EFFECTIVENESS OF SELECTED MASS EXTENSION METHODS ON ACCESS TO AGRICULTURAL TECHNOLOGIES AMONG SMALLHOLDER FARMERS IN LAIKIPIA WEST SUB COUNTY, KENYA

EMILY NDANU KIOKO

A Thesis Submitted to the Graduate school in Partial Fulfillment of the Requirements for the Master of Science Degree in Agricultural Extension of Egerton University

EGERTON UNIVERSITY

SEPTEMBER 2023

DECLARATION AND RECOMMENDATION

Declaration

This thesis has not been presented to any other institution for an award of any Degree.

Signature …….……. Date: June 15, 2023

Emily Ndanu Kioko

EM12/3533/13

Recommendation

This thesis has been presented with our approval as the University supervisors

Signature…_____…. Date…15th June 2023…

Dr. Maurice O. Udoto

Department of Agricultural Education and Extension

Egerton University

Signature…… Date: June 27th ,2023…

Prof. Annie Hilda Onga'yo

Department of Environmental Studies (Community Development)

Pwani University

DEDICATION

I dedicate this Thesis to my Sons and Daughters. This one is for you, from me, your loving Mother.

ACKNOWLEDGEMENTS

I would first like to thank my University supervisors, Dr. Maurice Udoto of the Department of Agricultural Education and Extension, Egerton University and Prof. Annie Hilda of the Department of Environmental Studies (Community Development), Pwani University. The door to Dr. Maurice Udoto office was always open whenever I needed help and a mobile phone call to Prof. Annie Hilda was always answered whenever I had an enquiry about my research. They both consistently allowed this paper to be my own work, but steered me in the right direction whenever I needed it.

I would also like to thank the Department, Faculty and graduate school members for their help and support. Without their passionate participation and input, the study could not have been successfully conducted. I am extremely grateful to my colleagues in the Department of Agriculture, Livestock and Fisheries for sharing their expertise and encouragement during the study period.

Finally, I must express my very profound gratitude to my dearest family for providing me with unfailing support and encouragement throughout my years of study. This accomplishment would not have been possible without them.

ABSTRACT

Agricultural extension services play an important role in boosting agricultural productivity worldwide. Mass extension service delivery methods have been used to inform farmers about agricultural technologies by the government both at National and County level. Despite the investment in selected Mass extension methods, access to agricultural technologies by farmers remains limited. The purpose of this study was to establish the effectiveness of selected mass extension -methods which included Agricultural Exhibition, Road Extension Campaign and FM Radio on smallholder farmers' access to agricultural technologies. The study was carried out in Laikipia West Sub County. The study employed descriptive survey research design. The target population constituted all the 35,220 households in Laikipia West and an accessible population of 32,400 smallholder households who own farm size of 0.4- 2.5 hectares. Multistage sampling procedure was used to obtain a sample size of 128 respondents comprising of 120 smallholder households and eight senior representatives of the eight major groups of agricultural stakeholders. The study used questionnaire for both the smallholder farmers and the agricultural stakeholders. The validity of the instruments was enhanced by seeking expert guidance of lecturers from the Department of Agricultural Education and Extension of Egerton University. The reliability of the instrument was estimated after pilot testing. Reliability coefficient of 0.74 was obtained. Data was analyzed with the help of Statistical Package for the Social Science (SPSS) version 24. Among Agricultural Exhibitions, Road Extension Campaigns and FM Radio, Mass extension methods, FM Radio was the most preferred effective method by smallholder farmers. The study concluded that FM Radio extension method was the most effective in promoting access to agricultural technologies among smallholder farmers in Laikipia West Sub County. The researcher recommended that County governments in collaboration with agricultural stakeholders develop policies to support FM Radio Mass extension method and to improve the exhibition and road extension methods so as to have diverse methods of extension service delivery.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS AND ACRONYMS

ASDS	Agriculture Sector Development Support Programme
FAO	Food and Agricultural Organization of the United Nation
FFS	Farmer Field School
FM	Frequency Modulation
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
ICT	Information and Communication Technology
KNBS	Kenya National Bureaus of Statistics
NAEP	National Agricultural Extension Policy
NALEP	National Agriculture and Livestock Extension Programme
NASEP	National Agricultural Sector Extension Policy
NGO	Non-Governmental Organization(s)
SRA	Strategy for Revitalizing Agriculture
T & V	Training and Visit
USDA	United States Department of Agriculture
WDR	World Development Report

CHAPTER ONE
INTRODUCTION

1.1 Background of the Study

Agriculture is the main source of income for 2.5 billion people in the developing world. It remains the backbone of many African economies accounting for 57 percent of total employment, 17 percent of Gross Domestic Product (GDP) and 11 percent of the export earning on the continent (World Bank, 2008). According to Asiedu- Darko (2013), dissemination of the right information at the appropriate time among farmers is a key factor in providing change in agriculture for increased production. The agricultural extension service is a critical agent used worldwide to disseminate information aimed at transforming subsistence to modern and commercial agriculture which is important in promoting household food security, improving incomes and reducing poverty (Government of Kenya (GOK), 2017).

Agricultural extension services play an important role in agricultural development through delivery of knowledge, technologies and agricultural information and linking agricultural producers to other actors in the economy such as agro input dealers, agro processor, marketers and finance institutions. According to Romani (2003), agricultural extension services if properly designed and implemented, improves agricultural productivity. Agricultural extension services provide farmers with important information such as crop prices, new seed varieties, management practices, marketing and training in new technologies and also ensuring adequate and timely access by farmers to relevant advice and appropriate technologies suited to their socio- economic and agro- ecological circumstances.

Agricultural extension has been defined by Davis (2010) as systems that facilitate the access of farmers, their organizations and other market actors to knowledge, information and technologies. According to Smith *et al.* (2015), agricultural extension service delivery goes beyond technology transfer to facilitation, beyond training to learning and includes helping farmers form groups, deal with marketing issues, and partner with a broad range of service providers and agencies. Agricultural extension service delivery is therefore important for enhancing farmers' knowledge and skills, as well as promote and expand improved technologies which in turn improve smallholder farmers' farm productivity. It is therefore prudent to identify the most alternative effective extension method for delivery of agricultural

extension services. The constraints include lack of awareness of mass extension methods by farmers and underutilized of such methods by agricultural stakeholders (GOK, 2017).

In Kenya, the public sector extension service provision plays an important role through the afore mentioned different extension methods to implement programmes aimed at increasing smallholder farmers' agricultural production. The country has implemented several agricultural extension programmes using these different extension methods with varying degree of success. In 2001, the Kenya government through the ministry of agriculture, implemented the National Agricultural Extension Policy (NAEP) and the main objective was to introduce pluralistic and demand driven approach to improve the waning extension service delivery and lack of technology in the hands of the smallholder farmers. Several other initiatives such as Strategy for Revitalization of Agriculture, Farmer Field Schools were implemented to address the shortcoming of extension methods that were perceived to be performing marginally. The methods had weaknesses in that they were top-down and prescriptive in nature, with high human and capital demand (GOK, 2012). It was therefore necessary to establish the extent to which the methods were effective in improving farmers' access to agricultural technology.

According to the National Agricultural Sector Extension Policy (NASEP), a review of the NAEP (GOK, 2012), the various extension approaches which include Farmer Field Schools (FFS), Focal Area Approach(FAA) and Common Interest Groups (CIGs) were implemented to ensure farmer participation in packaging of technologies for improved agricultural production. NASEP was developed and implemented with an aim to address weaknesses in research- extension linkages, packaging and disseminating technologies and capacity building. NASEP adopted sector wide approach to providing extension services and spells out modalities for effective management and organization of agricultural extension in a pluralistic system where both public and private service providers are active participants. The government emphasizes on a well-functioning agricultural extension service and extension participatory methods operated by the public sector for increased agricultural productivity as outlined in Agricultural Sector Development Strategy(ASDS) (Government of Kenya, 2011). However, agricultural extension service delivery has been poorly done by agricultural stakeholders and underutilized by farmers (GOK, 2017).

The national government and the county governments together with development partners embraced more participatory and demand-driven agricultural extension methods envisioned in the Agricultural Sector Development Strategy 2010- 2020 (ASDS). This is anchored in the Constitution of Kenya, 2010 on the economic and social rights for the citizens to be free from hunger, and to have adequate food of acceptable quality (GOK, 2010). The constitutional framework spells out the participation of communities at the local level in governance for effective delivery of services, distribution of functions between the National government and the County government (GOK, 2010). Agriculture is a devolved function and therefore agricultural extension service delivery is mainly supported by the County government through the department of Agriculture, Livestock and Fisheries. The department is responsible for agricultural extension services County wide focusing mainly on thematic areas to bring services closer to the farmers for increased productivity.

In Laikipia County, delivery of agricultural extension services is decentralized. The devolution of agricultural extension service delivery has been affected by reduced staffing and financing of public sector extension by the County governments (GOK, 2012). The County embraced the use of mass agricultural extension methods, that is, agricultural exhibitions, road extension campaigns and FM radio to enhance awareness on access to agricultural technologies by smallholder farmers. The purpose was to increase agricultural knowledge on modern technologies used in agriculture with a view of increasing the farmers 'productivity. The three methods of mass extension are widely used across the county and beyond because of their simplicity and cost-effectiveness of the methods. There has been a tendency to replicate the agricultural mass extension methods across different agro-ecological zones and farming systems to avoid the dissemination of conflicting extension messages and wastage of resource. The challenge therefore, lies in the choice of appropriate, dynamic and holistic agricultural mass extension methods that consider the socio- economic, environment, value chain, market demand, cost effectiveness, agro- ecological diversity, client resourcefulness and mainstream relevant cross- cutting issues (GOK, 2012). the replication of mass extension methods should be guided by the choice of the smallholder farmers in selecting the most effective in ensuring access to agricultural technologies for increased productivity,

1.2 Statement of the Problem

Availing and sharing of agricultural information, technologies and innovation to smallholder farmers by agricultural extension providers is a major factor in the advancement of agricultural production. The national and county governments have facilitated Agricultural extension service delivery by advancing several methods of extension delivery. They include Mass Extension Methods such as Agricultural Exhibitions, Road Extension Campaigns and FM Radio. Despite the enhancement of Mass Extension Methods by Laikipia County Government to effectively reach many smallholder farmers, majority of them have inadequate access to agricultural technologies. Smallholder farmers still use poor farming practices such as inadequate use of certified crop seed varieties, inadequate use of fertiliser and pesticides, limited use of modern farming tools and equipment. Limited access to agricultural technologies affects the smallholder farmers in that the performance of agricultural production is significantly compromised. Information on the effectiveness of these selected Mass Extension Methods on accessibility to different agricultural technologies by smallholder farmers is not known. There is also no documentation on the effectiveness of Agricultural Exhibitions, Road Extension Campaigns and FM Radio and how they promote accessibility to agricultural technologies by smallholder farmers in Laikipia West Sub County. It is on this background that the current study sought to establish the effectiveness of Mass extension methods on access to agricultural technologies by smallholder farmers.

1.3 Purpose of the Study

The purpose of this study was to establish the effectiveness of Agricultural exhibitions, Road extension campaigns and FM Radio mass extension methods on access to agricultural technologies by smallholder farmers in order to improve their farming activities.

1.4 Objectives of the Study

The objectives of this study were to:

i. Establish the effectiveness of Agricultural Exhibitions on access to agricultural technologies among smallholder farmers in Laikipia West Sub County.
ii. Establish the effectiveness of Road Extension Campaigns on access to agricultural technologies among smallholder farmers in Laikipia West Sub County.
iii. Establish the effectiveness of FM Radio on access to agricultural technologies among smallholder farmers in Laikipia West Sub County.

iv. Identify the challenges of selected Mass extension methods faced by smallholder farmers in accessing agricultural technologies in Laikipia West Sub County.

1.5 Hypotheses of the Study

The following hypotheses were tested:

H_{01}: There is no statistically significant effectiveness of Agricultural Exhibitions on access to agricultural technologies among smallholder farmers in Laikipia West Sub County.

H_{02}: There is no statistically significant effectiveness of Road Extension Campaigns on access to agricultural technologies among smallholder farmers in Laikipia West Sub County.

H_{03}: There is no statistically significant effectiveness of FM Radio on access to agricultural technologies among smallholder farmers in Laikipia West Sub County.

1.6 Research Question

The following research question guided the study:

i. What challenges of Mass extension methods do smallholder farmers face in accessing agricultural technologies in Laikipia West Sub County?

1.7 Significance of the Study

The findings of this study may be beneficial because of the following: The Ministry and the County government may use the information to review planning, financing and up scaling of Mass extension methods. Agricultural training institutions may use the information for the enhancement and development of curriculum and training programmes, Agricultural extension staff may use the information to apply the best Mass extension methods to serve the smallholder farmers better. The smallholder farmers may use the information to engage in the most suitable Mass agricultural extension methods which enables them access to agricultural technologies.

1.8 Scope of the Study

The study was conducted in Laikipia West Sub County among smallholder farmers. It was confined to three mass extension methods which included Agricultural Exhibitions, Road Extension Campaigns and FM Radio Mass extension methods and how they enabled farmers' accessibility of major crop farming and livestock husbandry technologies. The three methods were selected because they are the mostly used agricultural mass extension in Laikipia

County owing to their cost-effectiveness. The technologies included use of improved crop seed varieties, on farm water harvesting technologies, conservation agriculture, on farm value addition, on farm feed conservation, Beekeeping and fish farming.

1.9 Limitation of the Study

The following limitations were considered in the study:

i. Difficulty of some farmers not understanding the questionnaire written in English, this was addressed by seeking assistance from the respondents for interpretation.
ii. Unwillingness of the farmers to discuss negative information which would have been construed to report Agricultural extension officers to their superiors. To overcome this, the respondents were reassured that the findings and information gathered were to be held confidential and only used for the study.
iii. Conflict and biasness which would have jeopardized the results and consequently the recommendations. To overcome this, the researcher carried out the study objectively and observed all ethical considerations of research.

1.10 Assumptions of the Study

The study was carried out with the assumption that:

i. The respondents would give honest feedback in regard to effectiveness of agricultural mass extension methods on access to agricultural technologies by smallholder farmers.

1.11 Definition of Terms

The key words used in this study were defined using standard definitions and operationalized as used in the current study.

Access to agricultural technologies: Access to Agricultural technologies is the availing of agricultural related information, content and knowledge from its authentic sources such as libraries, internet, newspaper and broadcast media (Dhehibi *et al.,* 2020). In this study, it means facilitating farmers to interact and acquire timely and appropriate information, knowledge and skills about innovative farming methods such as agricultural exhibitions, road extension campaigns and FM radio.

Agricultural exhibitions: This refers to public events and shows in exhibiting and demonstrating knowledge, equipment, animals, technologies, and innovation in agriculture (Aremu *et al.,* 2010). In this study, Agricultural extension service implies to temporary and short term events which provide an opportunity to agricultural service providers to display and disseminate improved agricultural technologies and innovations.

Agricultural extension method: This refer to the provision of technical knowledge and involves facilitation, brokering and coaching of farmers to improve agricultural productivity, market access, cope with changing weather patterns and protecting the environment. The primary focus is on providing advice and information to farmers (Smith, 2017). In this study agricultural extension service delivery refers to the provision of knowledge and skills to farmers through advisories, technology transfer and service delivery innovations.

Agricultural extension: It has been defined as the entire set of organizations that support and facilitate people engaged in agricultural production to solve problems and to obtain information, skills, and technologies to improve their livelihoods and well-being (Awad *et al.,* 2015). In this study, agricultural extension describes a service or system which assists farmers through educational procedures improve their farming methods and techniques while increasing agricultural production.

Agricultural Technologies: Awad *et al.* (2015) defines agricultural technologies as new, scientifically derived, often complex inputs such as mineral fertilizers, high yielding seeds, and crop and livestock agro chemicals used to improve the farming conditions. In this study it

refers to the application of knowledge, skills and innovations, physical objects such as feeds or fertilizer as well as new farming techniques.
'Agricultural technology' is a broad term that is used here to describe equipment, genetic material, farming techniques, and agricultural inputs that have been developed to improve the effectiveness of agriculture (Ruzzante *et al.*, 2021)

Effectiveness: Al-rimawi *et al.* (2016) defines effectiveness as a measure of the extent to which a specific intervention, procedure, regimen or service, when employed in the field in routine circumstances, does what it is intended to do for a specified population. In this study, it refers to the ability of agricultural extension services to mobilize their capacity to meet the demands of farmers.

FM radio: FM broadcasting is the method of radio broadcasting that uses frequency modulation (FM) to reach people within the reach of the frequency over a radio station (Hailu *et al.*, 2018). In this study, FM radio in this study will refer to the use a sustainable model of extension delivery to link extension providers, and farmers and communication of agricultural technologies to enhance farmer productivity and prosperity through a radio station.

Mass Extension Methods: According to Smith (2017) these are methods which involve the use of mass media such as radio, posters, campaigns, television to inform the public. In this study it means the use of Agricultural exhibitions, Road extension campaigns and FM radio for rapid spread of information about agricultural technologies to the farming community.

Production: The processes and methods employed to transform tangible inputs (raw materials, semi- finished goods) and intangible inputs (ideas, information, knowledge) into goods or services (Patil, 2012). In this study it refers to all the agricultural practices from soil preparation, sowing, fertilizer application, weed control, harvesting, storage, value addition and marketing of farm products.

Road extension campaigns: Refers to an intensive activity to mobilize people take action for solving their problems across a certain stretch of road (Acharya *et al.*, 2010). In this study, Road extension campaign refers to a coordinated effort to inform many farmers in relatively

short period of time about agricultural topics of widespread concern or interest to people served by certain roads.

Stakeholder: is any group, or institution that has vested interest in extension at a particular level and will be affected by extension activities, has something to gain or lose if conditions change or remain the same (Azumah *et al.,* 2018). In this study a stakeholder means persons or organizations collaborating in the delivery of Agricultural extension services.

Technology transfer: Dhehibi *et al.* (2020) describes technology transfer as the application of scientific principles to solve practical problems. Technology transfer in this study refers to the process of transferring skills, knowledge, and technologies among to farmers for the purpose of Agricultural production.

