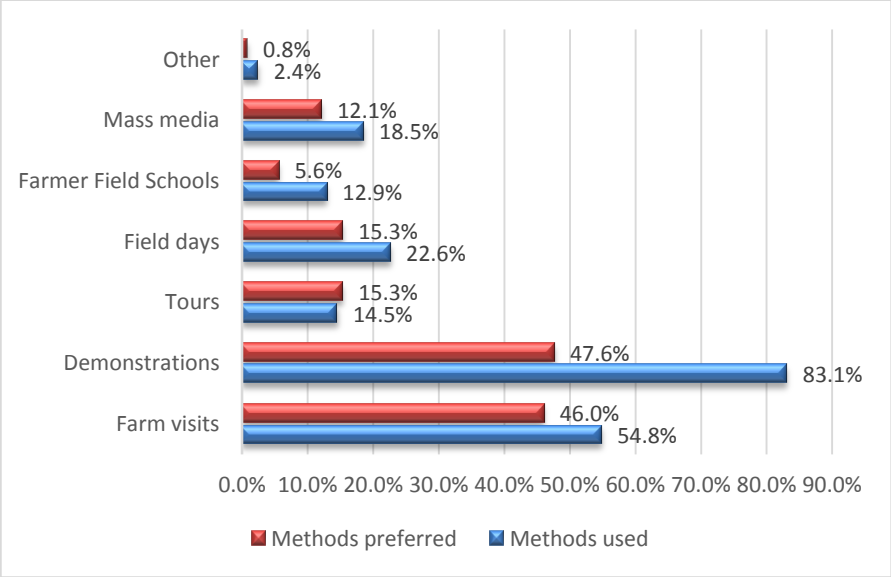

Figure 18. Methods of learning crop production technologies

The greatest discrepancy is noted in the use of demonstrations to teach crop production technologies with farmer preference being about half of extension agents' use of the method. Whereas over 80 percent of farmers reported being taught crop production technologies using demonstrations, only 47.6 percent preferred this method of learning as illustrated in *Figure 18.* The least preferred method was Farmer Field Schools at 5.6 percent.

It is interesting to note that for all the extension methods, except for tours and field trips, the percentages of farmers who reported that they preferred a given method were lower than the percentages who reported using the method. This implies that the farmers did not have a very strong preference for any of the methods.

The findings on extension methods used for learning livestock production technologies and the methods preferred are summarized in Figure 19.

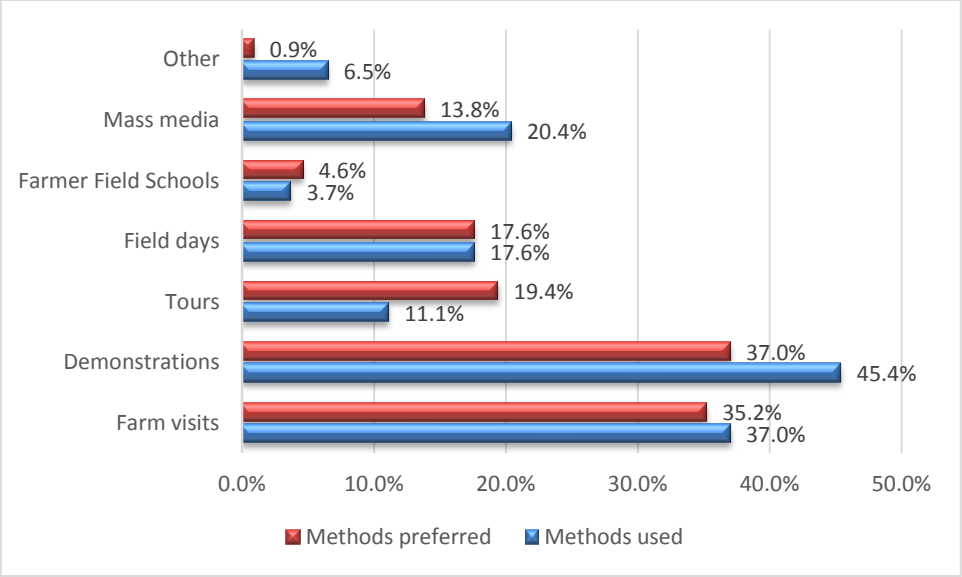

Figure 19. Methods of learning livestock production technologies

Differences between the methods used to teach farmers livestock production technologies and how they prefer to learn were not very wide. On the other hand, extension methods utilized by extension agents to teach livestock production technologies did not differ much from farmer preferences (see *Figure 19*). Comparing farmer and extension agents' preferences for extension methods revealed greatest discrepancies for farmer field schools, field days, demonstrations, and tours and field trips (see *Figure 20).* This agrees with findings of a study by the National Agriculture and Livestock Extension Programme (NALEP) (2011) on effective extension methods for different situations, which found that extension agents and farmers had different choices of the six most important extension methods. The study further found that while Farm and home visits were the most preferred method among farmers, they were unpopular among extension staff who viewed them as uneconomical in terms of time and staff.

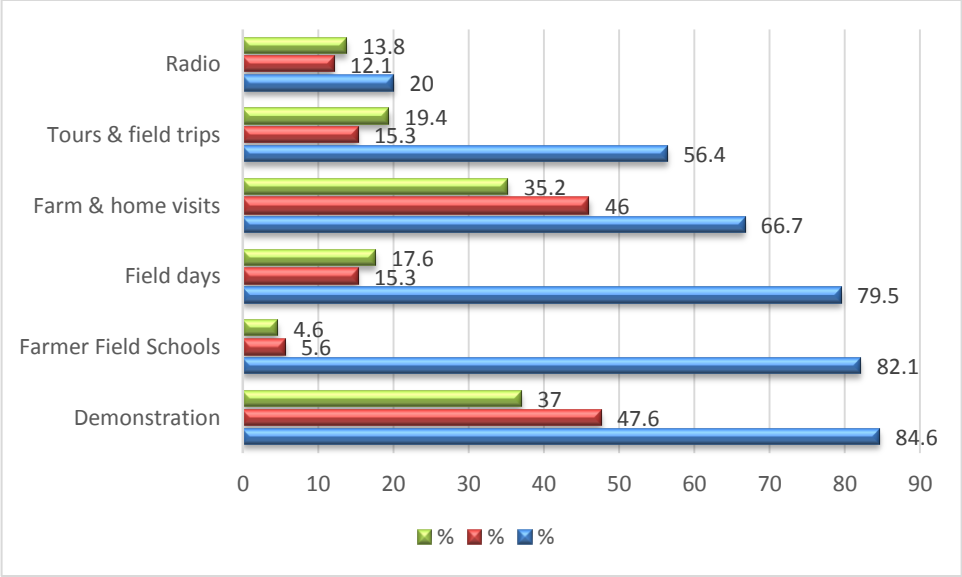

Figure 20 Preference for various extension methods

4.3.7 Principal Component Analysis of farmer learning preferences

Using Principal Component Analysis and Varimax with Kaiser Normalization rotation method, eight components of farmer learning preferences with Eigen values greater than 1 were extracted. Cumulatively, these eight components contributed to 67.05 percent of observed variance (see *Table 9*). The component with the highest loading was repetitiveness of extension message accounting for 11.7 percent of the observed variance. This implied a need to repeat extension message several times for farmers to understand and internalize. This was followed by concrete learning accounting for 11.14 percent of observed variance. Farmers preferred learning in an environment where they can try out what is being taught, especially in farmer farms.

Verification of information received through mass media either by consulting extension officers or fellow farmers was an important component accounting for 9.99 percent. Others were time of the day learning was taking place, preferring to learn in the afternoon rather than in the morning, solitary learning, learning through others rather than actively looking for information themselves, abstract learning, and peer learning rather than learning from extension officers. Peer learning is increasingly being used to train farmers especially where training videos are being used to pass extension messages. Chowdhury, Van Mele and Hauser (2011) as well as Gandhi *et al.* (2007)

found farmer-to-farmer training videos effective in communicating and convincing farmers to adopt an innovation especially when featuring actors similar to them in terms of education and agricultural expertise, culture, dialect and accent.