Utilization of agricultural technologies: According to Al-ajelli and Mohammad (2019) farmers' utilization and application of agricultural technologies implies that the beneficiary farmers having acquired the agricultural knowledge, they put into practice the advanced technology they have learnt with the supervision of agricultural extension provider. In this study it refers to the use or converting into action the accessed agricultural messages and technologies by farmers to perform agricultural production activity.

Value addition: It is the process of changing raw agricultural product into something new through storage, packaging, processing and or any other process that differentiates it from the original products (Government of Kenya, 2011). In this study it refers to the process of increasing the economic value and consumer appeal of an agricultural commodity.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter examines the status of Agricultural extension service delivery, access to agricultural technologies, agricultural extension models and approaches, Mass extension methods, Agricultural exhibitions, Road extension campaigns and FM radio. Theoretical and Conceptual framework that guided the study is also discussed.

2.2 Overview of Agricultural Extension Service Delivery

Extension and advisory services are a critical component of rural development, and have been shown to contribute to the reduction of hunger and poverty, increase adoption of improved agricultural technologies, increase productivity and capacity of farmers. Agricultural extension has changed from technology focused, public service- dominated, and transfer of technology approaches to a much broader scope with many different actors (Elia & Mubofu, 2017).

Agricultural extension provision is underpinned by productivity gap theory. The theory states that agricultural extension services can be delivered in a variety of forms but their ultimate aim is to increase farmers' productivity and income (Al-mashhadani *et al.*, 2017). Agricultural productivity improvements are only possible where there is a gap between the actual and potential productivity (Al-ajelli & Mohammad, 2019). According to Al-ajelli and Mohammad, (2017) there are two types of gaps that contribute to the productivity differential, the technology gap and the management gap.

Agricultural extension can contribute to the reduction of the productivity differential by increasing the speed of technology transfer and by increasing farmers' knowledge through dissemination of information, technology and innovations which is the key driver of extension services and improving farm management practices (Awad *et al.,* 2015). New agricultural technologies and improved extension has a significant potential of raising agricultural productivity. But the gains will not materialize without increased investment in agricultural extension services (FAO, 2011).

Agricultural extension service seeks to impart the necessary skills to the farmers for undertaking improved operations, to make available to them timely information, improved

practices in an easily understandable form suited to their level of literacy and awareness, and to create in them a favorable attitude for innovation and change (Aremu *et al.,* 2010). Effectiveness of agricultural production at regional, national or individual level depends on effective delivery of agricultural information and innovations to farmers (Okafor & Fabiyi, 2011). According to Piesse and Thirtle (2010), millions of smallholder farmers in developing countries are in the dark regarding modern technologies which are primarily based on efficient use of inputs such as chemical fertilizers, certified seeds and pesticides, best practices including strategic feeding protocols for livestock.

There is dire need to educate farmers on the importance of improved farming practices, access to proven and tested technologies and better utilization of land holdings through well-coordinated efforts of agricultural research and extension with allied developmental organizations (Setiawan, 2015). This is particularly urgent in developing countries where agriculture remains a central element of the economy and innovation is the key to agricultural growth needed to reduce poverty. In Tunisia, for example agriculture provides at least 20% of the national GDP, employing 22% of the total labor force, Agro- food exports also represent 15% of the total exports (Chebbi, 2010). Key to the continued contribution of agriculture in Tunisia's economy is the adoption of new management, communication, innovation and production practices which are expected to maintain long term profitable agricultural operation (Colliers & Dercons, 2014).

In Kenya, the agricultural extension is one of the priority functions of the agricultural sector. The institutional and functional changes spelt in the Vision 2030, and the Agricultural Sector Development Strategy 2010-2020 emphasize the need to improve the extension system delivery (GOK, 2012). The constraints that have hindered the proper functioning of the agricultural extension service must be addressed. The most critical ones are declining human capital and resources for public extension, uncoordinated pluralistic extension service delivery, lack of coordination between various actors and poor linkages with extension facilitating factors.

2.3 Access to Agricultural Technologies

Sustainable agricultural development is purely based on the transfer of innovations and technologies. These innovations are regarded as new ideas, practice which influence sustained increase in farm productivity and income (Umeh & Nwachukwu, 2015). The

innovations may be technical or social. Access to agricultural technologies is a catalyst to improving agricultural productivity, household incomes and has substantial dynamic benefits that improve the welfare of the smallholder farmers (World Bank, 2015). When rural farmers lack knowledge and information that would help them achieve maximum agricultural yield, they move to urban centers for employment for survival (Tunde *et al.,* 2018). For instance, in Nigeria, the Agricultural Development Programs (ADP), are intended to assist farmers improve their productivity through active participation in their activities and utilization of technologies to enhance their production capacity (Folitse *et al.,* 2016).

Dissemination of the right information at the appropriate time among farmers is key to providing change in agricultural productivity. It is therefore important to establish how effective and efficient extension and advisory services play an important role in agricultural development and can improve the welfare of the farmers who live in rural areas (Asiedu-Darko, 2013). According to Kassem (2014), Agricultural extension can be organized and delivered in a variety of forms such as through individual contacts, group contacts and mass media with the ultimate aim being to increase farmers' productivity and income. However, farmers are often blamed for poor adoption of agricultural extension services and success or failure is based on the level of adoption without considering the effectiveness of the extension delivery mechanisms.

Small scale farmers require information related to appropriate technological options, management of technologies, optimal use of inputs, changing farming systems, diversification and mixed farming, market demand for products and sustainable natural resource management. The transmission of this knowledge and information is required at every stage of agricultural production chain (International Food Policy Research Institute (IFPRI), 2010)

2.4 Extension Models and Approaches

Several extension approaches have been tested and adopted by countries in Africa to improve the technology dissemination process (Christoplos, 2010). Most of the approaches were mainly top down and public services dominated (Zhou, 2010). The approaches ranged from Top- down Training and Visit (TV), commodity based participatory approaches and more recently the farmer field schools. After independence, more persuasive and educational approaches and methods have been adopted across the board, implemented mainly through

the assistance of donor funded projects and programmes. The approaches were characterized by high demand for manpower, time and financial resources. In general, the approaches were essentially top- down and lacked participation in articulating client demand (GOK, 2012).

Based on the lessons learnt from the above approaches, the Government in collaboration with stakeholders has embraced more participatory and demand- driven extension approaches. Kenya's experience of using unsuccessful approaches to deliver agricultural extension services to farmers has taught policy makers that in order to be effective, extension agents should avoid top- down planning and implementation of interventions to farmers' problems in favor of demand- driven and farmer led, participatory approaches. Some of the extension methods used are Focal Area Development Approach and Farmer Field Schools, Mass extension methods such as Agricultural shows and exhibitions. Equally individual methods, on-farm demonstrations, shows and field days are used. The changes have implications of approaches and methods, coordination and linkage among stakeholders, and the optimal way of financing extension service in the Country (Lopokoiyit *et al.,* 2012).

2.5 Mass Extension Methods

Mass media and information technologies(ICT) are widely recommended for raising awareness, enhancing knowledge, and consequently contributing to the development of potential positive impacts on farmers' livelihoods and wellbeing in a short period (Azum *et al.,* 2018). Mass extension methods, according to Mahmood and Rufin (2005), involve the use of mass broadcast, print media and mass contact such as exhibition, fairs and road extension campaigns. Several forms of information and communication technology tools that provide technologies to improve crop production and food security are categorized into new technologies such as internet, mobile phones and old technologies such as radio, television and printed materials. These mass media tools have the potential of getting vast amount of information to the rural population in a timely, comprehensive and cost effective manner and could be used together with other traditional media.

Mass media holds considerable promise for awareness, transfer and exchange of information and technologies (Kumar, 2011). These tools connect small producers with local, regional and global markets and can improve business, production decisions and supply chains and distributions (Chowdhury, 2001). The advantage with mass extension method is that it can increase the impact of extension staff through rapid spread of information and many people

can be reached within a community. According to a study by HELVETAS Swiss cooperation (2014), the limitation in the use of mass media is that interactions are not possible, detailed explanations to the clients cannot be provided, responding to individual concern is not easily possible. Messages that are passed may not be understood by all. Mass media channels are expensive to produce and broadcast time may be a huge expense.

2.5. 1 Agricultural Exhibitions

Agricultural exhibitions and shows are temporal/ short term events which provide an opportunity to agricultural service providers to display and disseminate improved agricultural innovation. This is with a view to encouraging participants, mostly farmers who have not done very well and to emulate their more successful counterparts, and to motivate progressive farmers to further excel (Ifenkwe, 2012). Agricultural exhibitions bring different value chain actors together to share knowledge, information, processes and technologies by demonstrating their value chain interventions, businesses and service products. Agricultural exhibitions are temporary events which offer farmers the opportunity for study tours to see and gain experience. Agricultural exhibitions create quick and broad exposure to new ideas and technologies. The event provides an opportunity for producers, input and service providers, processing and marketing businesses, investors, credit institutions and policy makers to show case their products (Ifenkwe, 2012).

Organizing a successful agricultural exhibition demands collaboration and participation of scientists, agricultural firms, mass media, farm organizations, schools and the general public. The forum provides an opportunity for all those engaged directly or indirectly in agricultural production or related activities to show case agricultural raw materials, products of allied agro industries; and to interact to exchange ideas and information for overall improvement of the agricultural sector. The themes of agricultural exhibitions should address sensitive and topical issues in order to attract wide and quality patronage (GOK, 2017).

A successful exhibition stimulates linkages, educates and motivates participants to access and adopt agricultural technologies and innovations. Widespread access and adoption of good agronomic and animal husbandry practices will lead to enhanced productivity at household level and ultimately overall improvement of food security. Agricultural exhibitions can be organized at County and National levels (Mamusha & Fanos, 2016). However, organizing

agricultural exhibitions is both capital and labour intensive, and involves a lot of planning, action and evaluation.

2.5.2 Road Extension Campaigns

Road Extension Campaigns is one of the methods of extension which can reach a large number of beneficiaries in a short period of time (FAO, 2011). Road extension campaigns are used to focus the attention of the people on a particular issue, build confidence, and involve the people emotionally in a programme. According to Boa *et al.* (2016), a road extension campaign is an intensive activity to mobilize people take action for solving their problems. The information, technology and innovation provided revolve around a single theme and subject.

Road extension campaign is a coordinated effort to inform many farmers in relatively period of time about an agricultural topic of widespread concern or interest. The aim is to achieve quick, large- scale change in farmer behavior and practices through carefully choreographed efforts by different organizations (Acharya *et al.,* 2010). An extension campaign requires a sharp focus and a clear end point. It endeavors to deliver material benefits to farmers whose need and demands are paramount in shaping the campaign based on the topical area chosen by service providers and agricultural stakeholders. The chosen topic should have realistic and achievable outcomes. Campaigns are well suited to tackling plant health problems among others, where concerted effort is needed to mitigate risks and scale up proven but underutilized technologies.

Campaigns go beyond the limited scope of individual projects to promote technologies and innovations to farmers. Road extension campaigns focus on topics that matter most to people (Boa *et al.,* 2016). Launching of large scale extension campaigns require major funding, a range of social, communication and organizational skills, they can become over reliant on project funds and international organizations ignoring opportunities that are locally led (Badr *et al.,* 2019). Coordination can be challenging particularly ensuring timely availability of recommended inputs such as seeds and information materials. Partners with competing interest may complicate planning and implementation. Measuring of Extension campaigns outcomes is weak, partly because it is difficult to ascribe change to campaign alone, and not much emphasis is given to assessment during planning (Boa *et al.,* 2016).

2.5.3 Frequency Modulation (FM) Radio Use

The FM radio is appreciated as one powerful tool to access required information and innovations required to educate and empower farmers. Radio is a popular medium to rural residents, most of who have limited access to other media forms such as newspaper and television (Mogambi, 2011). In Communication for Development Round Table Report (UNCDR, 2010), radio still remains the most widely available and affordable mass medium for disadvantaged groups in rural areas as it is often the only one available. It is indicated in the same report that in some areas, it is the only source of information about weather, market prices and agricultural innovations.

Radio provides a good example of the technological advances in communication field. The advent of cheap transistor radio has brought radio to remote corners of the poor communities. It is inexpensive, has wide coverage and is readily available to very remote rural population. It is excellent for motivating farmers and for drawing their attention to new agricultural production and techniques (Hailu *et al.,* 2018).

Towela (2010) in his study, noted that half of population of Africa has radios, and thus rural radio has factors which legitimize it, including the use of local languages, a variety of topics which integrate all areas and sectors of economic, social and cultural development. Many rural radios for instance FAO rural, Farmers Voice radio have food security channels with programs on food production. This represents a new, sustainable model of extension delivery that links extension providers, and farmers and communication technologies to enhance farmer productivity and prosperity. In Ghana, a study by Al- Hassan (2013) to assess the role of FM radio towards improvement of livelihood of people, it was found that radio indeed improve people's awareness by addressing community problems ranging from agriculture to rural development.

Jemal (2013) posit that compared to television set, radio receivers are inexpensive and affordable to farmers who are accessed by neither telecast nor newspaper. Its affordability is the first step for the accessibility. He further argues that radio is the unsurpassed medium to reach rural mass where terrain and infrastructure is poor. Nakabugu (2010) argues that through radio, vital information for example on better harvesting methods, soil conservation techniques, post-harvest handling, use of improved seeds, timely planting can be passed. Dissemination of such information along with new concepts and farming techniques can

bring novel opportunities to the farmer (Retz & Hasbullah, 2010). According to Mtega (2012), information is a vital resource alongside land, labour, capital and skills. People need information for day to-day activities. He further argues that information plays a key role in decision making.

Nazari and Hassan (2010), noted that radio being an effective means of dissemination of knowledge, information and technologies, it also catalyzes adoption of technologies. According to GOK (2017), radio is effective in creating awareness within a short time because of its wide coverage. However, the method has its limitations in that it is weak in content, cost efficiency, limited number of technologies passed. According to Elia (2014), inadequate funds prevent farmers from purchasing batteries in rural areas with no electricity.

Despite the availability of FM radio programs which broadcast agricultural information on weekly basis, farmers' inadequate funds prevent them from receiving timely and appropriate agricultural information. Agricultural information from FM radio does not provide farmers with printed materials which they can read at their convenient time to recall and compare with information from other sources (Sani, 2014). A survey was conducted by Kenya Agricultural Institute (KARI) in 2009 to examine radio listening habits, accessibility and preference of small scale farmers in Kenya. The findings showed that 98 percent of farmers have access to a radio message from various audio technologies. However, farmers felt that radio programs are often centered more on farm inputs than their needs and preferences (KARI, 2009). Further, programs aired in FM radio do not reflect the reality but shape and filter it concentrating on a few issues and subjects. Maloba (2013) in his study noted that radio should be a two- way tool, providing information to the masses and allowing their views, ideas and opinion to filter back to the policy makers.

2.6 Theoretical Framework

The diffusion of innovations theory advanced by Rogers (2003) guided this study. Diffusion of innovations theory states that technologies are communicated over time among the members of a social system, and adopted according to various characteristics of both the technology and the user. The efficiency of technologies generated and disseminated depends on the effective communication which is the key process of information dissemination. Characteristics of good information sources are relevance, timeliness, accuracy, cost, effectiveness, reliability, usability, and exhaustiveness (Agbamu, 2006). According to Rogers (2003), the access of information and its interaction in society follows a four step process of

the awareness stage, interest stage, the examination and testing stage and the adoption/ rejection stage.

Rogers (2003), noted in his theory that access and application of technology or innovation may be influenced by its relative advantage in terms of cost and social status, compatibility in terms of consistence with existing and past experiences. Farmers' decision on what activities to carry out in their farms is based on timely awareness of existing information. For Rogers (2003) effective communication is a process in which participants create and share information with one another in order to reach a mutual understanding. The innovation-decision making process starts with awareness stage which implies that the farmers are not aware of the technology and its availability, thus through agricultural extension services the improved technology is made known to the beneficiaries. Farmers knowledge stage is whereby the farmers acquire knowledge about the agricultural practices and technology disseminated to them and put it into practice through testing and experimentation. An individual learns about the existence of innovation and seeks information about it. Access of information represents the knowledge about the existence and motivates the individual learn more about the innovation.

The theory informs this study because agricultural exhibitions, road extension campaigns and FM radio provide a basket of options for creating awareness about agricultural information and technologies to farmers intended to promote their learning and decision-making processes. It also allows for farmers' interaction with the sources of the information The theory is relevant in this study because, different sources of information and technologies are important for first hearing about the innovation, interaction with the change agent and for making the final decision to adopt or reject it. Agricultural exhibitions, road extension campaigns and local FM radio are some of the mass extension methods used for awareness creation and sensitization of farmers about the available information, knowledge, skills and technologies.

2.7 Conceptual Framework

The theory is diagrammatically conceptualized as shown in Figure 2. The conceptual framework depicts the connection between the selected Mass extension methods and smallholder farmers' access to agricultural technologies. The dependent variable, smallholder farmers' access to agricultural technologies is characterized by the number and type of

agricultural technologies accessed by farmers. The intervening variables are age, gender, education level of the farmer and other information sources such as print and internet. The socio- economic characteristics of the farmer were factored in when carrying out the study in order to control their effects.