Table 9 Principal Component Analysis of Farmer Learning Preferences

Component	Extraction loading	% of variance
Component 1: Repetitiveness of message		11.70
• When I am learning something, I prefer to hear it more than once	.888	
• When I hear something once I remember it well and don't need to have it repeated	-.883	
Component 2: Concrete learning		11.14
• I enjoy learning new things and am always ready to try them out	.744	
• I learn best when I try out what I am taught	.727	
• I prefer learning at my home/farm or at the home/farm of another farmer	.558	
Component 3: Verification of information		9.99
• Before I apply something learnt from the TV or radio, I have to check with my fellow farmers	.790	
• Before I apply something learnt from the TV or radio, I have to check with extensionists	.786	
• I apply technologies learnt from the TV or radio, without consulting other people	-.679	
Component 4: Timeliness of learning		8.26
• The best time for me to learn is in the morning hours	-.811	
• I prefer to learn during the afternoon hours	.743	
• I can learn well at any time of the day	.606	
Component 5: Solitary learning		7.57
• I prefer to learn or be taught alone	.788	
• I usually fear to try out new things and prefer to wait for others to try them out first	.610	
• I prefer to learn in a group together with other farmers	-.564	
Component 6: Learning through others		6.60
• I enjoy it more when I am taught in a location away from my usual surrounding	.697	
• I prefer to get information through other farmers or the extension service other than getting information for myself	.687	
Component 7: Abstract learning		6.29
• I like to look for new information for myself and do not wait to get it from other people	.750	
• I can understand and try out technologies even if I don't learn them practically	.686	
Component 8: Peer learning		5.49

• I learn better from my fellow farmers than from extension service providers	.706
• The best venue for being trained is at the Agriculture training centre	-.588

After reverse-coding the negatively loaded items in *Table 9*, Analysis of Variance (ANOVA) with Tukey HSD Post Hoc Test was conducted to determine whether farmers in rural wards (Butsotso South and Kola-Muumandu Wards) and those in peri-urban wards (Shieywe and Mutituni-Ngelani Wards) differed significantly in their learning preferences. Results showed there were significant differences for concrete learning, timeliness of learning, solitary learning and abstract learning but famers did not differ in their need for repetitiveness of message, verification of information, learning through others, and peer learning as indicated in *Table 10*.

Table 10 Analysis of Variance (ANOVA) for farmer learning preferences between Wards

Learning preferences		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
i. Repetitiveness of message	Between Groups	15.567	3	5.189	1.384	.250
	Within Groups	506.116	135	3.749		
	Total	**521.683**	**138**			
ii. Concrete learning	Between Groups	65.452	3	21.817	5.171**	.002
	Within Groups	573.770	136	4.219		
	Total	**639.221**	**139**			
iii. Verification of information	Between Groups	52.267	3	17.422	1.949	.125
	Within Groups	1224.896	137	8.941		
	Total	**1277.163**	**140**			
iv. Timeliness of learning	Between Groups	178.211	3	59.404	8.168***	.000
	Within Groups	938.180	129	7.273		
	Total	**1116.391**	**132**			
v. Solitary learning	Between Groups	60.495	3	20.165	3.122*	.028
	Within Groups	872.095	135	6.460		
	Total	**932.590**	**138**			
vi. Learning through others	Between Groups	2.108	3	.703	.243	.866
	Within Groups	398.681	138	2.889		
	Total	**400.789**	**141**			
vii. Abstract learning	Between Groups	48.953	3	16.318	3.898**	.010
	Within Groups	577.695	138	4.186		
	Total	**626.648**	**141**			
viii. Peer learning	Between Groups	10.210	3	3.403	.911	.437
	Within Groups	515.487	138	3.735		
	Total	**525.697**	**141**			

. Mean difference significant at ρ< .05, **. Mean difference significant at ρ< .01, *. Mean difference significant at ρ< .001*

When means were separated per administrative ward using Tukey HSD Post Hoc Test, statistically significant differences were noted for concrete learning, timeliness of learning and abstract learning but there were no statistically significant differences for solitary learning (see Table 11 in Appendix). Farmers in Shieywe, which is a peri-urban ward in Lurambi Sub-county preferred concrete learning more than farmers in Mutituni-Ngelani, a peri-urban ward in Machakos Sub-county (Mean difference=1.397, sig. .044). Likewise, farmers in Butsotso South ward, a rural ward in Lurambi Sub-county preferred concrete learning more than farmers in Kola-Muumandu Ward (Mean difference=1.341, sig. .024) and Mutituni-Ngelani (Mean difference=1.563, sig. .013). These differences could be attributed to differences in formal education levels. Farmers in Machakos Sub-county recorded higher education levels compared to those in Lurambi Sub-county, with Butsotso South Ward recording the lowest education levels (see Figure 8).

Overly, Lurambi Sub-county farmers were more sensitive to the time of the day learning was taking place than Machakos Sub county farmers. They preferred afternoons to mornings as training time probably to allow for time to attend to both domestic and farm chores. Specifically, farmers in Shieywe Ward were more sensitive to time of the day learning was taking place than farmers in Kola-Muumandu (Mean difference=2.972, sig. .000) and Mutituni-Ngelani wards farmers (Mean difference=2.536, sig. .002), preferring to learn in the afternoon than in the morning. Likewise, more farmers in Butsotso South Ward preferred learning in the afternoon than those from Kola-Muumandu Ward (Mean difference=1.736, sig. .034). Both of these are rural wards.

Mutituni-Ngelani Ward farmers recorded stronger preferences for abstract learning than farmers in Kola-Muumandu Ward (Mean difference=1.460, sig. .025) and Butsotso South Ward (Mean difference=1.560, sig. .010), both of them being rural wards. However, there were no statistically significant differences between farmers from Shieywe and Mutituni-Ngelani Wards in terms preference for abstract learning.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions of the Study

Based on the study objectives and findings, the following are the conclusions of the study:

i. There are many studies that have been carried out on extrinsic and intrinsic factors affecting uptake of technologies, and the meta-analysis has provided empirical evidence that most of the studies focus on extrinsic rather than intrinsic factors.
ii. Dissemination of agricultural technologies is informed by a number of learning frameworks and uses several channels of communication. This is taken into account by extension agents, who use a variety of methods to reach the farmers.
iii. Farmers in Lurambi and Machakos sub-counties have specific preferences in terms of learning and channels of communication used to convey extension messages to them.
iv. There are significant discrepancies between extension agents' perceptions of how farmers in the Lurambi and Machakos sub-counties learn, and the farmers' indicated learning preferences.
v. Farmer learning preferences are influenced by many factors including the environment, timing, peer learning, concrete experiences, repetitiveness of extension messages among others. These factors however, are not the same for all farmers.

5.2 Recommendations

In order to enhance adoption of agricultural technologies among small scale farmers, the study recommends the following:

i. Extension service providers should adopt a dialogue approach with small scale farmers by giving them the opportunity to express their learning preferences and give feedback on effectiveness of extension methodologies used.
ii. Extension agents should be sensitized or trained on how best to capture farmer learning needs and preferences so as to take these into account when delivering extension services.
iii. Extension service providers should organize periodic short courses to sensitize and/or refresh the extension agents on factors affecting technology adoption, especially the intrinsic factors, and how to take into account, so as to ensure effective service delivery to farmers.

iv. Policy makers and county governments should ensure proper funding and support for public extension services, so that extension agents can make more use of extension methods that have more potential to enhance uptake of agricultural technologies.

v. Extension agents should be supported to increase the level use of ICT based extension methods, which have been found to have great potential in promoting agricultural technology adoption.

vi. Researchers should be more intentional in focusing their studies on intrinsic factors affecting agricultural technology adoption, so as to create more understanding about their roles, and make recommendations on how best to promote technology adoption while taking them into account.

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APPENDIX 1

Meta-Analysis of Small Scale Farmer Learning Pathway Preferences and Agricultural Technology Uptake Studies

Ser. No.	Source/Link	Year, Author and Publisher	Publication Title	Major Findings On Technology Uptake	Explanatory Variables For Technology Uptake	
					Extrinsic	Intrinsic
1.	*Agroforestry Systems, Volume 55, Issue 2 pp 99-112* https://link.springer.com/article/10.1023/A:1020556132073	2002. Adesina, A.A. & Chianu, J.	Determinants of farmers' adoption and adaptation of alley farming technology in Nigeria.	Farmer characteristics that influenced adoption included the gender of the farmer, contact with extension agents, years of experience with agro-forestry and tenancy status in the village. Economic factors included the extent of village land pressure, extent of erosion intensity, village fuel wood pressure, importance of livestock as an economic activity in the village and the distance of the village locations from urban centers	-Gender -Extension -Experience -Tenancy status -Extent of problem -Importance of livestock -Distance to urban centre	

2.	*Agriculture, Ecosystems and Environment. Vol.80, Issue 3, Sept. 2000 pp 255-265* http://www.sciencedirect.com/science/article/pii/S0167880900001523	2000 Adesina A.A., Mbila D, Nkamleu G.B., & Endamana D.	Econometric analysis of the determinants of adoption of alley farming by farmers in the forest zone of Southwest Cameroon.	Male farmers were found to be more likely to adopt than women. Adoption was higher for farmers with contacts with extension agencies working on agroforestry technologies. Adoption was higher for farmers belonging to farmers' groups. Adoption was lower for farmers in areas with very high population pressure. Adoption was higher for farmers in areas facing fuel wood scarcity.	- Gender - Extension - Group membership -Natural resource constraints	
3.	*Agriculture Economics 13 (1995) 1-9* https://pdfs.semanticscholar.org/8869/14c82ec365aa92cb3659c55b2165e72ceb68.pdf	1995 Adesina AA, & Baidu-Forson J.	Farmers' perceptions and adoption of new agricultural technology: evidence from analysis in Burkina Faso and Guinea, West Africa	The results provided a strong case for future adoption studies to expand the range of variables used away from the broad socio-economic, demographic and institutional factors to include farmers' subjective perceptions of the characteristics of new agricultural technologies.		-Farmer's subjective perception of the characteristics of new agricultural technologies
4.	*Agricultural Economics,* 9 (1993) 297-311 Elsevier Science Publishers http://ageconsearch.umn.edu/bitstream/173225/2/agec1993v009i004a002.pdf	1993 Adesina A.A. & Zinnah M.M.	Technology characteristics, farmers' perceptions and adoption decisions: A Tobit model application in Sierra Leone	The estimated Tobit model results showed that farmer perceptions of the technology-specific attributes of the varieties are the major factors determining adoption and use intensities.		-Farmer perceptions about technology -specific attributes