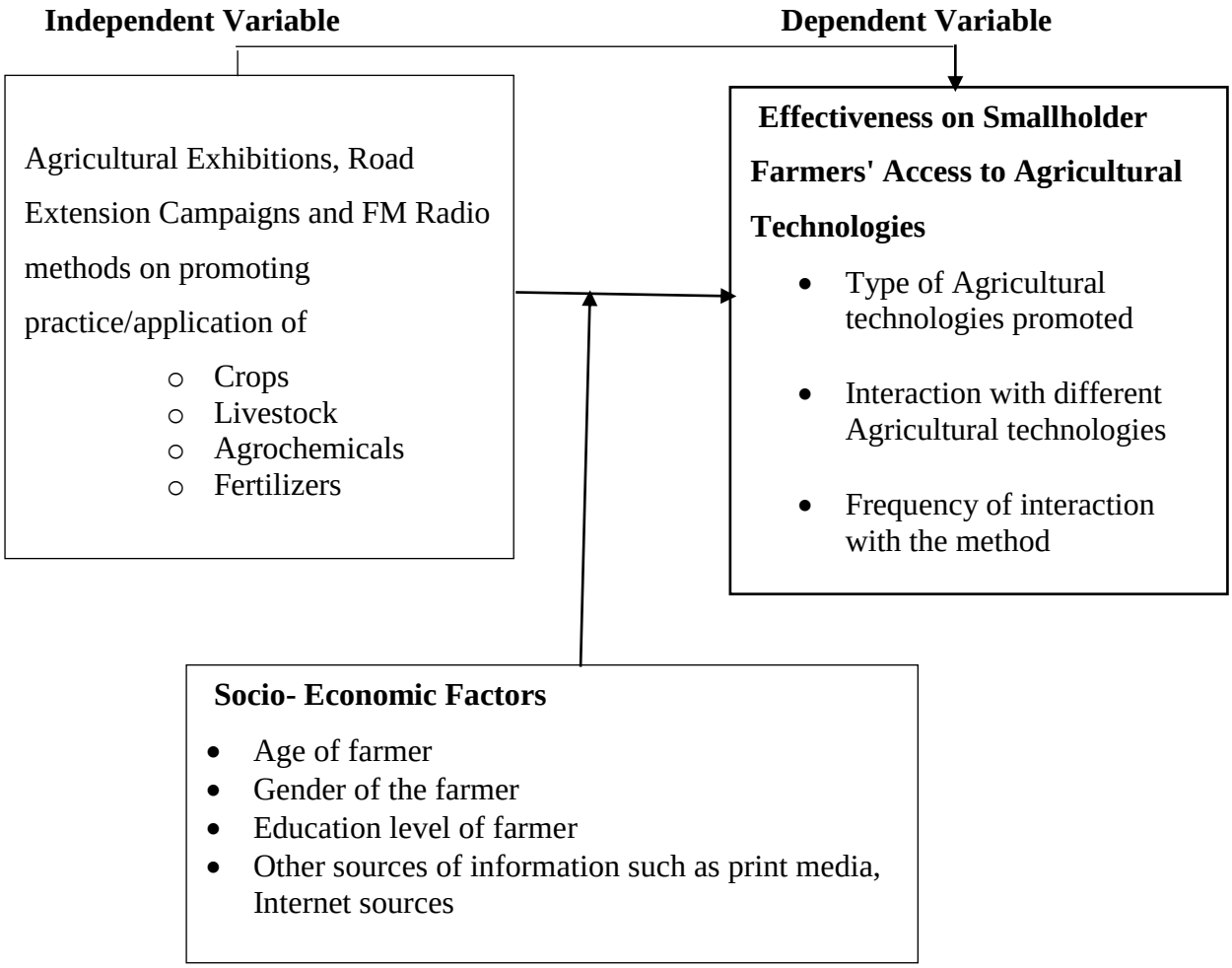

Figure 2.1. Conceptual Framework Depicting the Effectiveness of Selected Mass Extension Methods on Access to Agricultural Technologies.

The independent variable includes, Mass extension service delivery methods used to create awareness and inform the smallholder farmers about the available agricultural information, technologies and innovations and whose access and utilization result in improved agricultural production. The technologies should be clearly defined and validated, relevant and suitable so

that farmers can acquire and apply the knowledge and skills. The dependent variable shows the effectiveness of the selected mass extension delivery method. The effectiveness was measured by the number of farmers reached, the accessibility of the method by farmers, involvement of key service providers, farmer participation and gender responsiveness. The intervening variable includes the age of the farmer, gender, education level attained, farming experience and acreage of land under farming. The intervening variables were accounted for in the study by incorporating them both in the smallholder farmers' and the agricultural stakeholders' questionnaire.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

The chapter carries a brief explanation on the methodology used to achieve the objectives of the study. The chapter also highlights the research design, location of the study, target population, sampling procedure and sample size, instrumentation, data collection, data organization and analysis.

3.2 Research Design

The study employed a descriptive survey research design. The design allows for studying a situation as it is in an attempt to explain why the situation is the way it is (Bilgin, 2017). The descriptive survey research design allows for description of activities, objects and persons. Further, it offers a description and explanations, also identifies and predicts relations in between the variables of the study (Nicholson *et al.,* 2011). The design allowed the use of questionnaire to collect data from respondents and enabled collection of descriptive data on selected mass extension service delivery methods and explanation on their role in promoting access to agricultural technologies by smallholder farmers.

3.3 Location of the Study

The study location was Laikipia West Sub County, which is one of the three Sub Counties that make up Laikipia County and has its headquarters at Rumuruti Township. The Sub County borders Laikipia East and Laikipia North to the East and North respectively, with Nyandarua and Nakuru County to the South West and with Baringo County to the West. Laikipia West is made up of six (6) wards namely; Igwamiti, Marmanet, Rumuruti, Salama, Githiga and Olmoran. According to the Laikipia County Statistics report (2012), the Sub County had an estimated population of 208,725 and land mass of 2,579.5 square kilometers.

Laikipia West Sub County is situated at an altitude of 1800 to 2300 meters above the sea level, has a mean annual rainfall of 400 to 800 mm and mean annual temperatures of 16 to 26 degree Celsius. The population is predominantly smallholder farmers who practice mixed farming as their major economic activity. The main crops grown by farmers are Maize, Wheat, Beans, Potatoes and high value vegetables. The major livestock kept by farmers are cattle, sheep and goats. The Sub County was chosen for the study because majority of

smallholder farmers are engaged in agricultural production which is an important source of food and rural employment.

3.4 Population of the Study

The target population for the study consisted of all the households in Laikipia West Sub County. According to the Laikipia County Statistics report (2012), there were 35,220 households in Laikipia West out of which 92 percent are smallholder farmer households. The accessible population comprised of 32,400 smallholder farmer households who own farm size of 0.4- 2.5 hectares. Eight (8) major categories of agricultural stakeholders, one senior representative from each, operating in the Sub County was involved in the study. The eight major categories of Agricultural stakeholders consisted of Agricultural extension agents, Agro-input suppliers, Producer and Marketing organizations, Processors, Micro finance institutions, FM Radio agents, Private companies and NGOs. Table 1 shows both the total number of households and the accessible smallholder farmer households in Laikipia West Sub County.

Table 3.1 Population of the Study

Ward	Number of households	Number of accessible smallholder households
Rumuruti	3,245	2,985
Olmoran	3,983	3,664
Githiga	7,732	7,113
Igwamiti	8,432	7,757
Marmanet	8,255	7,594
Salama	3,573	3,287
Total	35,220	32,400

3.5 Sampling Procedure and Sample Size

Multi stage sampling procedure constituting purposive and proportionate random sampling was used. Laikipia West Sub County and all the six wards were purposively selected because it is agriculturally endowed and the selected Mass extension methods have been implemented. Proportionate random sampling was used to sample 120 smallholder farmers from the six wards. Sloan and Quan-Haase (2017) recommend that when a survey targets a major sub group, at least 100 cases should be investigated and an additional 20 cater for

attrition. Eight major Agricultural stakeholders, one senior representative from each category were purposively selected and completed the questionnaire. The total sample size was 128. The 120 respondents were distributed proportionately in the six wards as shown in the Table 2.

Table 3.2: Sample Size

Ward	**Number of Smallholder households**	**Proportion (percentage)**	**Sample Size**
Rumuruti	2985	9.21	11
Olmoran	3664	11.30	14
Githiga	7113	21.95	26
Igwamiti	7757	23.94	29
Marmanet	7594	23.43	28
Salama	3287	10.14	12
Total	32400		120

3.6 Instrumentation

The instrument used to collect data by the researcher was the questionnaire method, two sets of questionnaires were used, one for the smallholder farmers and the other one for the agricultural stakeholders. The was important in order to collect relevant and adequate information for the study

3.6.1 Instruments

Data was collected using a farmers' and stakeholders' questionnaires (Appendix A and B). The two sets of questionnaires were developed and administered by the researcher. The two questionnaires were designed to collect specific information on the effectiveness of selected Mass extension delivery methods on access to agricultural technologies. Questionnaire method of data collection was preferred because it is easy to administer and quantify results within limited time and is economical in terms of money resources (Latunde, 2017).

The items were developed based on the research objectives, research hypotheses, research question and related literature. Both the farmers' and the Agricultural stakeholders'

questionnaire were divided into six sections. Part I of the farmers' questionnaire contained six questions on; gender, age, highest education attained by the farmer, number of years in farming, size of land owned and the main agricultural activities practiced by the farmer. Part II contained 4 questions on whether the farmer had access to selected mass extension methods and the organizations that used the method to provide information about farming. Part III contained one question about the effectiveness of agricultural exhibitions on access to agricultural technologies in the study area and Part IV contained one question about the effectiveness of Road extension campaigns on access to agricultural technologies. Part V had one question about the effectiveness of FM radio on access to agricultural technologies while Part VI had two questions on challenges of the selected Mass extension methods and suggested ways to improve them in the study area.

The questionnaire for Agricultural stakeholders was divided into parts: Part 1 contained four questions on personal information, Part II contained four questions on selected extension methods used by their organization, Part III contained one questions about effectiveness of agricultural exhibitions on access to agricultural technologies and Part IV contained one question about effectiveness of road extension campaigns on access to agricultural technologies, Part V had two questions about effectiveness of FM radio on access to agricultural technologies and technologies promoted using the selected Mass extension methods. Part VI had two questions on challenges of Mass extension methods faced by smallholder farmers and suggestions on how to improve them. Likert scale, arbitrary scale and Dichotomous scales were used to score the items in the two questionnaires accordingly.

3.6.2 Validity

Validation of the research instruments was done before being administered to the study population. The purpose of validity testing was to establish the ability of instruments to measure what they were intended to measure (Miller & Whicker, 2017). To ascertain the validity of the instruments, the researcher sought for expert judgment from supervisors on face, content and construct validity in the Department of Agricultural Education and Extension at Egerton University. Consequently, the questionnaires were modified in line with the comments given by supervisors and other experts, to ensure their content validity.

3.6.3 Reliability

For successful data collection, internal consistency reliability of the farmers' and agricultural stakeholders' questionnaire was ensured before data collection. This was done by pilot-testing the questionnaire to 30 smallholder farmers and 8 agricultural stakeholders from Ngobit Ward in Laikipia East Sub County not included in the study. The pilot ward has similar characteristics as the study area. Pilot testing was carried out to ensure that there were no deficiencies and ambiguities in the final instrument. Cronbach's Alpha coefficient was calculated and a reliability coefficient of 0.74 obtained. According to Bryman (2015) a reliability of 0.70 or higher is acceptable for research purposes and is normally considered desirable for consistency levels.

3.7 Data Collection Procedures

An introductory letter was obtained from the Board of post Graduate Studies to facilitate for the application of a research permit from the National Commission for Science, Technology and Innovation (NACOSTI). Once the permit was obtained, the researcher sought permission from the Laikipia County administration, the research permit was then used by the researcher to seek permission from the County Director of Agriculture to engage the farmers. The researcher contacted and visited the Sub County agricultural officer for introduction to the Ward agricultural officers. The farmers involved in the study were identified with the help of agricultural extension staff, appointments to meet them at convenient time and venue were made. The smallholder farmers and agricultural stakeholder identification was done with the assistance of the Ward agricultural officers.

Out of the targeted study sample of 120 smallholder farmers, 101 filled the questionnaire correctly which were collected back for analysis. This represented a response rate of 84.2%. The study also sought to collect data from eight major categories of Agricultural stakeholders and managed to collect data from seven of them making a response rate of 87.5%. The overall response rate for the study was therefore 84.4%. Neuman (2014) recommends a response rate of at least 80% for the generalization of the research findings to the target population. The high response rate achieved is due to proper data collection procedure and adequate time given to the respondents to fill in the questionnaires.

3.8 Data Analysis

The data collected from smallholder farmers and the agricultural stakeholders was coded and the coding started from the field. The coded data was synthesized and cleaned to remove

outliers for analysis with the help of Statistical Package for the Social Sciences (SPSS) version 24. The data was summarized and presented using both descriptive and inferential statistics. The qualitative data generated from open ended questions was converted into quantitative and analyzed using descriptive statistics. The descriptive statistics used were frequencies, means and percentages and the findings presented in tables. Inferential statistics, Pearson correlation was used to analyze null hypothesis one, two and three. The Pearson correlation was used since the hypotheses of the study sought to establish the relationship between a set of two variables. All the three hypotheses in the study were tested at $\alpha = 0.05$.

3.8 Ethical Considerations

The research was conducted after the provision of research permit by NACOSTI. Privacy and confidentiality in handling the data was ensured by assuring the farmers of the purpose of the research, expected duration and procedure. The farmers were assured of guarding the information and integrity of the people by the researcher. Voluntary participation of respondents was guaranteed, participants' rights to decline to participate, withdrawal from research and any prospective benefits was discussed. The researcher discussed with the respondents on how to get back to them and disseminate the findings. Further, the participants were given contacts of the researcher in case they had any enquiries.

CHAPTER FOUR
RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the findings, interpretation and discussion of the study. The presentation is guided by the research objectives, research hypotheses and questions. The findings are presented in tables and figures that clearly show the responses to the study variables. The results reflect the demographic characteristics of the farmers and the stakeholders, effectiveness of Agricultural exhibitions on access to agricultural technologies, effectiveness of Road extension campaigns on access to agricultural technologies, effectiveness of FM radio on access to agricultural technologies and the challenges of selected mass extension methods faced by smallholder farmers in Laikipia West Sub County. The results were discussed to provide information that can lead to effective Mass Agricultural extension service methods for improved access to Agricultural technologies by smallholder farmers in Laikipia West Sub County.

The study sample comprised of 120 smallholder farmers and eight agricultural stakeholders. However, out of the targeted sample of 120 smallholder farmers, 101 of the questionnaires were correctly filled and collected back for analysis. This represents a response rate of 84.2%. The study sought to collect data from eight agricultural stakeholders and managed to collect data from seven making a response rate of 87.5%. The overall response rate for the study was therefore 84.4%. Neuman (2014) recommends a response rate of at least 80% for the generalizability of the research findings to the target population. This implies that the achieved response rate was adequate for generalization to all stallholder farmers in Laikipia West Sub County. The high response rate achieved in the study is due to proper data collection procedures and adequate time given to the respondents to fill in the questionnaires.

4.2 Background and Socio-Economic Characteristics of the Respondents

The study identified various demographic characteristics of the respondents which may have had an influence on the effectiveness of the selected Mass extension methods on access to agricultural technologies. The respondents were asked to indicate their personal information as indicated in Table 3 which shows the background and socio-economic information of both the smallholder farmers in Laikipia West Sub County.

Table 4.1: Background and Socio-Economic Characteristics of the Smallholder Farmers

Characteristic	**Category**	**Frequency**	**Percent (%)**
Gender of Smallholder farmers	Male	62	62.62
(N=101)	Female	38	37.38
	20-30	3	3.0
Age in years of Smallholder farmers	31-40	14	13.9
(N=101)	41-50	29	28.7
	51-60	30	29.7
	> 60	25	24.8
Highest level of education attained	None	4	4.0
(N=101)	Primary	44	43.6
	Secondary	30	29.7
	College	22	21.8
	University	1	1.0
Number of years in farming (N=101)	<5	2	2.0
	5- 10	12	11.9
	11-15	18	17.8
	> 15	69	68.3
Acreage under agriculture (N=101)	<1 Acres	8	7.9
	1-5	72	71.3
	6-10	15	14.9
	> 10	6	5.9
Main Agricultural activities (N=101)	Crop farming	98	97.0
	Livestock keeping	71	70.3
	Poultry	40	39.6
	Horticulture	24	23.8
	Beekeeping	11	10.9
	Agroforestry	2	2.0
Period of access to mass extension	<5	27	27.3
services (years) by smallholder	6-10	37	37.4
farmers (N=101)	11-15	11	11.1
	16-20	13	13.1
	>20	11	11.1

The results in Table 3 show that majority (62.62%) of the smallholder farmers were male, and 83.2% of smallholder farmers were above 40 years of age. Majority (43.6%) of the smallholder farmers had attained primary education as the highest level of education. A few (4.0%) smallholder farmers had no education. This implied that most of the farmers with some level of education had a wider opportunity to access information about agricultural technologies from magazines, television, posters, and internet sources. The finding of a study done in Embu by Chimoita, Onyango, Kimenju and Gweyi-onyango (2017) indicated that most of smallholder farmers had low education level, were at least 40 years of age and small acreage for farming.

The results also show that majority (71.3%) of smallholder farmers had between one and five acres of land under farming. The size of farming land is an important resource factor which determines the level of agricultural production, further farmers practicing mixed farming on small land holdings means that the farmers are small scale producers mainly practicing subsistence farming. Majority (97%) of the farmers engaged in crop farming, (70.3%) livestock keeping and (39.6%) poultry keeping. The results further showed that the farmers were predominantly smallholders practicing both crop and livestock farming on small land holdings. On the experience for smallholder farmers in farming, *et al.* (2018) found that most smallholder farmers did small scale farming for long years without upgrade to large scale farming, in which poverty was cited as major reason. The authors added that most smallholder farmers were not able to access agricultural extension services. Table 4 shows the background and socio-economic information of agricultural stakeholders in Laikipia West Sub County.

Table 4.2: Background and Socio-Economic Characteristics of the Agricultural Stakeholders

Characteristic	**Category**	**Frequency**	**Percent (%)**
Gender of Stakeholders (N=7)	Male	5	71.4
	Female	2	28.6
Number of years of stakeholders in	<5	2	28.6
agricultural extension provision	[5- 10]	1	14.3
(Years) (N=7)	[11-15]	2	28.6
	> 15	2	28.6

On the other hand, study revealed that majority of the stakeholders were male compared to females and that the majority had over 10 years in agricultural service provision. This implied that Agricultural service provision was carried out by both gender but predominantly by males. Further, the long experience of service provision implied that the agricultural stakeholders have adequate resources and capacity to serve the farmers in the different segments of the agricultural sector.