5.	Taylor and Francis online *Agriculture Economics Research, Policy and Practice in Southern Africa*, 53(2), 108-136 2014 https://www.tandfonline.com/doi/abs/10.1080/03031853.2014.915485	2014 Adong', A.	Impact of household membership of farmer groups on the adoption of agricultural technologies in Uganda: Evidence from the Uganda census of agriculture 2008/09.	Results showed plausible evidence of the positive impact of households' membership of farmers' groups on the adoption of improved technologies, particularly in the adoption of techniques such as making use of improved seeds, organic fertilizer and improved livestock breeds.	-Membership in groups	
6.	*Journal of Biology, Agriculture and Healthcare*, 2(3), 1-13 http://www.iiste.org/Journals/index.php/JBAH/article/view/1522	2012 Akudugu, M. A., Guo, E. &Dadzie, S. K.	Adoption of modern agricultural production technologies by farm households in Ghana: What factors influence their decisions?	The results showed that farm size, expected benefits from technology adoption, access to credit and extension services are the factors that significantly influence technology adoption decisions of farm households in the study area	-Farm size -Expected benefits from technology -Access to credit -Extension services	

7.	Unpublished MSc thesis, Egerton University, Kenya	2014 Andiema E.C.	Factors Influencing Adoption Of Energy-Saving *Maendeleo* Stove among Small Scale Farmers Households in Kapenguria Division, West Pokot County, Kenya.	The results demonstrated that the age of the respondent, ability of the *Maendeleo* stove technology to conserve energy, contact with extension and operatability of the *Maendeleo* stove technology increased the probability of adoption by users.	- Age - Technology characteristics - Contact with extension	
8.	*International Journal of Agricultural Management and Development*, 5(2), 89-99, 2015 http://www.sid.ir/en/VEWSSID/J_pdf/1025320150204.pdf	2015 Armand, M., Afrakhteh, H. &Bozayeh, F. A.	Analysis of factors affecting adoption and application of sprinkler irrigation by farmers in Famenin County, Iran.	Environmental factors eg. area under cultivation, access to water, water quality, household labour, employment diversity and extension training were found to affect adoption of sprinkler irrigation by farmers	- Area under cultivation - Household labour - Employment diversity - Extension training	

9.	American Journal of Experimental Agriculture. 3(2): 277-292 http://www.journalrepository.org/media/journals/AJEA_2/2013/Mar/1362974303-Asare322012AJEA1969.pdf	2013 Baffoe-Asare R., Danquah J.A. andAnnor-Frempong F.	Socioeconomic Factors Influencing Adoption of CODAPEC and Cocoa High-tech Technologies among Small Holder Farmers in Central Region of Ghana	Results indicated that experience, training, age of household head, household size and social capital as the key variables that positively influence decision of farmers to adopt Cocoa Pest and Disease Control (CODAPEC) and Cocoa High-Tech Technology packages.	-Experience -Training -Age of household head -Household size -Social capital	
10	Agricultural Economics 20 (1999); 231-239) http://ageconsearch.umn.edu/bitstream/174978/2/agec1999v020i003a004.pdf	1999 Baidu-Forson J.	Factors influencing adoption of land-enhancing technology in the Sahel: lessons from a case study in Niger	Higher percentage of degraded farmland, extension education, lower risk aversion, and the availability of short-term profits were found to be important for increasing the adoption and intensity of use of improved 'tassa' and half-crescent shaped earthen mounds. Age and attitudes to differential gains between farm and non-farm income showed no influence on adoption.	- State of the farmland - Extension education - Lower risk aversion - Availability of short term profits	
11	http://ageconsearch.umn.edu/bitstream/44111/2/7_2_3.pdf	2006 Bayard B., Jolly C.M. and Shannon D.A.	The Adoption and Management of Soil Conservation Practices in Haiti: The Case of Rock Walls	Results showed that personal characteristics of farmers (Age and education), institutional factors, such as local group membership, training in soil conservation, per capita household income and size of farm influence soil conservation adoption.	-Farmer's age and education -Local group membership -Training -Farm size -Per capita household income	

12	*Water SA*, 41(1), 33-39. https://www.ajol.info/index.php/wsa/article/view/110396/100130	2015 Baiyegunhil, L. J. S.	Determinants of Rainwater Harvesting Technologies (RWHT) adoption for home gardening in Msinga, KwaZulu-Natal, South Africa.	Gender, age, education, income, social capital, contact with extension agent and perception/attitude towards RWHT are statistically significant in explaining farmers' adoption of RWHT in the study area.	-Gender, -age, -education, -income, -social capital, -contact with extension agent	Perception/ attitude towards the technology
13	http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.955.5539&rep=rep1&type=pdf Masters thesis, Virginia Tech University	Bonabana-Wabbi J. 2002	Assessing Factors Affecting Adoption of Agricultural Technologies: The Case of Integrated Pest Management (IPM) in Kumi District, Eastern Uganda	Farmers' participation in on-farm trial demonstrations, accessing agricultural knowledge through researchers, and prior participation in pest training were associated with increased adoption of most IPM practices. Farm labor availability positively influenced growing of improved groundnut variety Igola-1. - The most influential variables in *celosia* adoption were institutional/informational factors, including farmers' access to information from researchers and training in pest control activities. - Farmers' participation in on-farm trial demonstrations had a positive influence on *celosia* technology adoption.	-Farmer participation in on-farm trials -Access to information and training -Farm labour availability	

14	http://lib.dr.iastate.edu/cgi/viewcontent.cgi?article=6238&context=etd Masters thesis, Iowa State University Digital Repository, 2015	Bwambale N. 2015	Farmers' knowledge, perceptions, and socioeconomic factors influencing decision making for integrated soil fertility management practices in Masaka and Rakai districts, Central Uganda	The study found that the relative advantage of a practice, ability to observe the success of the practice before adoption (either from fellow small scales or through experimentation), and compatibility of the practice with existing farm operations played a significant role in adoption.	-Technology characteristics i.e. relative advantage, observability and compatibility; - Trustworthiness of the information source.	
15	https://pdfs.semanticscholar.org/99a7/cd08d1ceb4fe6abcd267090013035b189a41.pdf Revue scientifique et technique (International Office of Epizootics) (REV SCI TECH OIE) 2001, 20 (3), 687-700	2001 Chilonda P., Huylenbroeck G.	A conceptual framework for the economic analysis of factors influencing decision-making of small-scale farmers in animal health management	The purpose of the study was to gain an improved understanding of the behaviour and decision-making processes of small-scale farmers, -The authors propose a conceptual model including variables that relate to characteristics specific to small-scale farmers and farms, economic factors, institutional setting and biophysical factors.	-Farmer and farm specific characteristics -Economic factors -Institutional setting -Biophysical factors	

16	Indian Research Journal of ExtensionEducation 7 (1) January 2007 http://www.seea.org.in/vol7-1-2007/12.pdf	2007 Deshmukh P.R., Kadam R.P. and Shinde V.N.	Knowledge and Adoption of Agricultural Technologies in Marathwada	Adoption of majority of respondents of various agricultural technologies was found to be very low. -Most of the respondents reported that they did not have adequate information regarding the agricultural technologies -Others who had knowledge reported that their main constraints were; availability of seed, high cost and long distance traveled to get the seed.	-Availability of the technology -Cost of technology -Access in terms of distance	Inadequate information on technology
17	Journal, Bangladesh Agricultural University 13(2): 291–298, 2015 http://ageconsearch.umn.edu/bitstream/235292/2/17.%20JBAU%20754-15.pdf	2015 Farid K.S., Tanny N.Z., and P. K. Sarma P.K.	Factors affecting adoption of improved farm practices by the farmers of Northern Bangladesh	The results showed that farmers' level of education, training status, communication score, and land holdings have strong positive relation with adoption of improved farm practices. On the other hand, age, involvement with cooperative society, and NGO affiliation did not have significant relation with adoption.	- Level of education -Training status -Exposure to extension information -Size of land holding	
18	Agroforestry Systems (47) , 305-321, 1999. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.459.6329&rep=rep1&type=pdf	1999 Franzel, S.,	Socioeconomic factors affecting the adoption potential of improved tree fallows in Africa.	Principal factors associated with acceptability include past perception of soil fertility problems, past use of measures for improving soil fertility, current fallowing, economic importance ofannual cropping, and wealth level.	- Past experience -Wealth level -Current practices -Economic importance of technology	Perception of soil fertility problems
19	Unpublished Masters thesis,	2012 Gido E.O.	Factors affecting	Factors found to affect adoption were:	-Age -Farm size	

	Egerton University,		adoption and intensity of use of organic soil management practices in maize production in Bungoma County, Kenya	-Age -Farm size -Farming experience -Education level of household heads -Training -Farm distance from homestead -Off-farm income -Occupational options	-Farming experience -Education level of household heads -Training -Farm distance from homestead -Off-farm income -Occupational options	
20	Unpublished Masters thesis, Egerton University http://ir-library.egerton.ac.ke/jspui/bitstream/123456789/679/1/Grace%20Waithira%20Gitu.pdf	2015 Gitu G.W., Onyango C. and Obara J.J	Selected factors affecting adoption of improved Finger millet varieties by small scale farmers in Mogotio district, Kenya	Results showed that house hold land control system, gender of the house head, age of the farmers and education level significantly affected the adoption	- Land ownership - Gender - Age - Education level	

21	*Journal on Economic and Sustainable Development. Vol.16 (22) 2015 pp 94-111* www.iiste.org/**Journals**/index.php/JEDS/article/download/27354/28044	2015 Ifeanyi A. Ojiako I.O., Udensi U. E., and Tarawali G.	Factors Informing the Small scale Farmers' Decision to Adopt and Use Improved Cassava Varieties in the South-east Area of Nigeria	Results revealed that plot size, farmer's age, education status, and awareness through workshops and trainings had significant positive influences on adoption and use.	-Plot size -Farmer's age -Education status -Workshops and trainings	
22	http://edepot.wur.nl/298444 A masters research project paper, Van Hall Larenstein University of Applied Sciences	2012 Inambao C.N.	Assessing the Factors influencing Farmers' Decisions in the Control of East Coast Fever in Kafue, Zambia	The study revealed that high cost of acaricide, inadequate water resources and the seasonality of ECF occurrence influenced farmer's decision making in carrying out dipping and spraying. These were compounded by low levels of literacy among farmers attributed to the farmers' inability to use the correct strength of acaricide Internal factors which influenced their decision on ECF control. These were; availability of labour, especially male labour, competition for water use in the house hold and household economic factors (constraints). The external factors were found to be distance to the dip tank, ECF policy, veterinary services, seasonality and the breed of the cattle owned.	Cost of technology -Literacy level -Availability of labour -competition with household needs -Household economic factors -Policy -availability and accessibility of support services e.g. veterinary services. -Breed of cattle owned (susceptibility)	inadequate knowledge leading to inability to apply technology

23	http://www.tropentag.de/2005/abstracts/full/310.pdf A paper presented at the DeutscherTropentag 2005 Stuttgart-Hohenheim, October 11-13, 2005 Conference on International Agricultural Research for Development	2005 Joshi G. and Pandey S.	Effects of Farmers' Perceptions on the Adoption of Modern Rice Varieties in Nepal	Farmers' perceptions of the varietal characteristics such as pest resistance, drought tolerance and suitability for making special products were important in determining technology choices in the areas where current adoption rates are quite high. -It was also found that the farms and farmers' specific variables such as education of the decision maker and his/her experience in rice farming, and availability of extension services have significant effect on adoption of modern varieties.	Education of the decision maker -Experience in rice farming. -Availability of extension services	-Farmers' perception on varietal characteristics
24	African Journal of Agriculture Research Vol 11 (46) pp 4704-4717 http://www.academicjournals.org/journal/AJAR/article-full-text-pdf/F2E33CD61705	2016 Kabwe G., Bigsby H., and Cullen R.	Why is adoption of agroforestry stymied in Zambia? Perspectives from the ground-up	The study found that factors that affect adoption included: Lack of seed, limited land size, method of ploughing, lack of interest and access to extension services.	-Lack of seed -Land size -Inappropriate farming methods -Access to extension services	-Lack of interest

25	http://ageconsearch.umn.edu/bitstream/97135/2/2009_9_Zambian%20Agroforestry%20Adoption_KabweG.pdf Paper presented at the 2009 NZARES Conference Tahuna Conference Centre – Nelson, New Zealand.	2009 Kabwe G., Bigsby, H. & Cullen, R.	Factors influencing adoption of agro-forestry among small scale farmers in Zambia	Statistical analysis showed an association between adoption of both improved fallows and biomass transfer technologies with knowledge of the technology, availability of seed, and having the appropriate skills. In addition some household characteristics are found to be linked to the incidence of adoption. However, the strength of association between these variables is low, giving an indication that there might be other factors at play limiting agro-forestry adoption.	-Availability of seed	-Knowledge of the technology -Having appropriate skills
26	http://www.tzonline.org/pdf/factorinfluencingadoptionofsoil.pdf Untitled Online Gateway	1999 Kalineza H.M.M., Mdoe N.S.Y., Mlozi M.R.S.	Factors Influencing adoption of Soil Conservation Technologies in Tanzania: A Case Study in Gairo	Technology related factors i.e. labour requirement and perceived technology benefits, obtaining knowledge through extension and training, and having secure land ownership were found to have a positive influence on adoption of soil conservation technologies	-Labour requirements -Perceived technology benefits -Extension -Land ownership status	
27	https://www.researchgate.net/publication/270512505_CHALLENGES_FACED_BY_SMALL_LAND_HOLDER_FARMER_REGARDING_DECISION_MAKIN	2014 Kavoi J. M., Mwangi J.G., &Kamau G.M.	Challenges Faced By Small Land Holder Farmer Regarding Decision Making In Innovative Agricultural Development:	-Some of the technologies disseminated did not consider the farmers' immediate needs or the prevailing circumstances. -Farmers need accurate information about technologies Their immediate needs and circumstances need to be taken into account	-adequacy of information on Technology characteristics -provision of technology with several utilization options -prevailing	

	G_IN_INNOVATIVE_AGRICULTURAL_DEVELOPMENT_AN_EMPIRICAL_ANALYSIS_FROM_KENYA		An Empirical Analysis From Kenya		needs and circumstances of the farmers	
28	Agriculture and Soil Sciences Vol 1 (2) pp 012-021 https://www.researchgate.net/publication/270512619_Factors_Related_to_the_Low_Uptake_of_Technologies_and_Innovations_in_Semi-Arid_Areas_of_Lower_Eastern_Kenya	2014 Kavoi J. M., Mwangi J.G., & Kamau G.M.	Factors Related to the Low Uptake of Technologies and Innovations in Semi-Arid Areas of Lower Eastern Kenya	The study found that weak linkages, breach of contracts and distorted farm gate and market prices negatively affected the uptake of poverty reduction joint initiatives.	-Institutional factors such as Joint activity planning and monitoring by stakeholders, -Stronger linkages, -Openness and trust	
29	http://edepot.wur.nl/345252 PhD thesis, Wageningen University	2015 KebebeE.G.	Understanding factors affecting technology adoption in small scale livestock production systems in Ethiopia	-Limited access to farm resources -Differentials in potential welfare of the technology -Lack of effective and reliable supply chains for inputs and outputs -Inadequate physical infrastructure -Weak institutions and policies	-Access to farm resources -Technology characteristics -Physical infrastructure -Strength of institutions and policies	
30	IJRDO-Journal	2016	Factors	Adoption is affected by	-Political	Farmers

	of Agricultural Research Vol.2. Issue-8, 2016 http://www.ijrdo.org/International-Journal-of-Research-&-Development-Organisation-pdf/Agriculture%20and%20Research/August-2016/Agricultural%20Research-August-5.pdf	Khatete K.W., Matuli H.M., Bor E.K.	influencing adoption of One acre fund project in Kanduyi Sub-county, Kenya	Governmental and political forces, farmers' perception of new projects, age of the farmers, extension agents' contact with the farmers	factors -Age of farmer -Extension contact	perception
31	http://erepository.uonbi.ac.ke/bitstream/handle/11295/76086/Kinyangi_Factors%20influencing%20the%20adoption%20of%20agricultural%20technology%20among%20small scale%20farmers%20.pdf?sequence=1 A masters research project, University of	2014 Kinyangi A.A.	Factors Influencing The Adoption of Agricultural Technology among Small Holder Farmers In Kakamega North Sub - County, Kenya	Factors found to have positive and significant association with adoption included: -capital and credit facilities (at varying degrees); extension training; market availability; farmers' education levels; gender and age	-Capital -Credit -Extension services -Market availability -Education level -Gender -Age	