4.3 Agricultural Exhibitions Extension Method and Farmers' Access to Agricultural Technologies

It was necessary to find out the effectiveness of agricultural exhibitions on farmers' access to agricultural technologies. In order to realize this objective, data on the rating by smallholder farmers and agricultural stakeholder and also on the types of agricultural technologies accessed and promoted through the exhibition method were established. data was collected using research administered questionnaires (Appendix A and Appendix B). Except for Promotion of technologies which as measured using frequency, a five-point rating scale was used with response ranging from Strongly Disagree = 5, Disagree = 4, Partially Agree/Disagree = 3, Agree = 2, and Strongly Agree = 1. According to Latunde (2017) in using a five Likert-type scale, a mean score below 3.0 would imply a tendency to agree to the corresponding statement while a mean score of at least 3.0 would imply a tendency to disagree. On the other hand, a standard deviation of less than 1.0 would imply a tendency to have consensus among the respondents and otherwise, lack of consensus in rating the corresponding metric (Nicholson *et al.*, 2011). The hypotheses of the study were tested at 5% significance level and the respective results are presented in the following sub-sections.

4.3.1 Smallholder Farmers' Rating of Effectiveness of Agricultural Exhibitions

To establish the effectiveness of agricultural exhibitions on farmers' access to agricultural technologies, respondents were asked questions pertaining the effectiveness of the extension method to access agricultural technologies. To determine an appropriate measure of central tendency to be used for interpretation of the results on the rating scale, the mean and standard deviation (SD) were calculated from the original responses. According to Latunde (2017) in using a five point rating scale, a mean score below 3.0 would imply a tendency to agree to the corresponding statement while a mean score of at least 3.0 would imply a tendency to disagree. On the other hand, a standard deviation of less than 1.0 would imply a tendency to have consensus among the respondents and otherwise, lack of consensus in rating the

corresponding metric (Nicholson *et al.,* 2011). The results of the rating are presented in Table 5.

Table 4.3: Smallholder Farmers' Rating of Effectiveness of Agricultural Exhibitions

Agricultural Exhibition	**SA**	**A**	**P.A/D**	**D**	**SD**	**Total**	
	F %	F %	F %	F %	F %	Mean	Std. Dev
Inform me about agriculture technologies	49 48.5	43 42.6	5 5.0	4 4.0	0 0.0	1.64	0.756
Is effective as a source of agricultural technologies	44 44.4	41 41.4	5 5.1	6 6.1	3 3.0	1.82	0.993
Help in access agricultural technologies	49 49.0	44 44.0	3 3.0	4 4.0	0 0.0	1.62	0.736
Makes agricultural technologies easily available	42 42.0	43 43.0	6 6.0	9 9.0	0 0.0	1.812	0.903
Improves adoption of agricultural technologies	44 46.8	38 40.4	7 7.4	3 3.2	2 2.1	1.73	0.894
Addresses the needs of the farmer	34 36.2	52 55.3	1 1.1	6 6.4	1 1.1	1.81	0.833
Packages information in a way which is easy to understand	36 37.5	47 49.0	4 4.2	6 6.2	3 3.1	1.89	0.972
Composite Scores (N=101)						1.76	0.870

The results show that a composite mean score of 1.76 and a composite standard deviation of 0.870 were achieved. The achieved composite mean score implies that on average the respondents agree to all statements rating the extent in which agricultural exhibition enabled smallholder farmers access agricultural technologies. The achieved composite standard deviation of less than 1.0 implied that on average the respondents were in consensus in rating all the statements in regard to agricultural exhibition and smallholder farmers' access to agricultural technologies. This is because through agricultural exhibitions farmers can observe, interact and understand better the agricultural technologies exhibited by the agricultural stakeholders. Additionally, agricultural technologies are demonstrated practically to farmers and stakeholders create better networks and linkages which can be pursued for future contacts and follow up.

These results are consistent to those by Setiawan (2015) who noted that agricultural exhibitions enable farmers in Indonesia to access agriculture technologies. The agricultural exhibitions were seen to promote agriculture (both crop growing and livestock keeping) significantly through adoption of improved agricultural technologies. The findings are also consistent with those of a study by Sanga *et al.* (2016) which found out that agricultural exhibitions are effective as they provide farmers with an opportunity to see a demonstration of various technologies and also have an opportunity to ask question and in the process be convinced to take up the demonstrated agricultural technologies as opposed to mere listening. Tunde *et al.* (2018) noted that, farmers were able to get information in regard to agricultural technologies to use in their farming through agricultural extension. This further implied that agricultural exhibitions are effective in the manner in which they enable farmers to access agricultural technologies. However, contrary to these findings, a study by Elia and Mubofu (2017) noted that agricultural exhibitions was considered ineffective in enabling farmers in Tanzania access agricultural technologies due to cost implications.

4.3.2 Stakeholders' Rating of Agricultural Exhibitions Method

In order to establish the effectiveness of agricultural exhibitions on access to agricultural technologies, it was important to obtain agricultural organization stakeholders' perspective. Stakeholders were asked the same questions as farmers, whereby a mean score below 3.0 implied the agricultural exhibitions method was effective. Composite scores were computed from the achieved mean scores on the individual statements in order to establish the overall effectiveness of the agricultural exhibitions. Table 6 shows the results on the effectiveness of agricultural exhibitions to access agricultural technologies as rated by the agricultural stakeholders.

Table 4.5: Stakeholders' Rating on Agricultural Exhibitions

Agricultural Exhibition	**SA**	**A**	**P.A/D**	**D**	**SD**	**Total**	
	F	F	F	F	F	Mean	Std.
	%	%	%	%	%		Dev
Inform me about agriculture	5	2	0	0	0	1.29	0.488
technologies	71.4	28.6	0.0	0.0	0.0		
Is effective as a source of	4	3	0	0	0	1.43	0.535
agricultural technologies	57.1	42.9	0.0	0.0	0.0		
Help in access agricultural	3	4	0	0	0	1.57	0.535
technologies	42.9	57.1	0.0	0.0	0.0		
Makes agricultural technologies	3	2	2	0	0	1.86	0.900
easily available	42.9	28.6	28.6	0.0	0.0		
Improves adoption of agricultural	2	4	1	0	0	1.86	0.690
technologies	28.6	57.1	14.3	0.0	0.0		
Addresses the needs of the farmer	4	3	0	0	0	1.43	0.535
	57.1	42.9	0.0	0.0	0.0		
Packages information in a way	3	3	1	0	0	1.71	0.756
which is easy to understand	42.9	42.9	14.3	0.0	0.0		
Composite Scores (N=6)						1.59	0.634

The achieved composite mean score was 1.59. This is an indication that the agricultural stakeholders on average tended to agree with all statements rating the extent in which agricultural exhibition was effective in enabling smallholder farmers access agricultural technologies. This implied that agricultural exhibition according to smallholder farmers was effective in enabling smallholder farmers access agricultural technologies. The results show that the composite standard deviation was 0.634 (less than 1.0). This was an indication that on average, the agricultural stakeholders were in consensus in rating all the statements in regard to effectiveness of agricultural exhibition enabling smallholder farmers' access agricultural technologies.

This is attributed to the fact that agricultural exhibitions provide an opportunity to farmers to seek detailed information and ask questions, provides an opportunity for agricultural stakeholders to exhibit many different agricultural technologies and backstop agricultural

service providers. Further, agricultural exhibitions play a multiple role for stakeholders which include informing and awareness creation, visual displays and exhibition of agricultural technologies which appeal to farmers. These results concur with those of Baig (2017) who noted that agricultural extension services through exhibitions helped farmers to access various technologies in agriculture. In the same context, Baringo County Government in its report of Annual Agricultural Review of (2017) noted that agricultural exhibitions by the county government improved the accessibility of farmers to agricultural technologies. Agricultural exhibition provides opportunity to demonstrate how to use some agricultural equipment and appliances and ability to ask to experts questions face to face (Al-mashhadani *et al.,* 2017).

4.3.3 Agricultural Technologies Accessed through Agricultural Exhibitions

It was important to establish the specific areas of agricultural practices in which agricultural exhibitions were effective in accessing the agricultural technologies information for improved farming. The opinions were measured using a rating scale; 1=Most times, 2=Sometimes, 3=Rarely and 4=Never. Using this scale, mean score of less than 1.8 implied that on average, the technology being rated occurs most of times and a mean score in the range between 1.75 and 2.5 implies that on average, the technology being rated occurs sometimes. A mean score in the range between 2.5 and 3.25 implied that on average the technology being rated rarely occurred. By obtaining a mean score of more than 3.25 it implied that on average, the rated technology never accessed by the smallholder farmer (Nicholson *et al.*, 2011). The findings are shown in Table 7.

Table 4.6: Agricultural Technologies Accessed through Agricultural Exhibitions

Technology	**Most times**	**Sometimes**	**Rarely**	**Never**	**Total**	
	F	F	F	F	Mean	Std.
	%	%	%	%		Dev
Use of improved seed varieties	63	30	2	2	1.41	0.641
	64.9	30.9	2.1	2.1		
Crop protection	50	41	6	2	1.60	0.699
	50.5	41.4	6.1	2.0		
Horticultural crop production	41	34	11	8	1.85	0.939
	43.6	36.2	11.7	8.5		
Soil sampling and testing	16	42	29	10	2.34	0.877
	16.5	43.3	29.9	10.3		
Green house farming	8	28	34	25	2.80	0.929
	8.4	29.5	35.8	26.3		
Sorghum contract farming	13	38	27	20	2.55	0.965
	13.3	38.8	27.6	20.4		
Pasture and fodder production	32	39	11	14	2.07	1.018
	33.3	40.6	11.5	14.6		
On farm feed conservation	27	46	12	9	2.03	0.897
	28.7	48.9	12.8	9.6		
On- farm grain storage	33	46	13	6	1.92	0.846
	33.7	46.9	13.3	6.1		
Conservation agriculture	43	36	7	10	1.83	0.959
	44.8	37.5	7.3	10.4		
Fish farming	9	32	27	29	2.78	0.981
	9.3	33.0	27.8	29.9		
Water harvesting	33	50	10	7	1.91	0.842
	33.0	50.0	10.0	7.0		
Small scale irrigation	22	42	18	14	2.25	0.973
	22.9	43.8	18.8	14.6		
Modern Bee keeping	19	42	17	20	2.39	1.022
	19.4	42.9	17.3	20.4		

Technology	Most times	Sometimes	Rarely	Never	Total	
	F %	F %	F %	F %	Mean	Std. Dev
Agro forestry farming	29 29.9	42 43.3	12 12.4	14 14.4	2.11	0.999
On- farm value addition	24 25.3	45 47.4	16 16.8	10 10.5	2.13	0.914
Marketing of agricultural products	41 41.8	40 40.8	10 10.2	7 7.1	1.83	0.885
Composite Scores (N=101)					2.11	0.905

The results indicate that a composite mean score of 2.11 achieved in respect to agricultural technologies accessed through agricultural exhibitions. This is an indication that on average the smallholder farmers sometimes accessed all the listed agricultural technologies. This implied that generally, agricultural exhibitions were effective in accessing most of the agricultural technologies. The study obtained a composite standard deviation of 0.905. This is an indication that on average all the respondents were in consensus in rating the technologies accessed through agricultural exhibitions. Use of improved seed varieties, crop protection, horticultural crop production, on- farm grain storage, conservation agriculture, water harvesting and marketing of agricultural products were major technologies accessed through agricultural exhibitions based on mean scores of between 1 and 2. Through agricultural exhibitions, stakeholders provide a wide range of agricultural technologies which they exhibit and demonstrate. Stakeholders are also able to explain and answer questions raised on technologies directly to the farmers.

According to a study by Badr *et al*. (2019) agricultural exhibitions enabled farmers to access technologies such as food storage, technology for horticultural production, technology on water harvesting and also technology on how to market their agricultural products using online platforms and applications. Al-mashhadani *et al.* (2017) also established farmers were able to access educational services through agricultural exhibitions on new and modern technologies which they could use to improve their production. It was also noted that most of the technologies that farmers needed to apply in their farms was effectively accessed through

the use of agricultural exhibitions for its ability to demonstrate to the framers on how to apply (Azumah *et al.*, 2018).

4.3.4 Agricultural Technologies Promoted through Agricultural Exhibitions

It was prudent to establish the agricultural technologies promoted by agricultural stakeholders through agricultural exhibitions. The results are presented in Table 8.

Table 4.7: Agricultural Technologies Promoted by Agricultural Stakeholders through Agricultural Exhibitions

Technology (N=6)	**Frequency**	**Percentage (%)**
Use of improved seed varieties	3	42.9
Pasture and fodder production	3	42.9
On farm feed conservation	3	42.9
Crop protection	2	28.6
Horticultural crop production	2	28.6
Soil sampling and testing	2	28.6
On- farm grain storage	2	28.6
Conservation agriculture	2	28.6
On- farm value addition	2	28.6
Marketing of agricultural products	2	28.6
Green house farming	1	14.3
Sorghum contract farming	1	14.3
Water harvesting	1	14.3
Small scale irrigation	1	14.3
Modern Bee keeping	1	14.3
Agro forestry farming	1	14.3

The study revealed that majority (42.9%) of the stakeholders indicate use of improved seed varieties, pasture and fodder production and on farm feed conservation as the technologies that were promoted majorly through agricultural exhibitions. The difference in the frequency of promotion of the different technologies may have been dependent on stakeholders' area of specialization. These findings are consistent to those by Tunde *et al.* (2018) who noted that farmers were able to access information on improved seed varieties, crop protection, marketing strategies, and information on soil sampling and testing as well as on value-addition to the farm produce through agricultural exhibitions because the services could be well demonstrated. However, Elia and Mubofu (2017) noted that agricultural exhibitions was expensive to carry out and therefore it was not considered as an effective method of mass extension by agricultural stakeholders since farmers could not access most of technologies used in agriculture.

4.3.5 Effectiveness of Agricultural Exhibitions on Access to Agricultural Technologies

In order to determine whether there was significant effectiveness of agricultural exhibitions on the access to agricultural technologies, the study used Pearson Correlation to test the null hypothesis stating; **H_{01}**: There is no statistically significant effectiveness of agricultural exhibitions on access to agricultural technologies among smallholder farmers in Laikipia West Sub County. According to Clements and Sarama (2016), a correlation coefficient of zero implies that there is no correlation between the two measured variables of the study while a correlation coefficient of one implies a perfect correlation between the two measured variables in the study. On the other hand, a correlation coefficient in the range of 0.01-0.39 implies a weak relationship; a correlation coefficient in the range of 0.40-0.69 implies a moderate relationship and a correlation coefficient in the range of 0.70-0.99 implies a strong relationship between the two variables of the study (Lin & Jeng, 2015; Ruijuan *et al.,* 2016). The results for the correlational analysis are as shown in Table 9.

Table 4.8: Correlation between Agricultural Exhibitions and Access to Agricultural Technologies

		Access of Agricultural Technologies
Agricultural Exhibitions	Pearson Correlation (P-value)	0.380**
	Sig. (2-Tailed)	0.000
	(r)	
	N	101

**. Correlation is significant at the 0.01 level (2-tailed).

The study revealed a statistically significant weak correlation coefficient of 0.380 at p-value <0.05. This indicates that there was a weak positive relationship between agricultural exhibitions and the access to agricultural technologies. The first hypothesis stating that there is no statistically significant relationship between agricultural exhibitions and access to agricultural technologies among smallholder farmers in Laikipia West Sub County was therefore rejected at 5% significance level. This implies agricultural exhibitions is related to access of agricultural technologies. This further indicates increase in agricultural exhibitions increases access of access of agricultural technologies. There are possible reasons that the relationship between agricultural exhibitions and the access to agricultural technologies was statistically significant. One, the agricultural stakeholders who use or partner in agricultural

exhibitions focus on the success of the delivery method. Secondly, stakeholders invest on the quality of agricultural technologies exhibited and the agricultural exhibitions generally. On the other hand, the farmers who participate in agricultural exhibitions are fully focused on accessing agricultural technologies in order to improve their farming practice. Therefore, agricultural exhibition is helpful to farmers in increasing agricultural information access.

The findings are in line to these findings of a study by Badr e*t al. (*2019) that noted that there was a significant relationship between the use of agricultural exhibitions and farmers' access to agricultural technologies. The study indicated that farmers got an opportunity to test some of the agricultural equipment and also got opportunity to ask questions during agricultural exhibitions. Al-mashhadani *et al.* (2017) also established that there was a positive and significant relationship between the agricultural exhibitions and access to agricultural technologies since agricultural exhibitions aimed at promoting agricultural technologies among the farmers.

4.4 Road Extension Campaigns Method and Farmers' Access Agricultural Technologies

It was important to find out in this study the effectiveness of road extension campaigns on farmers' access to agricultural technologies. In order to realize this objective, smallholder farmers and Agricultural stakeholders rated the effectiveness of road extension campaigns and accessibility to agricultural technologies by farmers using a five point Likert scale and interpreted according to Latunde (2017) and Nicholson *et al.* (2011) as explained in section 4.4. A correlation between road extension campaigns and access to agricultural technologies were performed to determine if there was any significant relationship between agricultural exhibitions and access to agricultural technologies among smallholder farmers. The results are present in the subsequent sections.

4.4.1 Smallholder Farmers' Rating on Effectiveness of Road Extension Campaigns

Smallholders and stakeholders were asked questions pertaining to the effectiveness of the extension method to access to agricultural technologies using a five-point rating scale. To determine an appropriate measure of central tendency to be used for interpretation of the rating scale results, the mean and standard deviation were calculated from the original responses, with a mean score below 3.0 implying that the road extension campaigns were effective and a mean score above 3.0 implying that the road extension campaigns were no effective. The results of the rating are presented in Table 10.

Table 4.9: Smallholder Farmers' Rating on Effectiveness of Road Extension Campaigns

Statement	**SA**	**A**	**P.A/D**	**D**	**SD**	**Total**	
	F	F	F	F	F	Mean	Std.
	%	%	%	%	%		Dev
Road Extension Campaigns inform me about agriculture technologies	17 17.0	27 27.0	29 29.0	19 19.0	8 8.0	2.74	1.186
Road Extension Campaigns is very effective as a source of agricultural technologies	17 17.0	26 26.0	25 25.0	20 20.0	12 12.0	2.84	1.269
Road Extension Campaigns has helped me access agricultural technologies	15 15.3	26 26.5	27 27.6	18 18.4	12 12.2	2.86	1.244
Road Extension Campaigns makes agricultural technologies easily available	16 16.5	21 21.6	29 29.9	22 22.7	9 9.3	2.87	1.213
Road Extension Campaigns improves adoption of agricultural technologies	14 14.1	27 27.3	30 30.3	19 19.2	9 9.1	2.82	1.173
Road Extension Campaigns addresses the needs of the farmer	16 17.2	24 25.8	27 29.0	12 12.9	14 15.1	2.83	1.291
The information through Road Extension Campaigns is packaged in a way which is easy to understand	17 18.3	22 23.7	27 29.0	14 15.1	13 14.0	2.83	1.291
Composite Scores (N=101)						2.83	1.238

The composite score realized in this study by computing the mean score of the mean scores achieved on the various statements was 2.83. The composite standard deviation was 1.238. The achieved composite mean score implies that on average the smallholder farmers agreed that road extension campaigns promoted the access of different agricultural technologies. On the other hand, the achieved composite standard deviation implied that the respondents on average were not in consensus in rating the different metrics of road extension campaigns.

This could be due to low frequency of road extension campaigns in the area and thus the farmers being unsure of their effectiveness as indicated by various stakeholders in this study Chimoita *et al.* (2017) noted that road extension services were not very effective in educating the farmers on different agricultural technologies. Road extension campaigns were not effective in availing education to farmers on the use of new agricultural technologies since they were short lived and do not allow for questions and answers sessions as well as demonstrations by farmers (Smith, 2017). However, contrary to these findings, Demiryurek *et al.* (2015) noted that road extensions were cheap and reached a wider scope of farmers and therefore effective in sensitizing farmers to use modern technologies.

4.4.2 Stakeholders' Rating of Road Extension Campaigns

With an aim of establishing the effectiveness of road extension campaigns on access to agricultural technologies, it was crucial to obtain agricultural organization stakeholders' perspective. Stakeholders were asked the same questions as farmers to rate effectiveness of read extension campaigns to access to agricultural technologies. A mean score below 3.0 implied the road extension campaigns was effective. The results are as shown in Table 11.

Table 4.10: Agricultural Stakeholders' Rating on Effectiveness of Road Extension Campaign Method

Statement	**SA**	**A**	**P.A/D**	**D**	**SD**	**Total**	
	F %	F %	F %	F %	F %	Mean	Std. Dev
Many organizations use Road extension campaigns to inform farmers about agriculture technologies	0 0.0	3 50.0	2 33.3	1 16.7	0 0.0	2.67	0.816
Road extension campaigns is very effective as a source of agricultural technologies	1 16.7	2 33.3	3 50.0	0 0.0	0 0.0	2.33	.816
Road extension campaigns helps farmers access agricultural technologies	0 0.0	3 50.0	2 33.3	1 16.7	0 0.0	2.67	0.816
Road extension campaigns makes agricultural technologies easily available	0 0.0	3 50.0	2 33.3	1 16.7	0 0.0	2.67	0.816
Road extension campaigns improves adoption of agricultural technologies	0 0.0	3 50.0	2 33.3	1 16.7	0 0.0	2.67	0.816
The Road extension campaigns addresses the needs of the farmer	1 16.7	1 16.7	4 66.7	0 0.0	0 0.0	2.50	0.837
The information in Road extension campaigns is packaged in a way which is easy to understand	1 16.7	3 50.0	2 33.3	0 0.0	0 0.0	2.17	0.753
Composite Scores (N=101)						2.53	0.810

The results show the average composite mean scores 2.53 on the various statements used to determine the overall effectiveness of the road extension campaigns. This indicates that most agricultural stakeholders agreed that road extension campaigns enabled smallholder farmers to access different agricultural technologies. Additionally, stakeholders were in consensus in their responses due to a composite standard deviation of 0.810. These results were contrary to those by smallholder farmers and therefore an indication of divergent of views. Awad *et al.* (2015) noted that the uncertainty of the effectiveness of road extension campaigns could be due to the fact the method is a recent introduction as a mode of extension delivery, may be

the delivery method is not well understood by farmers. Further, road extension campaigns are costly and complex to execute. Only limited content on agricultural technologies can be passed by stakeholders through road extension campaigns and some technologies may not be passed at all for example use of machines. Agricultural stakeholders across the globe have noted inefficiencies associated with road extension campaigns such as poor roads, loud music through the accompanying entertainment and poor presentation style to the farmers (Dhehibi *et al.*, 2020). Al-ajelli and Mohammad (2019) noted that most of the road extensions campaigns were poorly organized and lacked opportunity for farmers to ask questions.

4.4.3 Agricultural Technologies Accessed through Road Extension Campaigns

The study sought to establish the specific areas of agricultural practices in which road extension campaigns were effective in ensuring smallholder farmers access to agricultural technologies and information for improved farming. The descriptive statistics are shown in Table 12.

Table 4.11: Agricultural Technologies Accessed by Smallholder Farmers through Road Extension Campaigns

Technology	**Most times**	**Sometimes**	**Rarely**	**Never**	**Total**	
	F %	F %	F %	F %	Mean	Std. Dev
Use of improved seed varieties	20 20.6	23 23.7	17 17.5	37 38.1	2.73	1.177
Crop protection	14 14.4	27 27.8	16 16.5	40 41.2	2.85	1.121
Horticultural crop production	11 11.8	17 18.3	23 24.7	42 45.2	3.03	1.058
Soil sampling and testing	7 7.1	21 21.4	21 21.4	49 50.0	3.14	0.995
Green house farming	5 5.2	11 11.5	21 21.9	59 61.5	3.40	0.888
Sorghum contract farming	6 6.2	17 17.7	19 19.8	54 56.2	3.26	0.965
Pasture and fodder production	9 9.2	26 26.5	15 15.3	48 49.0	3.04	1.064
On farm feed conservation	7 7.4	19 20.0	23 24.2	46 48.4	3.14	0.985
On- farm grain storage	7 7.3	25 26.0	18 18.8	46 47.9	3.07	1.018
Conservation agriculture	11 11.5	22 22.9	17 17.7	46 47.9	3.02	1.086
Fish farming	5 5.4	13 14.0	19 20.4	56 60.2	3.35	0.917
Water harvesting	10 10.2	19 19.4	20 20.4	49 50.0	3.10	1.050
Small scale irrigation	11 11.2	20 20.4	18 18.4	49 50.0	3.07	1.077
Modern Bee keeping	6 6.2	10 10.4	25 26.0	55 57.3	3.34	0.904

Technology	Most times	Sometimes	Rarely	Never	Total	
	F %	F %	F %	F %	Mean	Std. Dev
Agro forestry farming	9 9.3	18 18.6	23 23.7	47 48.5	3.11	1.019
On- farm value addition	10 10.2	24 24.5	14 14.3	50 51.0	3.06	1.082
Marketing of agricultural products	13 13.5	22 22.9	14 14.6	47 49.0	2.99	1.129
Composite Scores (N=101)					3.10	1.031

The results show that; a mean composite score of 3.10 was achieved. This indicates that on average the respondents indicated that they rarely accessed various agricultural technologies via road extension campaigns. In addition, the smallholder farmers were not in consensus in responding to the various statements in which road extension campaigns enabled the access to agricultural technologies. This is evidenced by composite standard deviation of 1.031 that was attained in this study in respect to the effectiveness of road extension campaigns.

Road extension campaigns are considered more as a way of creating awareness, publicity of events and promoting products and services as opposed to a method of accessing agricultural technologies. Additionally, the method does not focus on particular target groups of farmers. In line to this, Azumah *et al.* (2018) also agreed that most of the agricultural technologies could not be effectively delivered through road extension campaigns Al-rimawi *et al.* (2016), added that road extension campaigns were only used to create awareness of other agricultural extension services available for the farmers but not as a primary method for mass extension for farmers.

In order to establish the frequency of interaction, the smallholder farmers were asked to indicate whether they interacted with the road extension campaigns on weekly, monthly, quarterly, semi-annually or annual basis and the results are shown in Table 13.

Table 4.12: Frequency of Interaction in Road Extension Campaigns

Time	Frequency	Percentage (%)
Weekly	44	48.4
Monthly	3	3.3
Within 3 months	9	9.9
Within 6 months	9	9.9
Within a year	26	28.6
Total	91	100

Results in Table 13 shows that majority (48.4%) of smallholder farmers interacted with Road extension campaigns on weekly basis. The results also reveal that 28.6% of the smallholder farmers interacted with road extension campaigns once a year with the rest (3.3%, 9.9%, 9.9%) interacting with the same method of mass extension on monthly, quarterly and semi-annually respectively. Though most of the farmers indicated that the road extension campaigns were done on weekly basis by the agricultural stakeholders, the agricultural stakeholders indicated that the smallholder farmers rarely participated in the campaigns. Hailu *et al.* (2018) asserts that for any agricultural mass extension method to be effective, the service must be used more often. However, Elia and Mubofu (2017) noted that a method may never yield the desired outcomes even if it is used for a long time due to low level of farmers education on farming methods.

4.4.4 Agricultural Technologies Promoted through Road Extension Campaigns

It was important to establish the various agricultural technologies promoted through the use of road extension campaigns partnerships. The results are presented in Table 14.

Table 4.13: Agricultural Technologies Promoted by stakeholders through Road Extension Campaigns

Technology	Frequency	Percentage (%)
Use of improved seed varieties	1	14.3
Crop protection	1	14.3
Horticultural crop production	1	14.3

The results show that 14.3 percent of agricultural stakeholders promoted information on all the three technologies (use of improved seed varieties, crop protection and horticultural crop

production) respectively through use or partnership with Road extension campaigns. This means that only three technologies were promoted by Agricultural stakeholders through road extension campaigns. The reason for limited use could be because Road extension campaigns are costly to conduct in terms of resources and logistics, require complex planning which requires bringing together a multi-disciplinary team. On the other hand, from the interviews stakeholders mostly use road extension campaigns to introduce new and high value products and services into the market. The findings concur with those by Awad *et al.* (2015) who noted that Road extension campaigns were not effective in helping farmers decide on the best agricultural technology to use.

4.4.5: Effectiveness of Road Extension Campaigns on Access to Agricultural Technologies

In order to determine the effectiveness of road extension campaigns on the access to agricultural technologies, the study used Pearson Correlation to test the null hypothesis stating; **H_{02}**: There is no statistically significant effectiveness of road extension campaigns on access to agricultural technologies among smallholder farmers in Laikipia West Sub County. The results for the correlational analysis are as shown in Table 15.

Table 4.14: Correlation between Road Extension Campaigns and Access of Agricultural Technologies

		Access of Agricultural Technologies
Road extensions campaigns	Pearson Correlation (P-value)	0.596**
	Sig. (2-Tailed)	0.000
	(r)	
	N	99

**. Correlation is significant at the 0.01 level (2-tailed).

The results show correlation coefficient of 0.596 and a P<0.05. Indicating that there was a moderately positive and statistically significant relationship between access of agricultural technologies and road extension campaigns among smallholder farmers. The null hypothesis was therefore rejected at 5% significance level. This implied that an increase in road extension campaigns led to an increase in the access of agricultural technologies and vice versa. This therefore means that road extension to some extent promoted the access to agricultural technologies. However, these results differ significantly to those by Al-

mashhadani *et al.* (2017) who found that there road campaigns as a method of agricultural mass extension did not significantly affect the uptake of agricultural technologies among the farmers. This further implied that, though the method showed a positive relationship with access of agricultural technologies, only a limited number of agricultural technologies could be accessed through the method.

4.5 FM Radio on Access and Agricultural Technologies

The study found it necessary to find out the effectiveness of FM Radio on farmers' access to agricultural technologies. In meeting this objective, smallholder farmers and stakeholders were asked questions pertaining the effectiveness of FM Radio in enabling access to agricultural technologies. Frequencies, mean scores, standard deviations and correlation were used to determine the correlation road extension campaigns and access to agricultural technologies. The mean and standard deviation were calculated from the original responses. A mean score below 3.0 implied that the FM radio was effective and a mean score of at least 3.0 implied the FM radio was not effective in enabling smallholder farmers' access modern agricultural technologies. A standard deviation of less than 1.0 implied presence of consensus among the responses of the smallholder farmers; otherwise, a lack of consensus.

4.5.1 Smallholder Farmers' Rating of Effectiveness of FM Radio

To determine the effectiveness of FM Radio on farmers' access to agricultural technologies, smallholder farmers were asked to rate the effectiveness of the extension method to access agricultural technologies using a five-point rating scale. The results are presented as shown in Table 16.

Table 4.15: Smallholder Farmers' Rating on Effectiveness of FM Radio

Statement	**SA**	**A**	**P.A/D**	**D**	**SD**	**Total**	
	F %	F %	F %	F %	F %	Mean	Std. Dev
FM Radio inform me about agriculture technologies	57 56.4	37 36.6	3 3.0	2 2.0	2 2.0	1.56	0.818
FM Radio is very effective as a source of agricultural technologies	49 49.0	38 38.0	5 5.0	6 6.0	2 2.0	1.74	0.949

Statement	SA	A	P.A/D	D	SD	Total	
	F	F	F	F	F	Mean	Std.
	%	%	%	%	%		Dev
FM Radio has helped me access agricultural technologies	53	39	4	1	1	1.55	0.720
	54.1	39.8	4.1	1.0	1.0		
FM Radio makes agricultural technologies easily available	54	31	9	1	3	1.65	0.921
	55.1	31.6	9.2	1.0	3.1		
FM Radio improves adoption of agricultural technologies	46	41	4	2	3	1.70	0.896
	47.9	42.7	4.2	2.1	3.1		
FM Radio addresses the needs of the farmer	61	28	4	2	1	1.48	0.767
	63.5	29.2	4.2	2.1	1.0		
The information through FM Radio is packaged in a way which is easy to understand	52	35	4	4	1	1.61	0.838
	54.2	36.5	4.2	4.2	1.0		
Composite Scores (N=101)						1.61	0.844

The composite mean score obtained was 1.61 and the composite standard deviation was 0.844. It was therefore noted that on average the smallholder farmers were able to access several agricultural technologies through the use of FM Radio and that there was consensus in rating of the access to the technologies accessed through FM Radio. The results attributed to the wide use of FM radio is due to the wide range of information availed to farmers about agricultural technologies, its affordability, its wide reach even in the rural areas without adequate electricity and telephone network connectivity.

In line to this, Sanga *et al.* (2016) asserted that FM radio was an effective method of mass extension in agricultural sector for its wide reach of farmers, FAO (2020), Radio creates awareness for the availability of several agricultural technologies. The organization also noted that extension service providers were able to give step by step of some of the procedures needed in using various agricultural technologies. Some of the advantages given for the wide use of FM radio to avail information to farmers about new technologies that needs to be adopted included affordability of radio by farmers, wide reach, an opportunity to call for questions and the programmes could be aired at times that the farmers were free, in this case, in the evening (Murumba & Mogambi, 2017).

These findings were further supported by the frequency in which smallholder farmers interacted with FM radio to access to agricultural technologies. The results are as shown in Table 17.

Table 4.16: Frequency of Farmers' Interaction with FM Radio

Time	Frequency	Percentage (%)
Weekly	80	82.5
Monthly	5	5.2
Within 3 months	4	4.1
Within 6 months	2	2.1
Within a year	6	6.2
Total	97	100

Results in Table 17 pointed that majority of farmers accessed Agricultural technologies through FM radio on a weekly basis and therefore high interaction level. The high level of interaction with FM radio is because a lot of information on agricultural technologies is provided through the method, information delivered is highly verified and factual hence a trusted source. FM radio has an already established audience whose interest has to be maintained. The high level of interaction is also because FM radio is considerably a cheap source of information. Murumba and Mogambi (2017) established that listening to radio for long time to provide information to farmers on agricultural technologies helps in convincing the farmers to embrace new technologies of farming.

4.5.2 Stakeholders' Rating of Effectiveness of FM Radio

In order to determine the effectiveness of FM Radio on access to agricultural technologies, it was important to obtain agricultural organization stakeholders' perspective. In respect to this, the stakeholders were asked the same questions as farmers. Table 18 shows the descriptive statistics on the effectiveness of FM Radio to access agricultural technologies as responded to by the agricultural stakeholders.

Table 4.17: Stakeholders' Rating of Effectiveness of FM Radio

Statement	**SA**	**A**	**P.A/D**	**D**	**SD**	**Total**	
	F	F	F	F	F	Mean	Std.
	%	%	%	%	%		Dev
Many organizations use the FM radio to inform farmers about agriculture technologies	4	1	0	1	0	1.67	1.211
	66.7	16.7	0.0	16.7	0.0		
FM radio is very effective as a source of agricultural technologies	4	1	1	0	0	1.50	0.837
	66.7	16.7	16.7	0.0	0.0		
FM radio helps farmers access agricultural technologies	3	1	2	0	0	1.83	0.983
	50.0	16.7	33.3	0.0	0.0		
FM radio makes agricultural technologies easily available	2	2	2	0	0	2.00	0.894
	33.3	33.3	33.3	0.0	0.0		
FM radio improves adoption of agricultural technologies	2	1	3	0	0	2.17	0.983
	33.3	16.7	50.0	0.0	0.0		
The FM radio addresses the needs of the farmer	2	2	2	0	0	2.00	0.894
	33.3	33.3	33.3	0.0	0.0		
The information in FM radio is packaged in a way which is easy to understand	2	3	1	0	0	1.83	0.753
	33.3	50.0	16.7	0.0	0.0		
Composite Scores (N=6)						1.857	0.936

A composite mean score of 1.857 was achieved. This implied that on average the smallholder farmers were in agreement with most of statements rating the effectiveness of FM radio in accessing agricultural technologies. The achieved composite standard deviation was 0.936. This implied that the respondents were on average in consensus in giving their responses on the effectiveness of FM radio in enabling the access of agricultural technologies to farmers. The results imply that agricultural stakeholders can tap more into the use of FM radio which is considered effective and widely embraced by farmers. Furthermore, the agricultural stakeholders may use the FM radio to advertise their technologies, products and services in local languages which is easily understood by farmers.