	Nairobi					
32	Unpublished Masters thesis, Egerton University, Njoro, Kenya	2014 Kyambo, O.M.	Determinants of adoption of improved amaranthas among small scale farmers of Buuri-subcounty, Meru county	Factors found to influence adoption were: Age of the chief decision maker, Farm distance from the homestead of the farmer, farmer's perception Farmer's ability to access credit Type of land ownership and extension agents contact with the farmers were found to be positively associated with the decision to adopt	-Age of household head -Farm distance -Access to credit -Land tenure -Extension contact	Farmer's perception
33	Food Policy Vol 32 (4) pp 515-536 http://www.sciencedirect.com/science/article/pii/S0306919206001011	2006 Marenya, P. Barett C.,	Household-level determinants of adoption of improved natural resources management practices among small scale farmers in western Kenya	Determinants of adoption included: Resource constraints, size of farm, value of livestock, off-farm income, family labor supply, education, and, gender of household head	-Resource constraints -Gender of household head -Farm size -Value of livestock -Off-farm income -Family labour -Education	
34	Sustainable Agriculture Research; Vol. 3, No. 1; 2014 Pp 24-36 file:///C:/Users/CODAGED/Downloads/32958-111343-2-	2014 Martey E. , Wiredu, A.N., Etwire P. M., Fosu M., Buah S. S. J., Bidzakin J. , Ahiabor B.D.K., & Kusi	Fertilizer Adoption and Use Intensity Among Small scale Farmers in Northern Ghana: A Case Study of the AGRA Soil	Adoption of fertilizer technology was found to be determined by age, nativity, farm size, access to credit, and distance to agricultural office.	-Age, -Nativity, -Farm Size, -Access to Credit, -Distance to agricultural office	

	PB.pdf	F.	Health Project			
35	African Journal of Agricultural Research Vol 5(8) pp 818-823, May 2010 http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.674.2766&rep=rep1&type=pdf	2010 Matata P. Z., Ajay O. C., Oduol P. A. and Agumya A.	Socio-economic factors influencing adoption of improved fallow practices among small scale farmers in Western Tanzania	Lack of farmer awareness of the technology, and inability of farmers to wait for two years before obtaining direct benefits from the technology were found to be the major constraints to planting improved fallows.	-Time taken to benefit from the technology	-Level of awareness about the technology
36	*Agricultural Systems, 101*, 20–29. DOI: 10.1016/j.agsy.2009.02.002 · Source: RePEc	2009 Mazvimavi, K., &Twomlow, S.	Socioeconomic and institutional factors influencing the adoption of conservation farming by vulnerable households in Zimbabwe.	Results from the study show that institutional support and agro-ecological location have strong statistical influence on the adoption intensity of different conservation farming components	-Institutional support -Agro-ecological location	
37	Kenyatta University institutional repository	2009 Mbugua F.	An Analysis of Factors Influencing Adoption of the Recommended Maize Technology's Package in Makuyu Division, Murang'a South	The factors influencing adoption were: Risk perceived, education, complexity, perceived benefits, income, technology characteristics, contact with extension, gender and age	-Gender -Age -Education -Income -Extension contact	Perceived technology characteristics

			District, Kenya			
38	Journal of Environmental Psychology 43 (2015) 1e12 https://www.sciencedirect.com/science/article/pii/S0272494415300098	2015 Meijer S.S., Catacutan D., Sileshi G.W., Nieuwenhuis M.	Tree planting by small scale farmers in Malawi: Using the theory of planned behaviour to examine the relationship between attitudes and behaviour	The study found that membership of a farmer group and attitudes had a significant positive influence on reported behaviour. Poverty was found to be a barrier to tree planting. The study demonstrated that positive attitudes towards agro-forestry do lead to more trees being planted on farms	-Poverty - Competition for resources with household needs. - Membership of a farmer group	-Attitudes towards tree planting.
39	International Journal of Agricultural Sustainability, 2015 Vol. 13, No. 1, 40 –54, http://dx.doi.org/10.1080/14735903.2014.912493	Meijer S.S., Catacutan D., Ajayi O.C., Sileshi G.W. & Nieuwenhuis M. 2014	The role of knowledge, attitudes and perceptions in the uptake of agricultural and agro-forestry innovations among small scale farmers in sub-Saharan Africa	-More emphasis laid on the role of extrinsic factors such as the characteristics of the adopter and the external environment in the decision-making process. -Concluded that the uptake of agricultural technologies is a complex process influenced by both extrinsic and intrinsic variables, and recommended that future studies aiming to understand the adoption process of agricultural innovations take into account both sets of variables.	-age, -education - level, gender, -the external environment -technology characteristics eg relative advantage and compatibility	
40	Merit Research Journal of Agricultural Science and Soil Sciences Vol. 4(10) pp. 131-	2016 Michura E.G.	Impacts of Extension Methods on Women Small Scale Farmers Adoption of	Results showed that the type of extension Method used significantly influenced women farmers' adoption of conservation agriculture	-Extension method	

	138 http://meritresearchjournals.org/asss/Content/2016/October/Eliud.pdf		Conservational Agriculture in Nakuru County, Kenya			
41	http://suaire.suanet.ac.tz:8080/xmlui/bitstream/handle/123456789/1206/DJANA%20BABATIMA%20MIGNOUNA.pdf?sequence=1&isAllowed=y	2011 Mignouna, D.B.	Adoption and Impact of Improved Agricultural Technologies In Developing Countries: The Case of Imazapyr-Resistant Maize in Western Kenya	Factors found to be linked to adoption were: -Characteristics of household head eg age, farming experience, gender of household head, years of schooling of household head -Household size -Farm size -Gap between production and consumption -Risk taking -Number of extension visits -Membership to social group -Effectiveness of dissemination pathway -Complexity of the technology -Perceived benefits	-Age -Experience -Gender -Education -Household size -Farm size -Group membership -Extension contact -Dissemination pathway	-Perceived technology characteristics -Risk taking
42	Journal of Agribusiness in Developing and Emerging Economies, Vol. 6 Iss 2 pp. 110 – 126, 2016 http://dx.doi.org/10.1108/JADEE-07-2014-0022	2016 Mshenga P.M., Saidi M., Nkurumwa A.O., Magogo J.R., and Oradu S.I.	Adoption of African indigenous vegetables into agro-pastoral livelihoods for income and food security.	The study aimed at determining factors affecting adoption of African indigenous vegetables (AIVs) into the agro-pastoral farming systems. Gender, age, farm size, education level, off-farm income and number of extension visits were found to positively influence adoption	Gender, age, farm size, education level, off-farm income - extension contact	

43	African Development Bank Working Paper No. 233 https://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/WPS_No_233_Technology_Adoption_and_Risk_Exposure_among_Small scale_Farmers-Panel_Data_Evidence_from_Tanzania_and_Uganda_B.pdf	2016 Mukasa A.	Technology Adoption and Risk Exposure among Small scale Farmers: Panel Data Evidence from Tanzania and Uganda	Results revealed that: -lack of sufficient resources to purchase modern inputs, -Relatively low profitability in agriculture -limited access to credit and labor constraints -high transaction and transportation costs -insufficient knowledge about new agricultural technologies or their availability, and, high production, climatic, or price risks, were the factors that affected technology adoption	-Lack of resources -low profitability -limited access to credit -High costs -High risks	-insufficient knowledge
44	Journal of Environment and Natural Resources Research; Vol. 5, No. 2; 2015 www.ccsenet.org/**journal**/index.php/enrr/article/download/48017/25804	2015 Mwase W., Sefasi A., Njoloma J., Betserai I. Nyoka B.I., Manduwa D., & Nyaika J.	Factors Affecting Adoption of Agroforestry and Evergreen Agriculture in Southern Africa	The study revealed that the major factors affecting adoption of agroforestry were; high initial costs of agroforestry practices, low extension knowledge; unavailability of agroforestry germplasm for economic, social and biophysical categories respectively. A large majority of key informants indicated that awareness of the connection between agroforestry and land quality improvement could lead to wide scale adoption of the technology.	-High initial costs of technology - unavailability of agroforestry germplasm	- Level of awareness - Low extension knowledge
45	*Journal of*	Namwata, B.	Adoption of	Results indicated that increased	-Household	

	Animal and Plant Sciences, 8(1), 927-935 http://www.m.elewa.org/JAPS/2010/8.1/4.pdf	M. L., Lwelamira, J., &Mzirai, O. B. (2010).	improved agricultural technologies for irish potatoes (Solanumtuberosum) among farmers in Mbeya Rural District, Tanzania: A case of Ihungu Ward.	household income, being a male or married by a household head, increased farming experience, access to credit and extension services were positively and significantly associated with overall adoption.	income -Sex -Marital status -Farming experience -Access to credit -Extension services	
46	http://suaire.suanet.ac.tz:8080/xmlui/bitstream/handle/123456789/474/ELISARIA%20SAMWEL%20NASSARI.pdf?sequence=1&isAllowed=y Masters thesis, Sokoine University of Agriculture	2013 Nassari S.E.	Institutional and Socio-Economic Factors Influencing Adoption of Conservation Agriculture With Trees (CAWT) in Karatu and Mwanga Districts, Tanzania	Results indicated farmer's age had a significant influence on CAWT packages adoption. Sex and education level were found to be statistically insignificant ($P<0.05$) but significant ($P<0.1$) for Cover Crop and Crop Rotation implying less influence to CAWT adoption. Policy analysis showed that few SSFs had with title deed, weak market links with less access to CAWT inputs which are not affordable. Institutional frameworks analysis showed poor coordination of CAWT amongst stakeholders and political support.	-Age -Sex Education level -Policy framework -Political support -Coordination among stakeholders	
47	International Journal of Social Science and	2016 Nato G.N., Shauri H.S. and	Influence Of Social Capital On Adoption Of	The findings showed that group involvement and social support are the two important components of	-Group involvement -Social support	