These results are in line with those by Mithamo *et al.* (2015) who noted that the FM radio was effective in making awareness of various agricultural technologies and was widely embraced by farmers as a trusted source of agricultural information. Use of vernacular language for all smallholder farmers to understand various agricultural technologies was also seen as the reason for high acceptance level of the use of FM radio to communicate on agricultural extension services (Dhehibi *et al.*, 2020). Ability to listen to radio while doing other chores also is an indicator of effectiveness of FM radio to communicate on agricultural technologies (Smith, 2017). The Agricultural stakeholders were asked how frequently their organizations used or partnered in the use of FM radio to access agricultural technologies to farmers. The frequencies in which agricultural stakeholders used or partnered in FM radio are presented in Table 19.

Table 4.18: Frequency of Stakeholders' Promotion of Agricultural Technologies through FM Radio

Time	**Frequency**	**Percentage (%)**
Weekly	2	33.3
Monthly	1	16.7
Within 3 months	1	16.7
Within 6 months	1	16.7
Within a year	1	16.7
Total	6	100

The results in Table 19 indicated that majority (33.3%) of the stakeholders used or partnered in the use of FM radio on weekly basis, and 16.7 percent on monthly basis, within 3 months, within 6 months and within a year respectively. This implied that there was high level of interaction with FM radio in offering mass extension services to farmers. Murumba and Mogambi (2017) noted that the frequency in which farmers listen to radio programmes giving information on new farming technologies contributed to their farming systems.

4.5.3 Agricultural Technologies Accessed through FM Radio

The study sought to establish the specific areas of agricultural practices in which FM Radio was effective in accessing the agricultural technologies for improved farming. The

descriptive statistics for the various agricultural technologies accessed using FM radio are shown in Table 20.

Table 4.19: Agricultural Technologies Accessed through FM Radio

Technology	**Most times**	**Sometimes**	**Rarely**	**Never**	**Total**	
	F %	F %	F %	F %	Mean	Std. Dev
Use of improved seed varieties	70 70.0	27 27.0	2 2.0	1 1.0	1.34	0.572
Crop protection	68 68.0	28 28.0	2 2.0	2 2.0	1.38	0.632
Horticultural crop production	49 51.0	40 41.7	4 4.2	3 3.1	1.59	0.719
Soil sampling and testing	20 20.8	45 46.9	24 25.0	7 7.3	2.19	0.850
Green house farming	19 19.2	30 30.3	29 29.3	21 21.2	2.53	1.034
Sorghum contract farming	19 19.8	34 35.4	27 28.1	16 16.7	2.42	0.991
Pasture and fodder production	34 35.1	43 44.3	11 11.3	9 9.3	1.95	0.917
On farm feed conservation	37 38.1	38 39.2	17 17.5	5 5.2	1.90	0.872
On- farm grain storage	33 34.0	41 42.3	16 16.5	7 7.2	1.97	0.895
Conservation agriculture	41 41.4	39 39.4	13 13.1	6 6.1	1.84	0.877
Fish farming	20 20.0	44 44.0	20 20.0	16 16.0	2.32	0.973
Water harvesting	38 38.4	40 40.4	11 11.1	10 10.1	1.93	0.950
Small scale irrigation	32 33.0	38 39.2	18 18.6	9 9.3	2.04	0.946

Technology	Most times	Sometimes	Rarely	Never	Total	
	F %	F %	F %	F %	Mean	Std. Dev
Modern Bee keeping	26 26.3	39 39.4	17 17.2	17 17.2	2.25	1.034
Agro forestry farming	31 32.0	39 40.2	17 17.5	10 10.3	2.06	0.955
On- farm value addition	31 33.0	43 45.7	14 14.9	6 6.4	1.95	0.860
Marketing of agricultural products	46 47.4	38 39.2	7 7.2	6 6.2	1.72	0.851
Composite Scores (N=101)					1.96	0.878

The composite mean score of 1.96 and a composite standard deviation of 0.878 were obtained. This implied that on average most of the smallholder farmers relied on FM radio to access most of agricultural technologies. These results therefore implied that on average the FM radio was more effective in accessing agricultural technologies compared to agricultural exhibitions and road extension campaigns. This is because through the use of the FM radio, farmers were able to access more agricultural technologies. These results concur with those by Sanga *et al.* (2016) who established that information on the use of improved seed varieties, green house farming, small scale irrigation and marketing strategies of agricultural products was effectively delivered to smallholder farmers through the use of radios. On the other hand Al-mashhadani *et al.* (2017) found that information in how to protect crops, to carry out horticulture and small scale irrigation was also effectively availed via radios. Murumba and Mogambi (2017) also established that farmers were taught on water harvesting for crop production and as well as how to carry out beekeeping and fish farming.

4.5.4 Agricultural Technologies Promoted through FM Radio

The study further sought to establish the various agricultural technologies promoted through the use of FM Radio partnerships. The results of the agricultural technologies promoted through FM radio partnerships are presented in Table 21.

Table 4.20: Agricultural Technologies Promoted by Agricultural Stakeholders through FM Radio Partnerships

Technology	**Frequency**	**Percentage (%)**
Use of improved seed varieties	2	28.6
Crop protection	3	42.9
Horticultural crop production	1	14.3
Soil sampling and testing	2	28.6
Green house farming	2	28.6
Sorghum contract farming	1	14.3
Pasture and fodder production	2	28.6
On farm feed conservation	1	14.3
On- farm grain storage	1	14.3
Conservation agriculture	2	28.6
Fish farming	2	28.6
Water harvesting	1	14.3
Agro forestry farming	1	14.3
On- farm value addition	1	14.3
Marketing of agricultural products	2	28.6

The results indicated that agricultural stakeholders mostly (42%) used FM radio to promote crop protection, compared to other technologies. Broadcasting and airing of programmes through FM radio time is costly and there is also competition by different customers for prime time allocation as indicated by the stakeholders interviewed in this study. Thus agricultural stakeholders considered airing only key information on agricultural technologies and use FM radio method mainly for awareness creation. FM radio was effective in enabling the farmers to access key agricultural technologies. Several authors and researchers (Al-mashhadani *et al.,* 2017; Chimoita *et al.,* 2017; Demiryurek *et al.,* 2015; Murumba & Mogambi, 2017; Sanga *et al.,* 2016; Smith, 2017; Tunde *et al.,* 2018) in agriculture have shown the effectiveness of the FM radios in enabling farmers to access several and diverse agricultural technologies. These differs with the findings of the current study.

4.5.5 Correlation between Road Extension Campaigns and Access to Agricultural Technologies

In determining the effectiveness of road extension campaigns on the access to agricultural technologies, the study performed Pearson Correlation to test the third hypothesis which stated that; **H_{03}**: There is no statistically significant effectiveness of FM Radio on access to agricultural technologies among smallholder farmers in Laikipia West Sub County. The results for the correlational analysis are as shown in Table 22.

Table 4.21: Correlation between FM Radio and the Access to Agricultural Technologies

		Access of Agricultural Technologies
FM Radio	Pearson Correlation (P-value)	0.496**
	Sig. (2-Tailed)	0.000
	(r)	
	N	101

**. Correlation is significant at the 0.01 level (2-tailed).

The results revealed that the P-value was less than the significance level of 0.05($P<0.05$). The correlation coefficient of $r = 0.496$ and therefore positive and moderate. There was therefore a statistically significant relationship between access of agricultural technologies and FM radio method among smallholder farmers in Laikipia West Sub-County. The hypothesis was therefore rejected. This further implied that the increase in the use of FM radio method of sensitization would lead to an increase in the access of agricultural technologies. These results concur with those by Murumba and Mogambi (2017) and Mojaki and Keregero (2019) who established that there was a significant and positive relationship between the use of FM radio to convey information on agricultural technologies and the use of the technology in farming among the smallholders farmers.

4.6 Comparison of the effectiveness of the Mass Agricultural Extension Methods

In order to establish the most effective Mass extension method in accessing Agricultural technologies, the smallholder farmers were asked to rank the three Mass extension methods. The results are shown in Table 23.

Table 4.22: Smallholder Farmers' Ranking of Mass Extension Methods

Method	**Rank 1**	**Rank 2**	**Rank3**
	F	F	F
	%	%	%
FM radio	56	30	6
	60.2	32.3	6.5
Agricultural exhibitions	36	49	6
	39.1	53.3	6.5
Road extension	1	11	73
campaigns	1.1	12.0	79.3

The results show that majority of the respondents ranked FM radio first, Agricultural exhibitions were second, while Road extension campaigns were ranked third. Reasons noted for high ranking of FM Radio by farmers as mean of agricultural extension service included: Most farmers owned Radios because they were affordable and cheap to maintain, most farmers listened to agricultural programmes aired in the morning and evenings when farmers were at home. Some smallholder farmers indicated that they preferred FM radio since they could listen to radio while doing other duties in the farm, house or anywhere else. FM radio covered wide range of topics and that success stories were shared by fellow farmers.

The reasons given by farmers for ranking agricultural exhibition second was that they were able to see a wide variety agricultural technologies, a wide range of agro products and services availed. Farmers also indicated that they could buy seed and chemicals at discounted prices during agricultural exhibitions, create networks and market linkages. On the other hand, the reasons given by farmers for ranking road extension campaigns third included: the method does not provide opportunities to ask questions and that the method was not suitable for farmers living away from the main roads and market centers. Farmers also noted that the method was mostly used by agro vet related companies to advertise their products.

4.7.1 Agricultural Stakeholders' Rating of Most Preferred Mass Extension Method

Similarly, agricultural stakeholders were asked to rate their most preferred mass agricultural extension method as shown in Table 24.

Table 4.23: Agricultural Stakeholders' Rating of Most Preferred Mass Extension Method

Method	Frequency	Percentage (%)
Agricultural exhibitions	5	71.4
FM radio	2	28.6
Road extension campaigns	0	0.0
Total	7	100

The results indicate that Agricultural exhibition method was the most preferred method and then followed by FM radio. Road extension campaigns were not preferred at all by any of the stakeholders. Majority of Agricultural stakeholders preferred Agricultural exhibitions to the other two methods. This implies that the Agricultural stakeholders preferred to provide information, exhibit and demonstrate the agricultural technologies directly to the farmers using agricultural exhibitions. Further, this means that the method provides opportunities for face to face interaction between extension service providers and farmers, create networks and provide market linkages during the agricultural exhibitions. The results further imply that agricultural exhibitions provide an opportunity for face to face interaction, much easier to observe the farmer's physical reaction, allows for probing by farmers on pertinent issues observed. Agricultural exhibitions also provide an opportunity for further consultations on agricultural technologies with individual farmers and groups.

On analysis of diverse options used for mass agricultural extension services, several researchers have indicated that FM radio was the most effective in communicating to farmers on agricultural technologies (Chimoita *et al.*, 2017; FAO, 2020; Smith, 2017). Most of the researchers indicated that radio programs could be done more frequently and reached large audience and did not require people to stop what they were doing to participate in the program unlike other mass extension services (Mojaki & Keregero, 2019; Tunde *et al.*, 2018). Some researchers however differ with this findings by indicating that radio do not offer an interactive session for farmers and thus preferred the use of agricultural exhibitions (Al-mashhadani *et al.*, 2017; Sanga *et al.*, 2016). However the findings differ with some researchers who have revealed that agricultural exhibitions are expensive and therefore could

not be done much often and that the method required participants to be presents (Al-ajelli & Mohammad, 2019; Badr *et al.*, 2019).

4.7 Challenges of Selected Mass Extension Methods

Objective five sought to identify the challenges of selected mass extension methods faced by smallholder farmers and stakeholder in accessing agricultural technologies in Laikipia West Sub County. The researcher asked the respondents to list challenges of Agricultural exhibitions, Road extension campaigns and FM radio in accessing agricultural technologies in an open-ended questionnaire. The respondents were further asked to suggest solutions to the identified challenges. The qualitative results are presented in the subsequent subsections.

4.7.1 Challenges of Agricultural Exhibition

The smallholder farmers stated several challenges of agricultural exhibition which included: agricultural exhibitions being held at distant localities, expensive to attend due to travelling costs. Farmers indicated that the agricultural exhibitions were not held frequently, coincided with busy periods for farmers to attend, participants unfairly influenced by selfish product marketers, limited time for agricultural exhibitions, inadequate publicity and notice about where and when agricultural exhibitions were held. Suggested solutions to the challenges faced by smallholder farmers in Laikipia West Sub County included having the agricultural exhibitions in easily accessible areas, County government to subsidize travel cost to agricultural exhibitions, hold agricultural exhibitions frequently and creating adequate awareness and publicity. Using simple language which is easily understood by farmers, mobilization through churches, schools, groups and posters and establish permanent demonstration farms.

4.7.2 Challenges of Road Extension Campaigns

Majority of the smallholder famers in Laikipia West Sub-County indicated that road extension campaigns were not frequently held, and that they had no prior information about when road extension campaigns would be held. Poor roads, loud music, the accompanying entertainment, presentation style, poor organization and lack of opportunity to ask questions were cited as challenges of the method by the smallholder farmers. Suggested solution to the challenges included holding the road extension campaigns more frequently, service providers to create awareness prior to the campaigns as well as improving road network. Making presentation style friendlier, and use of understandable language and terminologies.

4.7.3 Challenges of FM Radio

Farmers cited the following challenges of FM radio in accessing agricultural technologies: Agricultural programmes aired at odd hours when farmers were busy doing other activities, lack of power in most households, lack of reference materials, lack of practical demonstration. Farmers also cited that FM radio does not provide an interactive session for questions and answers. In order to overcome these challenges, the respondents recommended that agricultural programmes to be aired preferably in the morning evenings when most of the farmers are at home, provision of affordable electricity and solar power to households. Farmers also suggested that FM radio programmes to be backed up with reference materials as well as creating more time and repeating the programmes several times.

CHAPTER FIVE
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary of the research findings, conclusion and recommendations of the study. The study findings presented are based on the four objectives, the three null hypotheses and one research objective. The suggestions for further research are also presented in the chapter.

5.2 Summary of Findings of the study

The researcher sought to establish the effectiveness of selected Mass extension methods on farmers' access to agricultural technologies among smallholder farmers in Laikipia West Sub County. The objectives of this study were to establish the effectiveness of agricultural exhibitions, road extension campaigns and FM Radio on access to agricultural technologies among smallholder farmers in Laikipia West Sub County. The study further sought to identify the challenges of selected mass extension methods faced by smallholder farmers in accessing agricultural technologies in Laikipia West Sub County. The research question was what challenges of Mass extension methods smallholder farmers face in accessing agricultural technologies in Laikipia West Sub County. The study sought to test the hypotheses that there was no statistically significant effectiveness of Agricultural Exhibitions, Road Extension Campaigns and FM Radio on access to agricultural technologies among smallholder farmers in Laikipia West Sub County.

5.2.1 Key Findings of the study

The study revealed that

i. There was a weak positive and significant relationship between agricultural exhibitions and the access to agricultural technologies. Agricultural exhibitions method was effective in accessing agricultural technologies among smallholder farmers in Laikipia West Sub County
ii. There is a moderately positive and statistically significant relationship between access of agricultural technologies and road extension campaigns among smallholder farmers in Laikipia West Sub County. The road extension campaigns method was effective in accessing agricultural technologies among smallholder farmers in Laikipia West Sub County.

iii. There was a moderately positive and statistically significant relationship between access of agricultural technologies and road extension campaigns among smallholder farmers in Laikipia West Sub County. The road extension campaigns method was effective in accessing agricultural technologies among smallholder farmers in Laikipia West Sub County.

iv. There was a statistically significant relationship between access of agricultural technologies and FM radio method among smallholder farmers in Laikipia west Sub-County. It was noted that FM Radio was effective in accessing agricultural technologies among smallholder farmers in Laikipia West Sub County.

v. Among Agricultural exhibitions, Road extension campaigns and FM radio; FM radio was the most used mass extension method by smallholder farmers.

vi. The major challenge that smallholder farmers experienced in accessing agricultural technologies was the cost associated with agricultural exhibitions that were held far from farmers' locality.

5.3 Conclusion of the Study

The following conclusions were made from this study;

i. Agricultural exhibitions method is effective in promoting access to agricultural technologies among smallholder farmers to a moderate extent. This is because farmers are able to see a wide variety agricultural technologies, create networks and market linkages and also have demonstration of various agricultural technologies.

ii. Road extension campaigns method is effective in promoting access to agricultural technologies among smallholder farmers to a small extent. This is because there is low publicity and low awareness prior to conducting the road extension campaigns and also farmers cannot ask questions and clarification through road extension campaigns

iii. FM radio method is effective in promoting access to agricultural technologies among smallholder farmers to a large extent. This is because FM radio covers a wide range of topics and reach many famers across large geographical coverage.

iv. Among agricultural exhibitions, road extension campaigns and FM radio, FM radio is the most effective and widely used mass extension method by smallholder farmers. This is because most farmers own radios since they were affordable and cheap to maintain and most farmers can listen to radio while doing other duties in the farm, house or anywhere else.

5.4 Recommendations of the Study

On the basis of conclusions of the study, the following recommendations were made:

i. Based on moderate usage of agricultural exhibitions, County government in collaboration with agricultural stakeholders should hold agricultural exhibitions within the locality of the smallholder farmers through establishment of permanent demonstration farms.

ii. Due to low utilization of road extension campaigns, agricultural stakeholders should publicize and create awareness prior to conducting the road extension campaigns to make them more effective through different platforms and media such as churches, community meetings, notices and posters.

iii. Since FM radio is widely used, agricultural stakeholders should facilitate airing of agricultural programmes more often in order to increase access to agricultural technologies among smallholder farmers.

iv. Based on established challenges in accessing agricultural technologies, County governments in collaboration with agricultural stakeholders should develop policies on funding, upscaling and coordination which make FM radio programmes and agricultural exhibitions more effective.

5.5 Suggestions for Further Research

The current study recommends further research to be carried out:

1. On mass extension methods and adoption of agricultural technologies.
2. To establish the reasons for the weak correlation between some Mass extension methods such agricultural exhibition, road extension campaigns and access to agricultural technologies among smallholder farmers

REFERENCES

Agbamu, J.U. (2006). *Essentials of Agricultural Communication in Nigeria.* Lagos. Malthous Press Limited.

Al-ajelli, S. A., & Mohammad, D. S. M. (2019). Level of usage of extension methods by agricultural extension workers in level of usage of extension methods by agricultural extension workers in Sulaimani Governorate. *Alexandria Science Exchange Journal*, *38*(2), 1–10.

Al-mashhadani, A. L. J., Magd, Z. H., & Keshta, A. E. A. (2017). Levels of use and importance of extension methods and aids in the process of dissemination of agricultural technologies in the Republic of Iraq. *IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)*, *10*(5), 1–6. https://doi.org/10.9790/2380-1005020106

Al-rimawi, A., Tabieh, M., & Al-qudah, H. (2016). Assessing growers' perceptions of effective extension methods and information communication technologies for training vegetable growers in Jordan. *International Journal of Economics and Finance*, *8*(8), 229–236. https://doi.org/10.5539/ijef.v8n8p229

Awad, A., Altalb, T., Filipek, T., & Skowron, P. (2015). The role of agricultural extension in the transfer and adoption of agricultural technologies. *Asian Journal of Agriculture and Food Sciences*, *03*(05), 500–507.

Azumah, S. B., Donkoh, S. A., Awuni, J. A., & Yildiz, F. (2018). The perceived effectiveness of agricultural technology transfer methods: evidence from rice farmers in Northern Ghana. *Cogent Food & Agriculture*, *4*(00), 1–11. https://doi.org/10.1080/23311932.2018.1503798

Badr, M. M., Bellundagi, V., & Hassan, M. (2019). Farmers' willingness to pay for agricultural extension service, a case study of nubaria's farmers, Egypt. *Asian Journal of Agricultural Extension, Economics & Sociology*, *30*(2), 1–13. https://doi.org/10.9734/ajaees/2019/v30i230107

Bilgin, Y. (2017). *Qualitative Method Versus Quantitative Method in Marketing Research: An Application.* Sage Publications.

Boa, E., Papania, P., Mulema, J., & Franzel, S. (2016). Extension campaigns. Note 24. GFRAS. *Good Practice Notes for Extension and Advisory Services.* GFRAS: Lausanne, Switzerland.

Bryman, A. (2015). *Research Methods and Organization Studies.* Taylor & Francis Group.

Chimoita, E. L., Onyango, C. M., Kimenju, J. W., & Gweyi-onyango, J. P. (2017). The agricultural extension agents influence on the uptake of improved sorghum technologies in Embu County, *Kenya. Universal Journal of Agricultural Research, 5*(4), 219–225. https://doi.org/10.13189/ujar.2017.050403

Demiryurek, K., Rukkwamsuk, T., Bado, V., Jafry, T., & Gelan, D. T. (2015). extension and rural development. *Journal of Agricultural Extension and Rural Development*, *7*(4), 1–61.

Dhehibi, B., Rudiger, U., Moyo, H. P., & Dhraief, M. Z. (2020). Agricultural technology transfer preferences of smallholder farmers in Tunisia' s Arid Regions. *Sustainability (Switzerland)*, *1*(1), 1–18.

Elia, E., & Mubofu, C. (2017). Disseminating agricultural research information: a case study of farmers in mlolo, lupalama and wenda villages in Iringa district, Tanzania. *University of Dar Es Salaam Library Journal*, *12*(2), 1-10.

FAO (2011). The Fourth Annual Global South-South Development Expo (GSSD Expo): Major gains in agricultural extension efficiency. Rome, Italy. Retrieved from http://www.fao.org/news/story/en/item/116470/icode/

FAO (2020). *Agricultural extension in transition worldwide: policies and strategies for reform*. Rome. Retrieved from https://doi.org/10.4060/ca8199en

Government of Kenya (2011). *Agricultural sector development strategy 2010-2020.* Nairobi. Government Printers.

Government of Kenya (2017). Guidelines and *standards for agricultural extension & advisory services*. Nairobi

Hailu, G., Pittchar, J. O., Khan, Z. R., & Ochatum, N. (2018). Perceived preference of radio as agricultural information source

among smallholder farmers in Uganda. *International Journal of Agricultural Extension*, *5*(3), 119–130.

Ifenkwe, G. E. (2012). Organizing Agricultural Shows and Fairs in Nigeria. *International Journal of Academic Research in Progressive Education and Development*, *1*(4), 74-87.

Jemal, H. (2013). Challenges and opportunies in the use of radio broadcast for development in Ethiopia. *Journal of Communication and Media Technologies. 3*(2) *10-34*

Latunde, Y. C. (2017). Quantitative research methods. *Research in Parental Involvement*, *2*(1), 79–95. https://doi.org/10.1057/978-1-137-59146-3_5

Miller, G. J., & Whicker, M. L. (2017). *Handbook of Research Methods in Public Administration, Second Edition.* In Aggarwal printing press.

Mithamo, J. M., Onyango, C. A., & Mwangi, J. G. (2015). Role of private vernacular radio in facilitating access to agricultural messages required by small-scale farmers. *IOSR Journal of Agriculture and Veterinary Science*, *8*(4), 6–13. https://doi.org/10.9790/2380-08410613

Mojaki, R. A., & Keregero, K. J. B. (2019). Turning challenges into opportunity : Potential for adoption of e-extension in Lesotho. *Journal of Agricultural Extension and Rural Developmen*, *11*(11), 184–191. https://doi.org/10.5897/JAERD2019.1040

Mugenda, O. M., & Mugenda, A. G. (2003). *Research methods: Quantitative & qualitative apporaches* (Vol. 2, No. 2). Nairobi: Acts press.

Murumba, S. R., & Mogambi, H. (2017). Radio for farming. An analysis of regional Radio programs and Agricultural Productivity in Kenya School of Journalism and Mass Communication. *International Journal of Humanities and Social Science*, *7*(2), 84–103.

Nakabugu, S. (2010). *The role of radio in agricultural and rural development. Translating agricultural research information into messages for farm audiences.* Kampala

Nazari, M. R., & Hasbullah, A. H. (2010). Radio as an educational media: Impact on agricultural development. *The Journal of the South East Asia Research Centre for Communication and Humanities*, *2*, 13-20.

Neuman, W. L. (2014). *Social Research Methods: Qualitative and Quantitative Approaches.* London: Pearson Education Limited.

Nicholson, H., & Kershaw, B. (2011). Research methods in theatre and performance. *Researc h Methods for the Arts and the Humanities*, *3*(4), 1-33.

Parvan, A. (2011). Agricultural technology adoption: Issues for consideration when scaling-up. *The Cornell Policy Review*, *1*(1), 5-32.

Nazari, M. R., & Hasbullah, A. H. (2010). Radio as an educational media: Impact on agricultural development. *The Journal of the South East Asia Research Centre for Communication and Humanities*, *2*, 13-20.

Rogers, E.M. (2003). *Diffusion of innovations (5th edition*). New York: Free Press.

Sanga, C., Mlozi, M., Haug, R., & Tumbo, S. (2016). Mobile learning bridging the gap in agricultural extension service delivery: Experiences from Sokoine University of

Agriculture, Tanzania. *International Journal of Education and Development Using Information and Communication Technology (IJEDICT)*, *12*(3), 108–127.

Setiawan, I. (2015). Study of role of agribusiness young actors on optimalization of private agricultural extension in West Java Province, Indonesia Faculty of Agricultural Padjadjaran University. *International Journal of Humanities and Social Science*, *5*(9), 161–169.

Sloan, L., & Quan-Haase, A. (2017). *Social Media Research Methods*. SAGE Publications Inc.

Smith, S. C. (2017). Agricultural extension and technology adoption for food security: evidence from uganda agricultural extension and technology adoption for food security: evidence from Uganda. *Institute for International Economic Policy*, *7*(202), 1–56.

Towela N.J (2010). Unlocking the promise of ICTs for transforming agriculture in Africa. *CTA Publications.* Retrieved from

Tunde, A., Oluwole, F., & Yemi, A. (2018). *Strategies for scaling agricultural technologies in africa*. *forum for agricultural research in Africa (FARA)*. Accra Ghana.

Zhou, Y. (2010). *Reinventing agricultural extension to smallholders*. Syngenta Foundation for Sustainable Agriculture

Acharya, K.,Booth., Wambugu, C., Arimi, H., & Bender, S.(2010). *How can systems thinking, social capital and social networks analysis help programs achieve impact at scale? ICRAF (*working paper No.116), Nairobi: World Agroforestry

CentreAcharya, K., Booth, B., Wambugu, C., & Karanja, E. (2010). How can Systems Thinking, Social Capital and Social Network Analysis help Programmes Achieve Impact at Scale. *Results of a Demonstration Project in the Kenyan Dairy Sector. ICRAF (*Working Paper, 116). Nairobi: World Agroforestry Centre

Agbamu, J.U. (2006). *Essentials of Agricultural Communication in Nigeria.* Lagos. Malthous Press Limited.

Al-ajelli, S. A., & Mohammad, D. S. M. (2019). Level of usage of extension methods by agricultural extension workers in level of usage of extension methods by agricultural extension workers in Sulaimani Governorate. *Alexandria Science Exchange Journal*, *38*(2), 1–10.

Al-Hassan, A., Papaioannou, M. M. G., Skancke, M., & Sung, C. C. (2013). *Sovereign wealth funds: Aspects of governance structures and investment management*. International Monetary Fund.

Al-mashhadani, A. L. J., Magd, Z. H., & Keshta, A. E. A. (2017). Levels of use and importance of extension methods and aids in the process of dissemination of agricultural technologies in the Republic of Iraq. *IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)*, *10*(5), 1–6. https://https://ddoi.org/10.9790/2380-1005020106

Al-rimawi, A., Tabieh, M., & Al-qudah, H. (2016). Assessing growers' perceptions of effective extension methods and information communication technologies for training vegetable growers in Jordan. *International Journal of Economics and Finance*, *8*(8), 229–236. https://doi.org/10.5539/ijef.v8n8p229

Hailu, G., Pittchar, J. O., Khan, Z. R., & Ochatum, N. (2018). Perceived preference of radio as agricultural information source among smallholder farmers in Uganda. *International Journal of Agricultural Extension*, *5*(3), 119-130.

Asiedu-Darko, E. (2013). Agricultural extension delivery in Ghana: A case study of factors affecting it in Ashanti, Eastern and Northern regions of Ghana. *Journal of Agricultural Extension and Rural Development*, *5*(2), 37-41.

Awad, A., Altalb, T., Filipek, T., & Skowron, P. (2015). The role of agricultural extension in the transfer and adoption of agricultural technologies. *Asian Journal of Agriculture and Food Sciences*, *03*(05), 500–507.

Azumah, S. B., Donkoh, S. A., & Awuni, J. A. (2018). The perceived effectiveness of agricultural technology transfer methods: Evidence from rice farmers in Northern Ghana. *Cogent Food & Agriculture*, *4*(1), 1-11.

Azumah, S. B., Donkoh, S. A., Awuni, J. A., & Yildiz, F. (2018). The perceived effectiveness of agricultural technology transfer methods: evidence from rice farmers in Northern Ghana. *Cogent Food & Agriculture*, *4*(001), 1–11. https://doi.org/10.1080/23311932.2018.1503798

Badr, M. M., Bellundagi, V., & Hassan, M. (2019). Farmers' willingness to pay for agricultural extension service, a case study of nubaria ' s farmers , Egypt. *Asian Journal of Agricultural Extension, Economics & Sociology*, *30*(2), 1–13. https://doi.org/10.9734/ajaees/2019/v30i230107

Bilgin, Y. (2017). *Qualitative Method Versus Quantitative Method in Marketing Research: An Application.* Sage Publications.

Boa, E., Papania, P., Mulema, J., & Franzel, S. (2016). Extension campaigns. Note 24. GFRAS. *Good Practice Notes for Extension and Advisory Services.* GFRAS: Lausanne, Switzerland.

Bryman, A. (2015). *Research Methods and Organization Studies.* Taylor & Francis Group.

Chimoita, E. L., Onyango, C. M., Kimenju, J. W., & Gweyi-onyango, J. P. (2017). The agricultural extension agents influence on the uptake of improved sorghum technologies in Embu County, Kenya. *Universal Journal of Agricultural ResearchEmbu County, Kenya Evans*, *5*(4), 219–225. https://doi.org/10.13189/ujar.2017.050403

Christoplos, I. (2010). Climate information and agricultural advisory services: a square peg in a round hole. *Rural Development News*, *2*, 7-13.

Collier, P., & Dercon, S. (2014). African agriculture in 50 years: smallholders in a rapidly changing world. *World Development*, *63*, 92-101.

Demiryurek, K., Rukkwamsuk, T., Bado, V., Jafry, T., & Gelan, D. T. (2015). extension and rural development. *Journal of Agricultural Extension and Rural Development*, *7*(4), 1–61.

Dey, P. K., Malesios, C., De, D., Budhwar, P., Chowdhury, S., & Cheffi, W. (2022). Circular economy to enhance sustainability of small and medium sized enterprises. In *Supply Chain Sustainability in Small and Medium Sized Enterprises* (pp. 10-45). Routledge.

Dhehibi, B., Rudiger, U., Moyo, H. P., & Dhraief, M. Z. (2020). Agricultural technology transfer preferences of smallholder farmers in Tunisia' s Arid Regions. *Sustainability (Switzerland)*, *112*(1), 1–18.

Elia, E., & Mubofu, C. (2017). Disseminating agricultural research information: a case study of farmers in mlolo, lupalama and wenda villages in Iringa district, Tanzania. *University of Dar Es Salaam Library Journal*, *12*(2), 80-87.

FAO (2011). The Fourth Annual Global South-South Development Expo (GSSD Expo): Major gains in agricultural extension efficiency. Rome, Italy. Retrieved from http://www.fao.org/news/story/en/item/116470/icode/

FAO (2020). *Agricultural extension in transition worldwide: policies and strategies for reform*. Rome. Retrieved from https://doi.org/10.4060/ca8199en

Folitse, B. Y., Manteaw, S. A., Dzandu, L. P., Obeng-Koranteng, G., & Bekoe, S. (2019). The determinants of mobile-phone usage among small-scale poultry farmers in Ghana. *Information Development*, *35*(4), 564-574.

Government of Kenya (2011). *Agricultural sector development strategy 2010-2020*. Nairobi. Government Printers.

Government of Kenya (2017). Guidelines and *standards for agricultural extension & advisory services*. Nairobi

Hailu, G., Niassy, S., Zeyaur, K. R., Ochatum, N., & Subramanian, S. (2018). Maize–legume intercropping and push–pull for management of fall armyworm, stemborers, and striga in Uganda. *Agronomy Journal*, *110*(6), 2513-2522.

Hailu, G., Pittchar, J. O., Khan, Z. R., & Ochatum, N. (2018). Perceived preference of radio as agricultural information source

Ifenkwe, G. E. (2012). Organizing Agricultural Shows and Fairs in Nigeria. *International Journal of Academic Research in Progressive Education and Development*, *1*(4), 74-87.

Jemal, H. (2013). Challenges and opportunies in the use of radio broadcast for development in Ethiopia. *Journal of Communication and Media Technologies. 3*(2), *10-34.*

Latunde, Y. C. (2017). Quantitative research methods. *Research in Parental Involvement*, *2*(1), 79–95. https://doi.org/10.1057/978-1-137-59146-3_5

Lopokoiyit, M. C., Onyango, C., Kibett, J. K., & Langat, B. K. (2012). *Human resource development in agriculture extension and advisory services in Kenya* (No. 304-2016-4809, pp. 371-388).

Mahmood, I. P., & Rufin, C. (2005). Government's dilemma: The role of government in imitation and innovation. *Academy of Management Review*, *30*(2), 338-360.

Miller, G. J., & Whicker, M. L. (2017). *Handbook of Research Methods in Public Administration, Second Edition.* In *H*. Aggarwal printing press.

Mithamo, J. M., Onyango, C. A., & Mwangi, J. G. (2015). Role of private vernacular radio in facilitating access to agricultural messages required by small-scale farmers. *IOSR Journal of Agriculture and Veterinary Science*, *8*(4), 6–13. https://doi.org/10.9790/2380-08410613

Mojaki, R. A., & Keregero, K. J. B. (2019). Turning challenges into opportunity: Potential for adoption of e-extension in Lesotho. *Journal of Agricultural Extension and Rural Developmen*, *11*(11), 184–191. https://doi.org/10.5897/JAERD2019.1040

Mugenda, O. M., & Mugenda, A. G. (2003). *Research methods: Quantitative & qualitative apporaches* (Vol. 2, No. 2). Nairobi: Acts press.

Murumba, S. R., & Mogambi, H. (2017). Radio for farming. An analysis of regional Radio programs and Agricultural Productivity in Kenya School of Journalism and Mass Communication. *International Journal of Humanities and Social Science*, *7*(2), 84–103.

Nakabugu, S. (2010). *The role of radio in agricultural and rural development. Translating agricultural research information into messages for farm audiences.* Kampala

Nazari, M. R., & Hasbullah, A. H. (2010). Radio as an educational media: Impact on agricultural development. *The Journal of the South East Asia Research Centre for Communication and Humanities*, *2*, 13-20.

Nazari, M. R., & Hasbullah, A. H. (2010). Radio as an educational media: Impact on agricultural development. *The Journal of the South East Asia Research Centre for Communication and Humanities*, *2*, 13-20.

Neuman, W. L. (2014). *Social Research Methods: Qualitative and Quantitative Approaches*. London: Pearson Education Limited.

Nicholson, H., & Kershaw, B. (2011). Research methods in theatre and performance. *Researc h Methods for the Arts and the Humanities, 3*(4), 1-33.

Okafor, B. N., & Fabiyi, A. O. (2011). Application of soil information in Nigerian agriculture: a case study of some horticultural farms in Ibadan, Oyo State. *Continental Journal of Agricultural Science, 5*(2), 31-35.

Parvan, A. (2011). Agricultural technology adoption: Issues for consideration when scaling-up. *The Cornell Policy Review, 1*(1), 5-32.

Retz, M., & Hasbullah, D. (2010). „Radio as an educational media: Impact on Agricultural Development". *The Journal of South East Asia Research Centre for communication and Humanities, 2*.

Rogers, E. M., & Singhal, A. (2003). Empowerment and communication: Lessons learned from organizing for social change. *Annals of the International Communication Association, 27*(1), 67-85.

Rogers, E.M. (2003). *Diffusion of innovations (5th edition*). New York: Free Press.

Sanga, C., Mlozi, M., Haug, R., & Tumbo, S. (2016). Mobile learning bridging the gap in agricultural extension service delivery: Experiences from Sokoine University of Agriculture, Tanzania. *International Journal of Education and Development Using Information and Communication Technology (IJEDICT), 12*(3), 108–127.