	Technology Vol. 1 No. 1; July 2016 http://www.ijsstr.com/data/frontImages/1.pdf	Kadere T.T.	Agricultural Production Technologies Among Beneficiaries Of African Institute For Capacity Development Training Programmes In Kenya	social capital that were positively associated with and significantly influenced adoption of appropriate agricultural production technologies. Conversely, social networks, social trust, and collective action did not significantly influence the adoption of agricultural production technologies.		
48	Unpublished thesis, Egerton University, Njoro, Kenya	2012 Ndegwa, S.M	An evaluation of selected factors affecting adoption of zero grazing dairy production in Kirinyaga , Kenya	Factors found to affect adoption of zero grazing dairy production were: Low farmer extension agent contact Unstable of markets, high cost of technology, farm size, gender, age and level of education	- Extension - Markets - Cost of technology - Farm size - Age - Education level	
49	Unpublished Masters thesis, Egerton University, Njoro, Kenya	2012 Ndiema A.C.	Factors affecting adoption of selected wheat production technologies by farmers in Njoro district Kenya	Adoption is affected by Age, Credit constraints, Gender, Education level Inaccessibility by the technology	- Age - Credit - Gender - Education level - Access to technology	
50	*e-Journal of Agricultural and Development Economics* Vol. 2, No. 1, 2005,	2005 Ndjeunga, J. and Bantilan, C., .	Uptake of improved technologies in the semi-arid tropics of West	Limited productivity gain was found to be a major constraint to the uptake of technologies. Poorly functioning institutions, lack of information or poor exposure of	- Level of productivity gain - Poorly functioning	

	pp. 85-102 http://oar.icrisat.org/3185/1/eJADE_2_1_85-102_2005.pdf		Africa: Why is agricultural transformation lagging behind?	farmers to agricultural innovations and poor functioning or missing markets were also found to hinder the uptake of many new technologies.	institutions, - Lack of information or poor exposure to agricultural innovations, - Poor markets	
51	https://d.lib.msu.edu/islandora/search/Factors%20affecting%20Adoption%20of%20Information%20Communications%20Technology%20System%20for%20Agriculture%20in%20Uganda?type=dismax&keyword=Factors%20affecting%20Adoption%20of%20Information%20Communications%20Technology%20System%20for%20Agriculture%20in%20Uganda Thesis,	2015 Ninsiima D.	Factors affecting Adoption of Information Communications Technology System for Agriculture in Uganda	Lack of familiarity with text messaging was the most significant barrier to its use. Language did not only have a significant impact on ease of use but also on the system's usefulness. Results also show that cost, education, age and gender play a significant role in the adoption or rejection of a system.	- Complexity of technology - Language barrier - Cost - Education - Age - Gender	

	Michigan State University Digital Repository					
52	*International Journal of Science and Research* (IJSR) ISSN (Online): 2319-7064 https://www.ijsr.net/archive/v6i2/ART2017669.pdf	2015 Nyengere J.	Socioeconomic Factors Affecting Adoption of Use of Organic Manure as Climate Smart Agriculture Technology in Malawi	Education, household size and income were found to have significant influence on adoption organic manure use	Education Household size Income	
53	*Agricultural Research and Technology* Open Access Journal Submission: February 23, 2017; Published: April 21, 2017 https://juniperpublishers.com/artoaj/pdf/ARTOAJ.MS.ID.555676.pdf	2017 Obayelu A.E, Ajayi O.D, Oluwalana E.O.A and Ogunmola O.O.	What Does Literature Say About the Determinants of Adoption of Agricultural Technologies by Small scales Farmers?	Results showed that changes in technology adoption are associated with changes in the economic situation of the country, financial status of farm households and the net gain from adopting the technology, access to credit, access to information, travel cost, characteristics of the technology, scale of operation of the farmers, income, cultural norms and values, social network and human specific factors	-Financial status -Scale of operation -Access to information -Social network Cultural norms and values Access to credit -Human specific factors	
54	https://www.researchgate.net/profile/Dawit_Alemu/publication/314285316_Why_t	2013 Odame H., Kimenye L., Kabutha C., Alemu D., and	Why the low adoption of agricultural technologies in Eastern and	Study findings showed that factors affecting adoption were: Farm systems, farmer characteristics and preferences - performance of the technologies,	-Farmer characteristics -Farm systems -Performance of technologies	Farmer preferences

	he_low_adoption_of_agricultural_technologies_in_Eastern_and_Central_Africa/links/58bfc6b64585151c7030618a/Why-the-low-adoption-of-agricultural-technologies-in-Eastern-and-Central-Africa.pdf	Oduori L.H.	Central Africa?	their delivery and management mechanisms, access to extension and other support services, extent of commercialisation of commodities, effectiveness of marketing systems, gender-based constraints and the overall policy and institutional processes responsible for creating an enabling environment for adoption.	-Delivery of technologies -Access to extension -Extent of commercialization -Effectiveness of marketing systems -Gender -Overall policy and institutional environment	
55	*Journal of Agricultural and Food Economics2014, 2:12* https://link.springer.com/article/10.1186/s40100-014-0012-3	2014 Ogada, M.J., Mwabu G., Muchai, D.	Farm technology adoption in Kenya: a simultaneous estimation of inorganic fertilizer and improved maize variety adoption decisions	Household adoption decisions on inorganic fertilizer and improved maize varieties were found to be inter-dependent. Farmer characteristics, plot-level factors and market imperfections such as limited access to credit and input markets, and production risks affected adoption of the two technologies.	-Farmer characteristics -Farm related factors Access to credit and input markets -Production risks	
56	*International Journal of Humanities and Social Science*, Vol 5, No.3, March 2015	2015 Ogola T.D.O.;Lagat J.K. and Kosgey I.S.	Factors Influencing Small scale Dairy Farmers Participation in Voluntary Compliance of	Type of dairy bred and farmers education level were found to be positively related to participation	-Type of technology -Education level	

	http://www.ijhssnet.com/journals/Vol_5_No_3_March_2015/7.pdf		Decent Work Practices: Case Study in Nakuru County Kenya.			
57	*Journal of Human Ecology* 27 (2): 155-160 (2009) http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.542.8234&rep=rep1&type=pdf	2009 Okoedo-Okojie DU, Onemolease EA.	Factors affecting the adoption of yam storage technologies in the Northern Ecological zone of Edo State, Nigeria. J. Human Ecol. 27(2):155-160.	Logistic regression analysis indicated that age, farm size, farming experience and contact with extension agents had significant influence on farmers' adoption of improved yam storage technology. Major constraints limiting the farmers' adoption of these technologies were; ignorance of technology existence and high cost of the some of the storage technologies.	-Age, -Farm size -Farming experience, -Contact with extension -Availability of technology -Cost of technology	-Level of knowledge about the technology
58	http://researcharchive.lincoln.ac.nz/bitstream/handle/10182/3866/Pereira_PhD.pdf?sequence=3&isAllowed=y PhD thesis, Lincoln University	2011 Pereira Mariana de Aragão	Understanding technology adoption and non-adoption: a case study of innovative beef farmers from Mato Grosso do SulState, Brazil	The study found that farmers' choices depend both on their goals and values, and on the physical and financial bundle of resources that they have at their disposal. It is the resources, goals and values that determine the farming system. This, in turn, influences how these farmers perceive the technology attributes, particularly compatibility, and hence defines adoption and non-adoption of specific technologies.	-Physical and financial resources available	-Farmers' goals and Values --Perceived technology attributes
59	*Agricultural Systems* 79(2):131-144	2004 Phiri, D., Franzel S.,	Who is using the new technology?	Gender, marital status and household headship among women were not found to influence planting	-Wealth	

	https://www.researchgate.net/publication/223021191_Who_is_using_the_new_technology_The_association_of_wealth_status_and_gender_with_the_planting_of_improved_tree_fallows_in_Eastern_Province_Zambia	Mafongoya P., Jered I., Katanga R., and Phiri S.	The association of wealth status and gender with the planting of improved tree fallows in Eastern Province, Zambia.	improved fallows There was some association between planting improved fallows and wealth. Adoption of improved fallows was found to be a gender-neutral and wealth-neutral.		
60	*World Applied Sciences Journal* 6 (5): 644-651, 2009 https://pdfs.semanticscholar.org/1cf6/2f632a69b78d4b744761820764612b08870c.pdf	2009 Rezvanfar A., Samiee A. and Faham E.	Analysis of Factors Affecting Adoption of Sustainable Soil Conservation Practices among Wheat Growers	Results showed that level of knowledge could explain 83.5 percent of the variation in the adoption level of sustainable soil conservation practices.		-Level of farmer's knowledge
61	*American-Eurasian Journal of Agriculture and Environmental Science* 2(3): 220-226, 2007 https://www.idosi.org/aejaes/jaes	2007 Rousan L.M.	Factors influencing Adoption of Improved Farm Practices among Women Farmers in Northern Jordan.	Findings revealed that adoption of improved farm practices was positively influenced by; cost and relative advantage of the technology, land tenure, communication ability and credibility of the extension worker.	-Cost and relative advantage of technology -land tenure Communication ability and Credibility of the extension	