Setiawan, I. (2015). Study of role of agribusiness young actors on optimalization of private agricultural extension in West Java Province, Indonesia Faculty of Agricultural Padjadjaran University. *International Journal of Humanities and Social Science, 5*(9), 161–169.

Sloan, L., & Quan-Haase, A. (2017). *Social Media Research Methods*. SAGE Publications Inc.

Smith, S. C. (2017). Agricultural extension and technology adoption for food security: evidence from uganda agricultural extension and technology adoption for food security: evidence from Uganda. *Institute for International Economic Policy*, *7*(202), 1–56.

Towela N.J (2010). Unlocking the promise of ICTs for transforming agriculture in Africa. *CTA Publications.* Retrieved from Nyirenda-Jere, T. (2010). *Unlocking the promise of ICTs for Transforming Agriculture in Africa.* NEPAD, e-Africa Commissions, Pretoria, South Africa. http://scholar.google.com/scholar?cluster=11536162380237253608&hl=en&oi=scholarr

Tunde, A., Oluwole, F., & Yemi, A. (2018). *Strategies for scaling agricultural technologies in africa*. *forum for agricultural research in Africa (FARA)*. Accra Ghana.

Umeh, O. J., Ekumankama, O. O., Nwachukwu, I., & Ekwe, K. C. (2015). Comparative performance evaluation of the Agricultural development programmes of Abia and Enugu states, Nigeria. *Journal of Agricultural Extension*, *19*(2), 106-114.

Zhou, Y. (2010). *Reinventing agricultural extension to smallholders*. Syngenta Foundation for Sustainable Agriculture

APPENDICES

Appendix A: Questionnaire for Smallholder Farmers

Emily Kioko is a Master of Agricultural Extension student at Egerton University, and as part of research is collecting data from Smallholder farmers in Laikipia West. The purpose of the information collected is to write a research report. The information you give will be kept confidential and will only be used for the purpose of the study.

Part I: Farmers' Personal Information. Tick√ your response and write your answer to question No 6 in the spaces provided

1. Gender of the respondent
   i. Male [ ]
   ii. Female [ ]
2. Age of the respondent (in years)
   i. 20- 30 [ ]
   ii. 31- 40 [ ]
   iii. 41- 50 [ ]
   iv. 51- 60 [ ]
   v. Above 60 [ ]
3. Highest level of education attained
   i. None [ ]
   ii. Primary [ ]
   iii. Secondary [ ]
   iv. College [ ]
   v. University [ ]
4. How long have you been doing farming (in years)?
   i. Less than 5 [ ]
   ii. 5- 10 [ ]
   iii. 10-15 [ ]
   iv. Above 15 [ ]
5. Acreage of land under Agricultural production
   i. Less than 1acre [ ]
   ii. 1- 5 acres [ ]
   iii. 5-10 acres [ ]
   iv. Above 10 acres [ ]

6. List the main agricultural activities you engage in.

i……

ii. …….

iii. ……

iv. ……

v. …….

Part II: Mass Extension Methods. Tick√ the responses in the spaces provided and indicate your responses in question No 10 in spaces provided

7. Do you have access to Mass extension services that informs you about agricultural practices?

i. Yes [ ]

ii. No [ ]

If Yes proceed and answer question No 8 and 9

If No proceed to and question No 10 and 20

8. How long have you been accessible to Mass extension services?

a) Less than 5 years [ ]

b) 6-10 years [ ]

c) 11-15 years [ ]

d) 16- 20 years [ ]

e) 21+ years [ ]

Part III. Effectiveness of Agricultural Exhibitions to Access Agricultural Technologies. Tick√ your response in spaces provided in the table.

9. Rate the effectiveness of Agricultural exhibitions using the statements in the table below

Statements	**Strongly Agree**	**Agree**	**Partially Agree/Disagree**	**Disagree**	**Strongly Disagree**
Agricultural organizations use the method to inform me about agriculture technologies					
Method is very effective as a source of agricultural technologies					
Method has helped me access agricultural technologies					
Method makes					

agricultural technologies easily available						
Method improves access of agricultural technologies						
Frequency of interaction:	Weekly					
	Monthly					
	Within the last 3 months					
	Within the last 6 months					
	Within a year					
The method addresses the needs of the farmer						
The information is packaged in a way which is easy to understand						

Part IV. Effectiveness of Road Extension Campaigns to Access Agricultural Technologies. Tick√ your response in spaces provided in the table

10. Rate the effectiveness Road extension campaigns using the statements in the table below

Statements	**Strongly Agree**	**Agree**	**Partially Agree/Disagree**	**Disagree**	**Strongly Disagree**
Agricultural organizations use the method to inform me about agriculture technologies					
Method is very effective as a source of agricultural technologies					
Method has helped me access agricultural technologies					
Method makes agricultural technologies easily available					

Method improves access of agricultural technologies						
Frequency of interaction:	Weekly					
	Monthly					
	Within the last 3 months					
	Within the last 6 months					
	Within a year					
The method addresses the needs of the farmer						
The information is packaged in a way which is easy to understand						

Part V. Effectiveness of FM Radio to Access Agricultural Technologies. Tick√ your response in spaces provided in the table.

11. Rate effectiveness of FM radio using the statements in the table below

Statements	**Strongly Agree**	**Agree**	**Partially Agree/Disagree**	**Disagree**	**Strongly Disagree**
Agricultural organizations use the method to inform me about agriculture technologies					
Method is very effective as a source of agricultural technologies					
Method has helped me access agricultural technologies					
Method makes agricultural technologies easily available					
Method improves access of agricultural technologies					

Statements		Strongly Agree	Agree	Partially Agree/Disagree	Disagree	Strongly Disagree
Frequency of interaction:	Weekly					
	Monthly					
	Within the last 3 months					
	Within the last 6 months					
	Within a year					
The method addresses the needs of the farmer						
The information is packaged in a way which is easy to understand						

12. How effective is Agricultural exhibition in accessing the following information for improved farming activities?

Type of technology needed	Most times	Sometimes	Rarely	Never
i. Use of improved seed varieties				
ii. Crop protection				
iii. Horticultural crop production				
iv. Soil sampling and testing				
v. Green house farming				
vi. Sorghum contract farming				
vii. Pasture and fodder production				
viii. On farm feed conservation				
ix. On- farm grain storage				
x. Conservation agriculture				
xi. Fish farming				
xii. Water harvesting				
xiii. Small scale irrigation				
xiv. Modern Bee keeping				
xv. Agro forestry farming				

xvi.	On- farm value addition				
xvii.	Marketing of agricultural products				
xviii.	Others(Specify)				

13. How effective is Road extension campaign in accessing the following information for improved farming activities?

Type of technology needed		**Most times**	**Sometimes**	**Rarely**	**Never**
i.	Use of improved seed varieties				
ii.	Crop protection				
iii.	Horticultural crop production				
iv.	Soil sampling and testing				
v.	Green house farming				
vi.	Sorghum contract farming				
vii.	Pasture and fodder production				
viii.	On farm feed conservation				
ix.	On- farm grain storage				
x.	Conservation agriculture				
xi.	Fish farming				
xii.	Water harvesting				
xiii.	Small scale irrigation				
xiv.	Modern Bee keeping				
xv.	Agro forestry farming				
xvi.	On- farm value addition				
xvii.	Marketing of agricultural products				
xviii.	Others(Specify)				

14. How effective is FM radio in accessing the following information for improved farming activities?

Type of technology needed	Most times	Sometimes	Rarely	Never
i. Use of improved seed varieties				
ii. Crop protection				
iii. Horticultural crop production				
iv. Soil sampling and testing				
v. Green house farming				
vi. Sorghum contract farming				
vii. Pasture and fodder production				
viii. On farm feed conservation				
ix. On- farm grain storage				
x. Conservation agriculture				
xi. Fish farming				
xii. Water harvesting				
xiii. Small scale irrigation				
xiv. Modern Bee keeping				
xv. Agro forestry farming				
xvi. On- farm value addition				
xvii. Marketing of agricultural products				
xviii. Others(Specify)				

15. Which is your preferred Mass extension delivery method? Indicate the rank in spaces provided [1- Most preferred and 3- Least preferred]

Mass extension Method	Rank [1, 2, 3]
i. Agricultural exhibitions	
ii. Road extension campaigns	
iii. FM radio	

16. Explain the reasons for your ranking in question 15

a) Rank 1……

……..…

…….....

b) Rank 2…….....

……

……

c) Rank 3…….....

……

……

Part VI: Challenges of Mass Extension Methods. Indicate your responses in the spaces provided

17. List some of the challenges of Mass extension methods which prevent you from accessing agricultural technologies?

a) Agricultural exhibition

i. ……
ii. ……
iii. ……
iv. ……
……..

b) Road extension campaigns

i. ……
ii. ……...
iii. ……
iv. …….

c) FM radio

i. ……...
ii. ……
iii. ……
iv. ……

19. Suggest ways to improve the following Mass extension methods

a) Agricultural exhibitions

……

……

……

b) Road extension campaigns

……

……

……

C) FM radio

……

……

……

Appendix B: Questionnaire for Agricultural Stakeholders

Emily Kioko is a Master of Agricultural Extension Degree student at Egerton University, and as part of research is collecting data from Agricultural Stakeholders in Laikipia West. The purpose of the data is to write a research report on the effectiveness of Agricultural exhibitions, Road extension campaigns and FM Radio mass extension methods on access to agricultural technologies by smallholder farmers. The information you give will be kept confidential and will only be used for the purpose of the study.

Part I: Personal Information. Please tick√ your responses or write the answers to question 4 in the spaces provided

1. Gender of the respondent

i. Male [ ]

ii. Female [ ]

2. Highest level of education attained?

i. None [ ]

ii. Primary [ ]

iii. Secondary [ ]

iv. College [ ]

v. University [ ]

3. How long have you been involved in Agricultural service provision work (in years).

i. Less than 5 [ ]

ii. 5-10 [ ]

iii. 10- 15 [ ]

iv. Above 15 [ ]

4. List the main agricultural services you provide.

i. ……..

ii. ……..

iii. ……..

iv. ……..

Part II: Mass Extension Methods. Indicate your responses in the spaces provided.

5. What Mass extension methods do you use to inform farmers about agricultural technologies?

i…….

ii……

iii……

iv…….

6. Please give reasons for each of your choices in question No 5

i……..

ii…….

iii…….

iv…….

7. Which is the most preferred Mass extension method by your organization? Tick√ in the spaces provided.

Mass extension Method	**Most preferred**
i. Agricultural exhibition	
ii. Road extension campaign	
iii. FM radio	

8. Explain the reasons for your choice in question No 7

…….....

……..

……..

…….....

…….

Part III: Effectiveness of Agricultural Exhibitions to Access Agricultural Technologies.

Tick√ your responses in the spaces provided in the table

9. Rate the effectiveness of Agricultural exhibitions using the statements in the table below

Statements	**Strongly Agree**	**Agree**	**Partially Agree/Disagree**	**Disagree**	**Strongly Disagree**
i. Many organizations use the method to inform farmers about agriculture technologies					
ii. Method is an effective source of agricultural technologies					
iii. Method helps farmers access agricultural technologies					
iv. Method makes					

agricultural technologies easily available					
v. Method improves access of agricultural technologies					
vi. The method addresses the needs of the farmer					
vii. The information is packaged in a way which is easy to understand					

viii. How frequent does your organization use/ partner in Agricultural exhibitions to access agricultural technologies to farmers?

Weekly [ ] Monthly [ ] Every 3 Months [ ] Every 6 Months [ ] Once a year [ ]

Part IV: Effectiveness of Road Extension Campaigns to Access Agricultural Technologies. Tick√ your responses in the spaces provided in the table

10**.** Rate the effectiveness of Road extension campaigns using the statements in the table below

Statements	**Strongly Agree**	**Agree**	**Partially Agree/Disagree**	**Disagree**	**Strongly Disagree**
i. Many organizations use the method to inform farmers about agriculture technologies					
ii. Method is an effective source of agricultural technologies					
iii. Method helps farmers access agricultural technologies					
iv. Method makes agricultural technologies easily available					

v. Method improves access of agricultural technologies					
vi. The method addresses the needs of the farmer					
vii. The information is packaged in a way which is easy to understand					

viii. How frequent does your organization use/ partner in Road extension campaigns to access agricultural technologies to farmers?

Weekly [ ] Monthly [ ] Every 3 Months [ ] Every 6 Months [ ] Once a year [ ]

Part V: Effectiveness of FM Radio to Access Agricultural Technologies. Tick√ your responses in the spaces provided in the table

11**.** Rate the effectiveness of FM radio using the statements in the table below

Statements	**Strongly Agree**	**Agree**	**Partially Agree/Disagree**	**Disagree**	**Strongly Disagree**
i. Many organizations use the method to inform farmers about agriculture technologies					
ii. Method is an effective source of agricultural technologies					
iii. Method helps farmers access agricultural technologies					
iv. Method makes agricultural technologies easily available					
v. Method improves access of agricultural technologies					
vi. The method addresses the					

needs of the farmer					
vii. The information is packaged in a way which is easy to understand					

viii. How frequent does your organization use/ partner in FM radio to access agricultural technologies to farmers?

Weekly [ ] Monthly [ ] Every 3 Months [ ] Every 6 Months [ ]

Once a year [ ]

12. What agricultural technologies have you successfully promoted to farmers in the last 2 years using the following Mass extension methods?

Type of technology needed	**Agricultural Exhibitions**	**Road Extension Campaigns**	**FM Radio**
i. Use of improved seed varieties			
ii. Crop protection			
iii. Horticultural crop production			
iv. Soil sampling and testing			
v. Green house farming			
vi. Sorghum contract farming			
vii. Pasture and fodder production			
viii. On farm feed conservation			
ix. On- farm grain storage			
x. Conservation agriculture			
xi. Fish farming			
xii. Water harvesting			
xiii. Small scale irrigation			
xiv. Modern Bee keeping			
xv. Agro forestry farming			
xvi. On- farm value addition			
xvii. Marketing of agricultural products			

Part VI: Challenges of Mass Extension Methods. Write your responses in the spaces provided

13. List some of the challenges of Mass extension methods which prevent farmers from accessing agricultural technologies

a) Agricultural exhibitions

i…….

ii……

iii……

iv……

b) Road extension campaigns

i……

ii……...

iii……

iv……

c) FM radio

i……

ii……

iii……

iv……

14. Suggest ways to improve the following Mass extension delivery methods

a) Agricultural exhibitions

……..

……

……

b) Road extension campaigns

……

……

……

c) FM radio

……

……

……

Appendix C: Research Permit

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **657634**

Date of Issue: **16/August/2019**

RESEARCH LICENSE

This is to Certify that Ms.. EMILY KIOKO of Egerton University, has been licensed to conduct research in Laikipia on the topic: EFFECTIVENESS OF SELECTED MASS EXTENSION SERVICE DELIVERY METHODS ON ACCESS TO AGRICULTURAL TECHNOLOGIES AMONG SMALLHOLDER FARMERS IN LAIKIPIA WEST SUB-COUNTY, KENYA for the period ending : 16/August/2020.

License No: **NACOSTI/P/19/236**

657634

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

Appendix D: Permission to Conduct Study

COUNTY GOVERNMENT OF LAIKIPIA
DEPARTMENT OF AGRICULTURE, LIVESTOCK AND FISHERIES
P.O.BOX 1271-10400, NANYUKI.

COUNTY AGRICULTURE OFFICE,
P.O.BOX 31-10400,
NANYUKI.

29TH October, 2019

TO WHOM IT MAY CONCERN

Dear Sir/Madam

RE: LETTER OF PERMISSION TO CONDUCT STUDY

This letter serves to confirm that **Emily Ndanu Kioko** has permission to conduct his research on the "the *effectiveness of selected mass extension service delivery methods on access to Agricultural technologies among smallholder farmers in laikipia west sub-county, kenya*". In undertaking this research, she is also permitted to enlist assistance of the agricultural extension officers serving in the target wards in the identification of the farmers.

This permission to undertake research is issued under the following conditions:

- That all information gathered from employees will be used solely for academic purposes;
- That information gathered from the interviews will be summarised in a manner that does not explicitly detail confidential information of our organization; and
- That the anonymity of all respondents is guaranteed.

Yours sincerely,

COUNTY DIRECTOR OF AGRICULTURE
LAIKIPIA COUNTY
P.O. Box 31 NANYUKI

P. K. Gachugia,
Ag. County Director of Agriculture
Laikipia County.

Appendix E: Research Publication

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH AND KNOWLEDGE
ISSN-2213-1356 www.ijirk.com

Effectiveness of FM Radio Mass Extension Service Delivery Method on Access to Agricultural Technologies among Smallholder Farmers in Laikipia West Sub-County, Kenya

Emily N. Kioko
Master of Science Student in Agricultural Extension of Egerton University

Maurice O. Udoto
Department of Agricultural Education and extension, Egerton University

Annie Hilda Onga'yo
Department of Environmental Studies (Community Development), Pwani University

Abstract

Agricultural extension services play an important role in boosting agricultural productivity worldwide. Mass extension service delivery methods have been used to inform farmers about agricultural technologies by the government and development partners both at national and county level. Despite the investment in selected mass extension methods, access to agricultural technologies by farmers remains limited. The purpose of this study was to assess the effectiveness of FM radio mass extension service delivery method on access to agricultural technologies among smallholder farmers in Laikipia West Sub-County, Kenya. The study employed descriptive survey research design. The target population constituted 35,220 households and an accessible population of 32,400 smallholder farmers. Multistage sampling procedure was used to sample 128 respondents which comprised of 120 farmers and one senior representative from each of the 8 major groups of agricultural stakeholders. Two sets of structured questionnaires administered by the researcher were used to collect data from smallholder farmer households and the agricultural stakeholders. Data was analyzed with the help of Statistical Package for the Social Science (SPSS) version 25. The results revealed that there was a statistically significant relationship between access to agricultural technologies and FM radio extension method among smallholder farmers in Laikipia West Sub-County. The researcher concluded that FM radio extension method promotes access to agricultural technologies among smallholder farmers in Laikipia West Sub County. The