	2%283%29/3.pdf				worker	
62	http://kubanni.abu.edu.ng:8080/jspui/bitstream/123456789/1153/1/SOCIO-ECONOMIC%20FACTORS%20INFLUENCING%20ADOPTION%20OF%20RECOMMENDED%20COTTON%20PRODUCTION%20PRACTICES%20BY%20FARMERS%20IN%20ZAMFARA%20STATE,%20NIGERIA.pdf MSc Thesis, Ahmadu Bello University, Nigeria	2012 Saddiq N.M.	Socio-Economic Factors Influencing Adoption Of Recommended Cotton Production Practices By Farmers In Zamfara State, Nigeria	Education level, farming experience, extension contact, membership of social organization and affordability of the technology had positive influence of adoption. Labour was found to be negatively significant. Reduction in commodity prices also had negative influence on adoption	-Extension contact -Group membership -Labour -Commodity price -Farming experience Education	
63	*African Journal of Agricultural Research* Vol. 2 (10), pp. 544-551, October 2007 http://repository.	2007 Salasya, B., Mwangi W., MwabuD., and Diallo A.	Factors influencing adoption of stress-tolerant maize hybrid (WH 502) in western	Technology related attributes of WH 502 that influenced its adoption were high yield, early maturity and non-lodging. Important socio-economic factors found to influence adoption were; farm size, cattle ownership,	-Farm size -Cattle ownership -Education level -Locality specific	

	cimmyt.org:8080/xmlui/bitstream/handle/10883/3051/90133.pdf?sequence=1&isAllowed=y		Kenya	education level of the farmer and locality specific characteristics	characteristics	
64	http://oaktrust.library.tamu.edu/bitstream/handle/1969.1/157901/SHAW-THESIS-2014.pdf?sequence=1 Masters thesis, Texas A & M University	Shaw C.S. 2014	Agricultural Technology Adoption In West Africa	Results showed factors influencing adoption to be: Gender of household head, interaction with extension agents, membership in agricultural group, access to credit, age of household head, years of formal education, distance to market and, family size	-Gender of household head -Extension contact -Group membership -Age -Education -Family size -Distance to market	
65	http://ageconsearch.umn.edu/bitstream/126760/2/Simtowe1.pdf Selected Paper prepared for presentation at the International Association of Agricultural Economists (IAAE) Triennial Conference, Foz do Iguaçu,	2012 Simtowe F., Muange E., Diagne A.,	Technology Awareness and Adoption: The Case of Improved Pigeon pea Varieties in Kenya	Adoption was found to be prominent among farmers that are close to the agricultural offices, and among younger and wealthier farmers.	-Age -Wealth -Distance to the agricultural offices	

	Brazil, 18-24 August, 2012.					
66	file:///G:/EOA%202016/ADDITIONAL%20LITERATURE/Pedzisa_Determinants_2016.pdf PhD Thesis, University of Pretoria	2016 Tarisay P.	Determinants of yield impact and adoption of conservation agriculture among small scale farmers in Zimbabwe	The study assessed the yield advantage and adoption dynamics of conservation agriculture in Zimbabwe. Human capital, asset endowment and institutional variables (loss of NGO support in provision of fertilizers) affect dis-adoption decisions	-Human capital -Asset endowment -Institutional variables	
67	*Journal of Biology, Agriculture and Healthcare* Vol.3, No.15, 2013 www.iiste.org	2013 Ukaejiofo Rex Uzonna Gao Qijie	Effect of Extension Programs on Adoption of Improved Farm Practices by Farmers in Adana, Southern Turkey	Adoption of improved crop practices/technologies correlated significantly and positively with timeliness of training, method of training, number of media used and, availability of inputs.	-Timeliness of training -Method of training -Number of media used -Availability of inputs	
68	*African Journal of Agricultural Research* Vol 8 (35) pp 4490-4500 http://www.academicjournals.org/article/article1380899833_Berg.pdf	2013 Van den Berg, J.	Socio-economic factors affecting adoption of improved agricultural practices by small scale farmers in South Africa	Adoption of new technology in the form of Napier grass trap crops was significantly higher amongst farmers that relied only on farming as a source of income. There were no significant relationships between adoption of improved technologies and farmer age, off-farm income and cultivation methods	-Relying on farming as primary economic activity	
69	*Nutrient Cycling in Agro-*	2007 Waithaka,	Factors affecting the	The study found that the use of both manure and fertilizer reciprocally	-Household factors	

	ecosystems Volume 78, Issue 3, pp 211–224 July 2007 https://link.springer.com/article/10.1007/s10705-006-9087-x	M.M., Thornton, P.K., Shepherd, K.D. and Ndiwa N.N.	use of fertilizers and manure by small scale farmers: The case of Vihiga, western Kenya	influence each other and are strongly influenced by household factors, and also imply that manure and fertilizer uses are endogenous.		
70	*Journal of Information Technology for Development*. 22(2) pp 320-333 DOI: 10.1080/02681102.2015.1048184	2015 Wyche S. and Steinfield C.	Why don't farmers use cell phones to access market prices? Technology affordances and barriers to market information services adoption in rural Kenya	- Mismatch between the design of market information services and small scale farmers' perceptions of their mobile phones' communication capabilities		Perceived complexity and compatibility of technology

APPENDIX 2
Multiple Comparison Table for Farmer Learning Preferences

Table 11 Multiple comparisons of farmer learning preferences by ward using Tukey HSD

Dependent Variable	(I) Ward:	(J) Ward:	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Repetitiveness of message	Kola-Muumandu	Mutituni-Ngelani	.11398	.48313	.995	-1.1428	1.3708
		Shieywe	.10354	.46663	.996	-1.1103	1.3174
		Butsotso South	.79607	.44224	.278	-.3543	1.9465
	Mutituni-Ngelani	Butsotso South	.68209	.46980	.470	-.5400	1.9042
	Shieywe	Butsotso South	.69254	.45282	.423	-.4854	1.8705
Concrete learning	Kola-Muumandu	Mutituni-Ngelani	.22222	.52292	.974	-1.1379	1.5824
	Shieywe	Kola-Muumandu	1.17460	.48758	.080	-.0936	2.4428
		Mutituni Ngelani	1.39683*	.52611	.044	.0284	2.7653
	Butsotso South	Kola-Muumandu	1.34127*	.46652	.024	.1278	2.5547
		Mutituni-Ngelani	1.56349*	.50666	.013	.2456	2.8814
		Shieywe	.16667	.47010	.985	-1.0561	1.3894
Verification of information	Kola-Muumandu	Mutituni-Ngelani	.93391	.74610	.595	-1.0066	2.8744
		Butsotso South	1.29762	.67914	.228	-.4687	3.0640
	Mutituni-Ngelani	Butsotso South	.36371	.72193	.958	-1.5139	2.2413
	Shieywe	Kola-Muumandu	.08333	.71507	.999	-1.7764	1.9431
		Mutituni-Ngelani	1.01724	.75582	.535	-.9485	2.9830
		Butsotso South	1.38095	.68981	.192	-.4131	3.1751
Timeliness of learning	Mutituni-Ngelani	Kola-Muumandu	.43651	.67953	.918	-1.3322	2.2052
	Shieywe	Kola-Muumandu	2.97222*	.65520	.000	1.2668	4.6776
		Mutituni-Ngelani	2.53571*	.69786	.002	.7193	4.3521
		Butsotso South	1.23649	.65102	.233	-.4580	2.9310
	Butsotso South	Kola-Muumandu	1.73574*	.63133	.034	.0925	3.3790

		Mutituni-Ngelani	1.29923	.67550	.223	-.4590	3.0574
Solitary learning	Kola-Muumandu	Shieywe	.74242	.61254	.620	-.8510	2.3358
		Butsotso South	1.50000	.58052	.052	-.0101	3.0101
	Mutituni-Ngelani	Kola-Muumandu	.08621	.63419	.999	-1.5635	1.7359
		Shieywe	.82863	.64693	.577	-.8542	2.5115
		Butsotso South	1.58621	.61670	.054	-.0180	3.1904
	Shieywe	Butsotso South	.75758	.59440	.581	-.7887	2.3038
Learning through others	Kola-Muumandu	Mutituni-Ngelani	.15996	.42411	.982	-.9430	1.2629
	Shieywe	Kola-Muumandu	.03413	.40348	1.000	-1.0152	1.0834
		Mutituni-Ngelani	.19409	.42681	.969	-.9159	1.3040
	Butsotso South	Kola-Muumandu	.18651	.38605	.963	-.8175	1.1905
		Mutituni-Ngelani	.34647	.41037	.833	-.7208	1.4137
		Shieywe	.15238	.38901	.980	-.8593	1.1640
Abstract learning	Kola-Muumandu	Butsotso South	.09921	.46471	.997	-1.1093	1.3077
	Mutituni-Ngelani	Kola-Muumandu	1.46073*	.51052	.025	.1331	2.7884
		Shieywe	.99803	.51377	.215	-.3381	2.3341
		Butsotso South	1.55993*	.49399	.010	.2753	2.8446
	Shieywe	Kola-Muumandu	.46270	.48568	.776	-.8004	1.7258
		Butsotso South	.56190	.46827	.628	-.6559	1.7797
Peer learning	Kola-Muumandu	Mutituni-Ngelani	.50192	.48225	.726	-.7522	1.7561
		Shieywe	.32063	.45879	.897	-.8725	1.5138
		Butsotso South	.70635	.43898	.377	-.4353	1.8480
	Mutituni-Ngelani	Butsotso South	.20443	.46663	.972	-1.0091	1.4180
	Shieywe	Mutituni-Ngelani	.18128	.48532	.982	-1.0808	1.4434
		Butsotso South	.38571	.44234	.819	-.7646	1.5361

*. The mean difference is significant at the 0.05 level.

APPENDIX 3

Questionnaire for Small Scale Farmers

1. Names (Optional) _____ Tel. contact _____

2. Sub- County: _____

3. Ward: _____

4. Background Information

Sex 1=male 2=female	**Marital status** 1=Single 2=Married 3=Divorced 4=Separated 5=Widowed	**Age** (in years) 1=Below 25 2=25-35 3=36-45 4=46-55 5=Over 55	**Level of education** 1=no formal education 2=primary level 3=secondary level 4=college education 5=others(specify)____ _____	**Land Size and Ownership** 1=own 2-Family 3=Rented	**Years of farming experience**	**Sources of income** 1=Farm income 2=Business 3=Employment 4=Pension 5=Remittances 6=Other (specify) _____	**Average Income per Year** (KSh.) 1=Below 60,000 2=60,000- 119,000 3=120,000-179,000 4=180,000-240,00 5=Over 240,000
[-------]	[---------]	[---------]	[---------]	[----- acres] [---------]	[---------]	[----------]	[----------]

5. Information on Crops Production and Marketing

	Principle Crops Grown in Order of Importance		
	1……	2……	3……
Acreage			
Yield			
Quantity sold per season			
Money earned per season			

6. Information on livestock production and Marketing

Class of Livestock	**Breed/type**	**No. of animals owned**	**Quantity of Livestock / products sold per month/year**	**Unit Price**	**Total annual income**
Cattle			a=milk b=live animal c=dung		
Sheep					
Goats					
Chickens			a=Eggs (No. of trays) b=Live chicken		
Donkeys					
Rabbits					
Bees		No. of hives……..	Kgs of honey ……		

Q.7. Extension services

(Ask respondent about his or her own experiences in the last 12 months

Have you received any extension advice within the past 12 months? 1=Yes 0=No [If No skip to Q7.9]	From which source did you receive advice for the enterprises below: *a) Crops* b) *Livestock* *(Fill in the codes provided in the appropriate column)*		Distance to source of extension information For: *a) Crops* b) *Livestock*		Which two attributes made you use the service provider you have indicated? *Use codes below*		Which extension service provider do you prefer? For *a) Crops* *b) Livestock* *(tick in the appropriate column using codes in the first column)*		What is your level of satisfaction with the performance of various agricultural extension services? For: *a) Crops* *b) Livestock*	
0 **7.1**	**Q7.2**		**Q7.3**		**Q7.4**		**Q.7.5**		**Q7.6**	
	a	b	a	b	a	b	a	b	a	b
[____]										

Codes for Q.7.2, 7.5 and Q.7.10	**Codes for Q.7.3**	**Codes for Q.7.4**	**Codes for Q.7.6**
1= Government agent 2= NGOs 3=Farmer organizations 4=CBOs 5=Mobile phones 6=Input dealer/agri-enterprise 7=Neighbour/other farmers 8=Research organization 9=Radio/television 10=Newspaper/magazines/brochures 11=ASK Shows 12=Others (specify)……..	1=Near 2=Average distance 3=Far	1= Accessibility 2=Reliability 3=Repetition 4=Cost of service 5=Usefulness of information 6=Professionalism 7=Other(Specify)	1=very satisfied 2=satisfied 3=Dissatisfied 4= Very dissatisfied

Q.7 Extension Methods

Methods used to learn about: *a) Crop* b) *Livestock* (You can fill up to 3)		Which method do you prefer to learn? *a) Crop* b) *Livestock* *(Use the same codes as for Q7.7)*		Did you actively seek advice on crop or livestock in the last 12 months? 1=yes 0=No [skip to Q7.11] If yes, for what? *(Use codes below, fill column b)*		From which service provider did you get information from? *Use code for Q7.2* (Can fill up to 3 sources)	Why did you not seek advice? List up to two *(Use codes below)*	Which channels of information used in dissemination of agricultural technology do you know about? (Can fill up to 3 below)	
Q7.7		Q7.8		Q7.9		Q7.10	Q7.11	Q7.12	
a	b	a	b	a	b			a	d
Codes Q7.7 1= farm visits 2=demonstrations 3=tour 4=field day 5=farmer field school 6= mass media 7= other (specify)				**Codes Q7.9** 1=Crop production 2=horticulture 3=Dairy cows 4=Beef production 5=dairy goats 6= bee keeping		7= fish farming 8=Processing 9=Marketing 10=Poultry farming 11=other (specify) ……	**Codes for Q7.11** 1=Long distance 2= Expensive 3=takes too much time	4=extension agents not available 5=other	

Q.8. Preferred approaches/methods of being taught

Below are statements about your learning preferences with regard to extension. Tick as appropriate. (SD=Strongly disagree; D= Disagree; NS= Not Sure; A=Agree; SA=Strongly Agree)

Ser. No.	Statements about Preferred Learning Method	SD	D	NS	A	SA
1.	I prefer to learn or be taught alone					
2	I prefer to learn in a group together with other farmers					
3	The best time for me to learn is in the morning hours					
4	I prefer to learn during the afternoon hours					
5	I can learn well at any time of the day					
6	When I am learning something, I prefer to hear it more than once					
7	When I hear something once I remember it well and don't need to have it repeated					
8	I learn better from my fellow farmers than from extension service providers					
9	I like to look for new information for myself and do not wait to get it from other people					
10	Before I apply something learnt from the TV or radio, I have to check with my fellow farmers					
11	Before I apply something learnt from the TV or radio, I have to check with the extensionists					
12	I apply technologies learnt from the TV or radio, without consulting other people					
13.	I learn best when I try out what I am taught					
14.	I can understand and try out technologies even if I don't learn them practically					
15.	I enjoy learning new things and am always ready to try them out					
16.	I usually fear to try out new things and prefer to wait for others to try them out first					
17.	I prefer learning at my home/farm or at the home/farm of another farmer					
18.	The best venue for being trained is at the Agriculture training centre					
19.	I enjoy it more when I am taught in a location away from my usual surrounding					
20.	I prefer to get information through other farmers or the extension service other than getting information for myself					

Q.9. Give suggestions on how you prefer to learn or to be taught

_____

_____

_____

Q.10. Why do you prefer to learn or be taught the way you have stated above?

_____

_____

_____

APPENDIX 4
Questionnaire for Extension Service Providers

Instructions for completing the questionnaire:
Answer all questions

1. Names (Optional) _____ County: _____
2. Sub- County: _____ Ward: _____
3. Gender: Male ____ Female _____
4. Age (tick one)
   Less than 25 years ☐ 25-35 years ☐ 36- 45 years ☐ 46-55 years ☐ Over 55 years ☐
5. Highest level of training: (Certificate, diploma, degree, postgraduate) _____
6. Category of extension organization/provider (tick one) Public ☐ Private ☐
7. Area of specialization: Crops ☐ Livestock ☐ Other (specify)_____

8. Methods of Extension service delivery

Method of extension service delivery		Which methods do you commonly use? (choose all that apply from the list)	Which methods do you prefer to use? (choose all that apply from the list)	Reasons for preference: (Use the codes below) 1=Cost effective 2=Reaches more farmers 3=Easier to use 4=Less time consuming 5=Other (specify)	Which methods do you rarely use? (choose all that apply from the list)	For the methods not preferred, what are your reasons? 1=Lack of finances 2=Low attendance by farmers 3=Too demanding 4=Not effective 5=cost effectiveness	Which methods do you think bring about the most learning and participation from farmers?	If you were well supported, which methods would you use which you are not able to use now
		8.1	Q8.2	8.3	8.4	8.5	8.6	8.7
	codes							
Farm and home visits	1							
Field days	2							
Demonstrations	3							
Farmer groups	4							
Contact farmers	5							
Radio	6							
Television	7							
Videos	8							
Tours and field trips	9							
Printed materials	10							
ASK Shows	11							

Mobile phones	12							
Meetings/Barazas	13							
Other(Specify)_____ _____ _____	14							

APPENDIX 5

Map of Kenya Showing Kakamega and Machakos Counties